



IBUTHO COAL (PTY) LTD

FULENI ANTHRACITE PROJECT

DRAFT SCOPING REPORT

MARCH 2014

PROJECT DETAILS

Name of Project	Fuleni Anthracite Project
Reference Numbers	DMR Ref: KZN 30/5/1/2/1/10045 MR DAEA Ref: DC 28/0035/2013: KZN/EIA/0001371/2013
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GLOSSARY OF TERMS

TERM / ABBREVIATION	MEANING
AMD	Acid Mine Drainage
AQA	National Environmental Management: Air Quality Act 39 of 2004
Biome	A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate
CARA	Conservation of Agricultural Resources Act 43 of 1983
CBA	Cost Benefit Analysis
CRR	Comment and Response Report
DAEA	Department of Agriculture and Environmental Affairs
DAFF	Department of Agriculture, Forestry and Fisheries
dba	Decibels
DEA	Department of Environmental Affairs
DEMC	Desired Ecological Management Class
DMR	Department of Mineral Resources
DM	Dense Medium
DMS	Dense Medium Separator
DWA	Department of Water Affairs
Ecological integrity	Overall functioning of the ecological system as a whole
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity Classification
EMC	Ecological Management Class
EMP	Environmental Management Programme
ESA	Earlier Stone Age
ESP	Exchangeable sodium percentage
FAII	Fish Assemblage Integrity Index
GDP	Gross Domestic Product
GPS	Global Positioning system
HIA	Heritage Impact Assessment
HiM	Hluhluwe-iMfolozi Game Reserve
IAPs	Interested and Affected Parties
IDPs	Integrated Development Plans
IHAS	Invertebrate Habitat Assessment System
IHIA	Intermediate Habitat Integrity Assessment

TERM / ABBREVIATION	MEANING
ISP	Internal Strategic Perspective
IUCN	International Union for Conservation of Nature and Natural Resources
IWUL	Integrated Water Use Licence
IWWMP	Integrated Water and Waste Management Plan
KZN	KwaZulu-Natal
LCC	Land Claims Commissioner
LM	Local Municipality
LOM	Life of Mine
LSA	Late Stone Age
Mamsl	Meters above mean sea level
MAE	Mean Annual Evaporation
MAP	Mean Annual Precipitation
MAR	Mean Annual Run-off
MPRDA	Mineral and Petroleum Resources Development Act 28 of 2002
MSA	Middle Stone Age
Mtpa	Million Tonnes Per Annum
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act 107 of 1998
NEMBA	National Environmental Management: Biodiversity Act 10 of 2004
NEMWA	National Environmental Management: Waste Act 59 of 2008
NFA	National Forest Act 84 of 1998
NFEPA	National Freshwater Ecosystem Priority Areas
NHRA	National Heritage Resources Act 25 of 1999
NOMRA	New Order Mining Right Application
NOMR	New Order Mining Right
NWA	National Water Act 36 of 2008
NWCS	National Wetland Classification System
PEMC	Present Ecological Management Class
PES	Present Ecological State
PFD	Process Flow Diagram
PRECIS	Pretoria Computer Information Systems
QDS	Quarter Degree Square
RDL	Red Data List
RDM	Resource Directed Measures
RE	Risk estimation

TERM / ABBREVIATION	MEANING
REC	Recommended Ecological Category
RHP	River Health Programme
ROM	Run of Mine
SAM	Social Accounting Matrix
SANBI	South African National Biodiversity Institute
SAR	Sodium Absorption Ration
SASS5	South African Scoring System version 5
SDF	Spatial Development Framework
SEIA	Socio-Economic Impact Assessment
SSC	Species of Special Concern
SUR	Strict Unemployment Rate
TDS	Total Dissolved Solids
TOPS	Threatened or Protected Species
TWQR	Target Water Quality Range
UNESCO	United Nations Education, Science and Cultural Organizations
WMA	Water Management Area
WQO	Water Quality Objective
WQT	Water Quality Threshold
WZ	Weathered Zone

1 PROJECT BACKGROUND

1.1 INTRODUCTION

Ibutho Coal (Pty) Ltd (Ibutho) has submitted a New Order Mining Right application (NOMRA) for coal on a portion of the farm Fuleni Reserve 14375 in Northern KwaZulu-Natal to the Department of Mineral Resources (DMR) on 29 August 2013. This NOMRA was preceded by a Prospecting Right {Ref No. KZN311PR}.

The DMR accepted the NOMRA in terms of section 22(1) of the Mineral and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002) on 27 January 2014.

The project is known as the **Fuleni Anthracite Project**, or in short Fuleni Project.

1.2 PROJECT LOCATION

Fuleni is situated on a portion of the farm Fuleni Reserve 14375 in Northern KwaZulu-Natal, approximately 45 km north-west of the town of Richards Bay. The NOMRA area is situated within the Mfolozi Local Municipality and the Uthungulu District Municipality respectively. The NOMRA covers 14,615 ha of the farm Fuleni Reserve 14375 and traverses 20 kilometres of rural Zululand countryside. Fuleni is bordered by the Mfolozi River to the north, the Richards Bay railway line to the south and Hluhluwe-iMfolozi Game Reserve to the north-west. The existing Somkhele Mine is located to the north-east of Fuleni. Refer to Figure 1.

1.2.1 SURFACE OWNERSHIP

The registered description associated with the NOMRA is listed in Table 1 below. An official survey of the area of the farm Fuleni Reserve 14375 covered by the NOMRA is shown in Figure 3. Note the Remainder of farm Fuleni Reserve 14375 to the West.

Table 1: Surface ownership

Farm Name	Farm no.	Reg Div	Portion	Title deed nr	Extent (ha)	Surface owner
Fuleni Reserve	14375	KT	0	G26/1962 T64294/2000	14,615	Ingonyama Trust

The Ingonyama Trust, governed by the Ingonyama Trust Board (ITB) and established and regulated by the KwaZulu-Natal Ingonyama Trust Act No. 3 of 1994 (as amended), is the legal landowner of approximately 2.8 million hectares of land in KwaZulu-Natal (South Africa) including the farm Fuleni Reserve where the proposed Fuleni project is located.

His Majesty, the King, is the sole Trustee of the Trust, although the ITB is responsible for administering all land falling within its jurisdiction and control for the *“material benefit and social well-being of the individual members of the communities and tribes living on Ingonyama land”*.

The Act states that *“any land or real right therein of which the ownership immediately prior to the date of commencement of this Act vested in or had been acquired by the Government of KwaZulu shall hereby vest in and be transferred to and shall be held in trust by the Ingonyama as trustee of the Ingonyama Trust referred to in section 2(1) for and on behalf of the members of tribes and communities and the residents referred to in section 2(2).”*

The ITB head office is located in Pietermaritzburg (KwaZulu-Natal). Some of the key functions of the ITB include:

- Providing assistance and advice to communities on land related issues and possible joint venture schemes in furtherance of BEE and mining charter requirements, forestry privatization and tourism related projects.
- Ensuring that rural communities achieve fair deals from entrepreneurs and developers.
- Ensuring that land is made available for community care projects.
- Ensuring that land is made available for rural housing development purposes.
- Providing policy inputs in respect of rural housing, townships, commercial land and Integrated Development Plans (IDPs).
- Assessment, decision-making and management of the land for development purposes, primarily through the granting of formal leases upon application.

1.2.2 INSTITUTIONAL ARRANGEMENTS

Whilst the Ingonyama Trust owns the land, the Mfolozi Local Municipality is responsible for the provision and management of many facilities. This is for both private landholders and Ingonyama trust lessees within the municipality. The municipality is the principal authority in the municipal area, responsible for the provision and management of many services, including basic water, sanitation and energy supply.

There is a split of function between the uThungulu District and Mfolozi Local Municipalities. The district is responsible for electrical, health, water and sanitation and abattoirs, whilst the Mfolozi Local Municipality handles all other local authority functions at some level.

1.2.3 COMMUNITY DESCRIPTION

A number of communities are located within and adjacent to the Fuleni Project area. The majority of residents at the proposed mine site are scattered rural settlements with low population density and low skill level.

The nearest urban settlement is Kwambonambi, 30 km from the site. The district has within its boundaries the large industrial towns of Richards Bay and Empangeni, both home to skills and expertise in the mining industry which is just 55km from the site.

Sensitive receptors are being identified including any building, lodge or structure that may be affected in terms of sense of place, sound, visual and disruption of daily living patterns. The residences, schools and clinics may be defined as sensitive land uses in the study area.

The sensitive receptors in and around the Fuleni Project area were identified with the use of aerial photographs (ortho-photos) and are shown in Figure 2. These will be verified during Socio-Economic Impact Assessment (SEIA).

1.2.4 LAND CLAIMANTS / TRADITIONAL AUTHORITY

The proposed Fuleni Project is on Mhlana Traditional Authority / Council land.

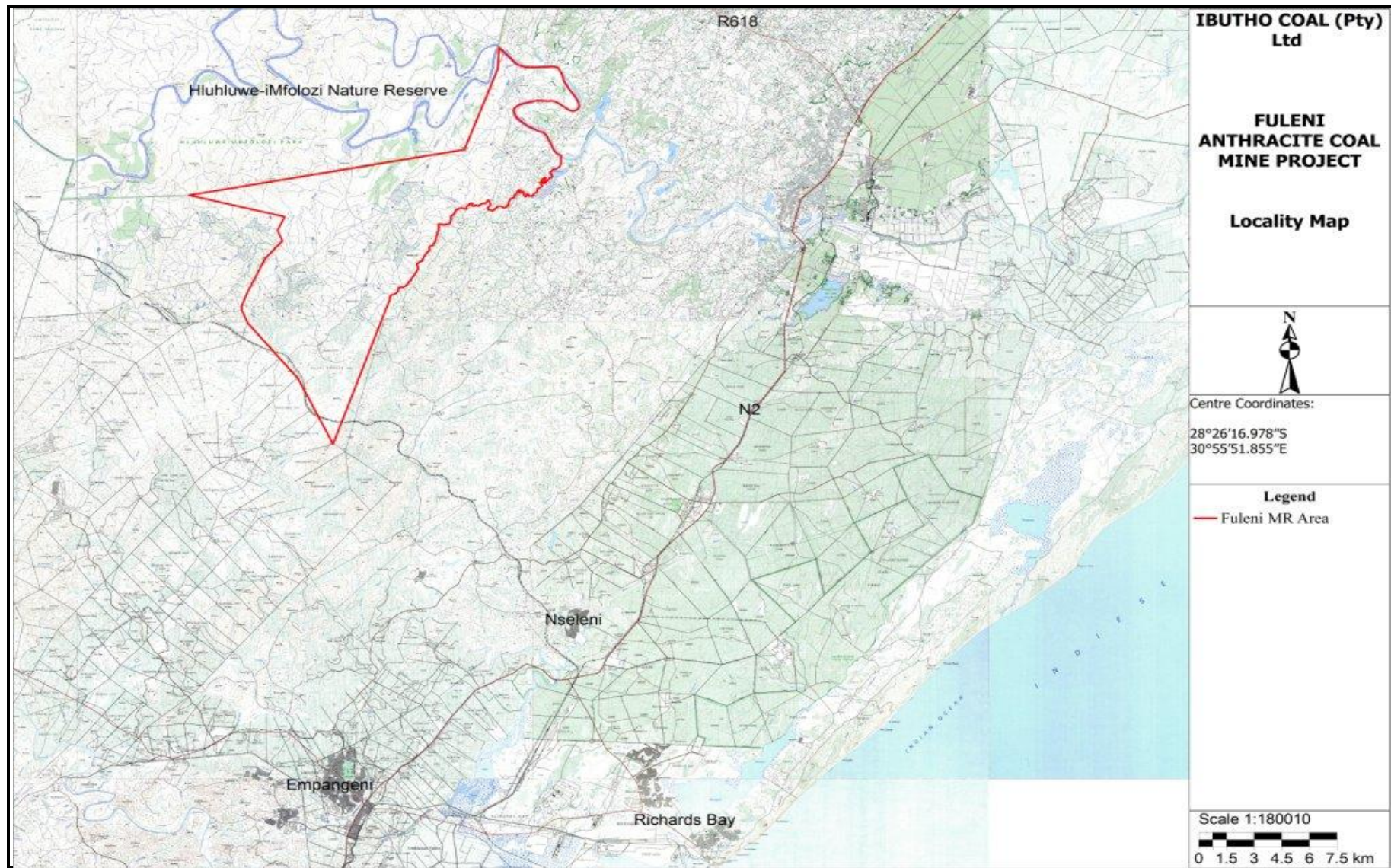


Figure 1: Locality map

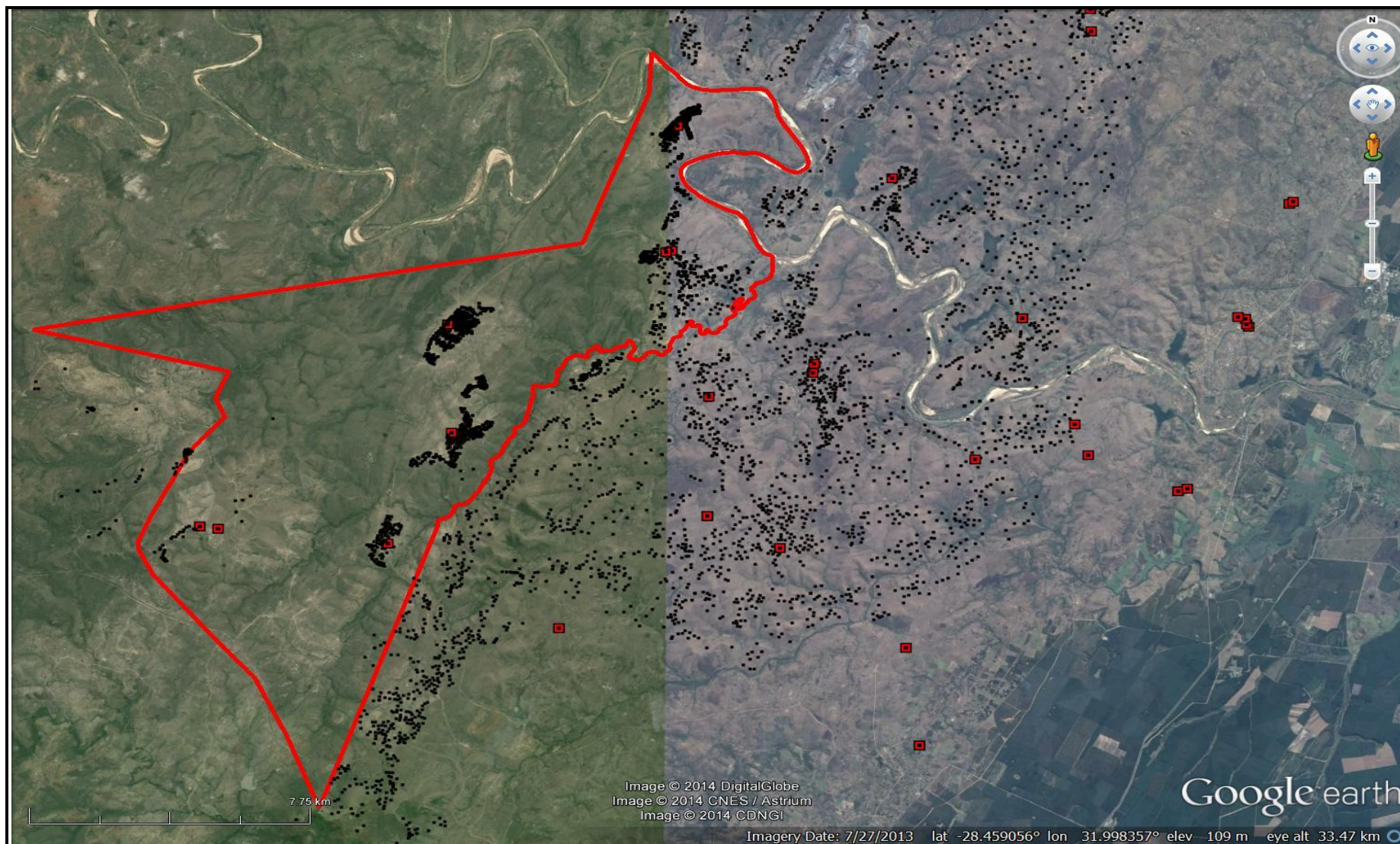


Figure 2: Aerial image of project location showing sensitive receptors
{Red line – NOMRA boundary; Black circles – houses / businesses; red blocks – schools}

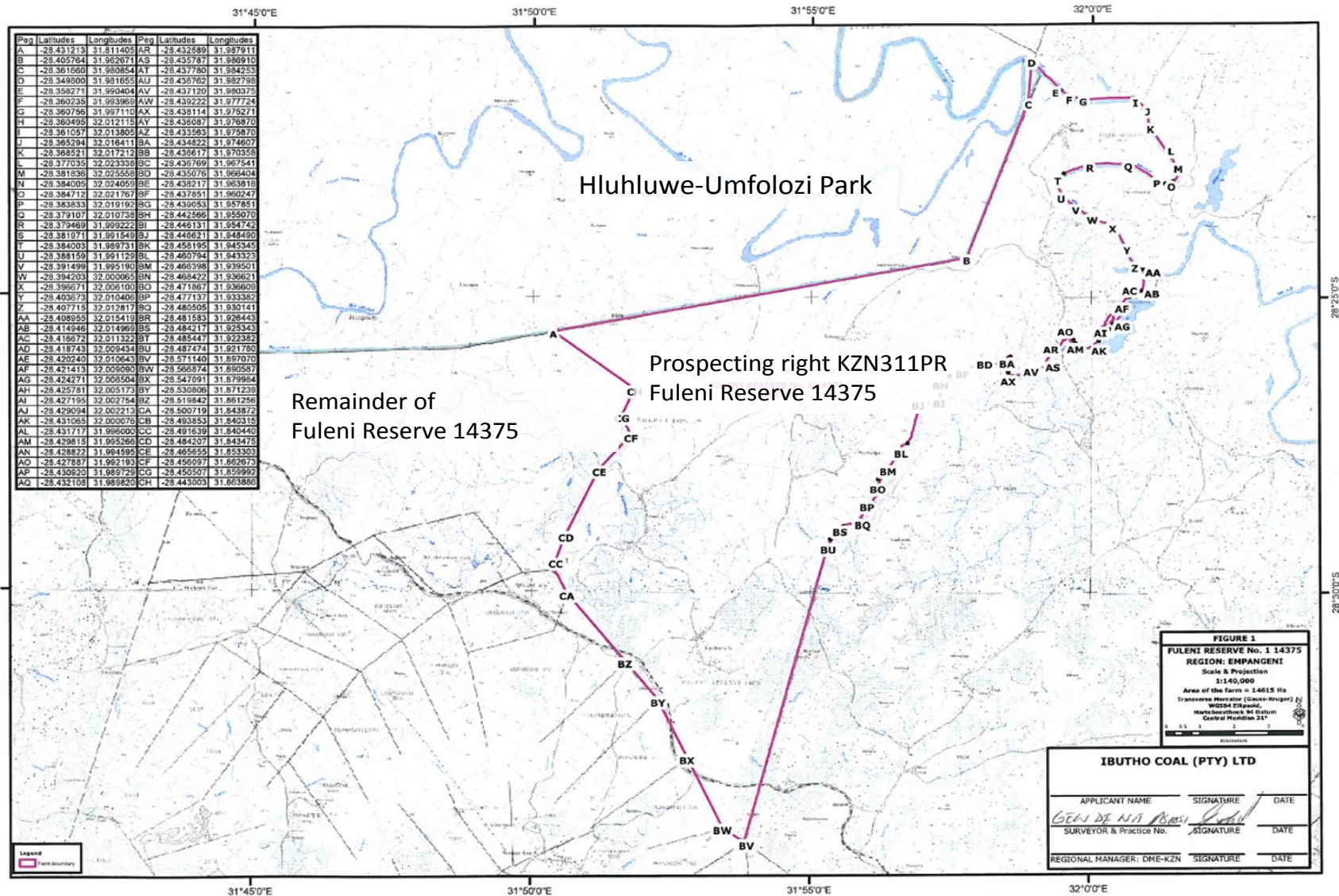


Figure 3: Fuleni NOMRA area

1.3 BRIEF PROJECT DESCRIPTION

The potential for both opencast and underground mining has been identified and the estimated Life of Mine (LOM) for Fuleni is 32 years with a mineable resource of 35.7 Mt Run-of-Mine (ROM) for the opencast production and 1.8 Mt for underground production. The process design allows for the production of a primary Anthracite product suitable for the export and inland market and a lower grade middling product for the thermal market.

The envisaged mining method for the opencast area is a conventional drill and blast operation with truck and shovel load and haul. Underground mining operations will commence from year 18 to the end of the mining schedule. Access will be from selected positions in the open pits and the coal will be mined through the typical bord-and-pillar methodology. A single production section is planned for all underground mining. After underground activities have been completed, the access to the underground areas will be closed with the final rehabilitation of the open pit.

The proposed infrastructure to be developed includes -

- Topsoil and overburden stockpiles;
- Haul roads and/or conveyor systems for ROM transport;
- ROM handling facility;
- Coal Handling Processing Plant (CHPP) with associated stockpiles;
- Pollution control dams;
- Temporary discard facility;
- Raw water storage facility(ies) and distribution systems;
- Access road to mine and for product transport; and
- Auxiliary infrastructure including workshops and stores, offices and change houses, sewage treatment plant, main electrical power supply and security fencing.

The washed coal will be transported via road to either a nearby siding on the Swaziland-Richards Bay railway line or directly to the Richards Bay Coal Terminal (RBCT) for export.

The final discard material from the plant will be disposed of in mined-out open pits. In the event that these pits are unavailable due to existing mining activities, the discard material will be placed on a temporary surface discard dump, from where it will be reclaimed and dumped into the mined-out open pits towards the end of the mine life as part of the rehabilitation of the mining site.

1.4 MOTIVATION FOR THE PROJECT

Anthracite is a carbon-rich, high quality coal whose key application is as a carbon feedstock (reductant), replacing coke in metallurgical processing industries, with a notable increase in the intensity of anthracite use i.e. as a substitute for coke in ferroalloy smelting activities. Other uses of anthracite include:

- A smokeless fuel for domestic heating and similar processes, typically in urban areas where pollution restrictions apply;
- Pulverised fuel for power generation in the older type coal burning utilities, especially in Europe; and
- The manufacture of carbon-rich products, such as Soderberg electrodes and carbon blocks.

- Anthracite competes with bituminous coals, chars and cokes as a reductant in the metallurgical industry, particularly in the production of ferroalloys. It also makes an ideal blend with high volatile matter thermal coal.

The quality of the Fuleni primary product should be well accepted by overseas customers in India, Middle East, Europe and China. The steel and ferroalloy industries (FeCr and FeMn) are key consumers of anthracite products, with Xstrata and Samancor as dominant players in the South African ferrochrome market. The secondary product is a thermal coal and will be typically accepted by Eskom. Ibutho Coal aims to developing new customers for Anthracite and Thermal Coal in the overseas and local markets.

1.5 SPECIALIST TEAM

The coordination and management of the EIA process is being undertaken by an Independent Environmental Assessor, namely Jacana Environmentals cc (Jacana) with appointed specialists providing the required supporting data. Integrated Development Management Consultants (IDM) has been appointed by Jacana to facilitate the required PPP component of the EIA.

The specialist team that has been appointed to assist Jacana Environmentals with the EIA is:

- | | |
|----------------------------------|----------------------------------|
| • Soil and land use capacity | Rossouw Associates |
| • Surface water | WSM Leshika Consulting (Pty) Ltd |
| • Groundwater | Groundwater Complete |
| • Biodiversity / Aquatic systems | Scientific Aquatic Services |
| • Noise | Jongens Keet Associates |
| • Air Quality | Royal Haskoning DHV |
| • Heritage | eThembeni Cultural Heritage |
| • Socio- and Macro-Economic | Graham Muller Associates |

Their qualification and professional registrations and affiliations are provided in Table 2.

Table 2: Qualification and professional registrations and affiliations of EIA specialists

Aspect	Firm	Responsible person	Qualification	Professional registrations and affiliations
EAP	Jacana Environmentals cc	Marietjie Eksteen	MSc Exploration Geophysics	Pr.Sci.Nat. - SACNASP Reg No. 400090/02.
Soils, land use & land capability	Rossouw Associates	PS Rossouw	MSc Agriculture Soil Science	Pr.Sci.Nat. - SACNASP Reg No. 400194/12. Member of Soil Science Society of South Africa (SSSSA), South African Soil Surveyors Organisation (SASSO) and South African Wetland Society (SAWS).
Biodiversity impact assessment	Scientific Aquatic Services	Stephen van Staden	BSc (Hons) Zoology MSc Environmental Management	Pr.Sci.Nat. - SACNASP Reg No. 400134/05. Registered by the SA RHP as an accredited aquatic biomonitoring specialist. Member of the Gauteng Wetland Forum and South African Soil Surveyors Association (SASSO).
Surface water impact assessment	WSM Leshika Consulting Pty Ltd	Anna Jansen van Vuuren	M Eng (Civil Engineering)	ECSA: Professional Engineer No 770359 (registered 21 November 1977) (Registration renewed for further 5 years from Feb 2013). SAICE: Member of the SA Institution of Civil Engineers: No 010181 (registered 14 April 1978). Fellow of SAICE 16 August 2002.
Groundwater impact assessment	Groundwater Complete	Gerhard Steenekamp	MSc. Geohydrology / Hydrology	Pr.Sci.Nat. - SACNASP Reg No. 400385/04.
Air quality impact assessment	Royal Haskoning DHV	Stuart Thompson	BSc (Hons) Applied Environmental Science	Society South African Geographers. South African Geophysical Association, M07/007. National Association for Clean Air. Air Pollution Information Network - Africa, Life time Membership. Astronomical Society for SA, Committee Member, THO003.
Noise impact assessment	Jongens Keet Associates	Derek Cosijn	BSc (Civil Eng) 1967 Diploma in Town Planning 1974	Engineering Council of South Africa: Professional Engineer No 720347 (registered 17 April 1972). SA Institution of Civil Engineers (SAICE): Member No 8527. SAICE: Fellow 5 October 2000. Southern African Acoustics Institute Member 12 May 2004.

Aspect	Firm	Responsible person	Qualification	Professional registrations and affiliations
				Certified Environmental Assessment Practitioner of South Africa. 15 July 2002.
Heritage and cultural impact assessment	eThembeni Cultural Heritage	Len van Schalkwyk	MA Archaeology	Association of Southern African Professional Archaeologists (ASAPA). ASAPA Council Member - Cultural Resources Management Portfolio (CRM): 2011-2013. ASAPA CRM Section - listed as Principal Investigator. Amafa aKwaZulu-Natali accredited heritage practitioner. South African Heritage Resources Agency's Archaeological Permit Advisory Committee (2004). South African member of International Scientific Committee for Archaeological Management, elected by ICOMOS-SA Executive (1999 – 2000). Provincial Representative: South African World Heritage Convention Committee (1998 - 2000). Southern African Museums Association (1984 -1999).
Socio- and macro-economic impact assessment	Graham Muller Associates	Graham Muller	BA (Hons) Economics MSc Statistics ACMA / CGMA	Economic Society of South Africa. Chartered Institute of Management Accountants.
Stakeholder Engagement	IDM Consultants	Karl Wiggishoff	BA (Legal) LLB (Law Degree) LLM (Masters Degree in Environmental Planning & Development Law)	Member of The Law Society of South Africa, The Environmental Law Association of South Africa and The KwaZulu-Natal Planning and Development (PDA) Forum.

2 LEGAL FRAMEWORK

2.1 APPLICABLE LEGISLATION

The legal frameworks within which the mining development, transport options and associated infrastructure aspects operate is complex and include many acts, associated regulations, standards, principle, guidelines, conventions and treaties on an international, national, provincial and local level. The main legal frameworks that require compliance in terms of Environmental and Water Use Authorisation are:

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

Other legislative frameworks applicable to a development of this nature include:

- Act No. 25 of 1999: National Heritage Resources Act (NHRA)
- Act No. 10 of 2004: NEMA: Biodiversity Act (NEMBA)
- Act No. 43 of 1983: Conservation of Agricultural Resources Act (CARA)
- Act No. 84 of 1998: National Forests Act (NFA)
- Act No. 39 of 2004: National Environmental Management: Air Quality Act (AQA)
- Act No. 57 of 2008: National Environmental Management: Protected Areas Act
- Act No. 59 of 2008: National Environmental Management: Waste Act (NEMWA)
- Act No. 101 of 1998: National Veld and Forest Fire Act
- Act No. 15 of 1973: Hazardous Substances Act
- GN No. R.527 of 23 April 2004: Mineral and Petroleum Resources Development Regulations
- GN No. 704 of 4 June 1999: Regulation on use of water for mining and related activities aimed at the protection of water resources
- GN No. R. 544-546 of 18 June 2010 and R. 922-923 of 2013: NEMA: EIA Regulations
- GN No. 718 of 3 July 2009 and R. 921 of 2013: NEMWA: Waste Management Activities
- GN No. 248 of 31 March 2010: AQA: Atmospheric Emissions Activities
- GN No. R.152 of 2007: NEMBA: Threatened or Protected Species (TOPS) Regulations
- Act No. 125 of 1991: Physical Planning Act
- Act No. 117 of 1998: Municipal Structures Act
- Act No. 32 of 2000: Municipal Systems Act
- Act No. 67 of 1995: Development Facilitation Act (DFA)
- Act No. 6 of 2008: KwaZulu-Natal Planning and Development Act
- Act No. 5 of 1999: KwaZulu-Natal Nature Conservation Management Act
- Act No. 4 of 2008: KwaZulu-Natal Heritage Act (KZNHA)
- Act 12 of 1996: KwaZulu-Natal Cemeteries and Crematoria Act
- Act 2 of 2005: KwaZulu-Natal Cemeteries and Crematoria Amendment Act
- Convention on Biological Diversity (1995)
- World Summit for Sustainable Development (2002)

2.2 APPROACH TO ENVIRONMENTAL AUTHORISATION AND STAKEHOLDER ENGAGEMENT

Every applicant who applies for a mining right in terms of Section 22 of the MPRDA must conduct an Environmental Impact Assessment (EIA) and submit an Environmental Management Programme (EMP) for approval to the DMR. The MPRDA allows 180 days (6 months) for this process to be completed.

Although the MPRDA governs environmental management in the mining sector, a number of the ancillary activities required for mining operations (such as the construction of pipelines and roads and the clearance of land) trigger the requirement for an Environmental Authorisation under the NEMA EIA Regulations GN Nos. R.544-546 of 2010 and R. 922-923 of 2013.

In addition, many activities will also trigger the requirement for water use authorisation in terms of Section 21 of the NWA, including (for example) taking water from a water resource, storing of water and disposing of waste in a manner that may detrimentally impact on a water resource. The final water uses applied for will depend on the final layout and position of infrastructure associated with the project.

Refer to Table 3 for a high-level assessment of the listed activities and water uses applicable to the Fuleni Project. These are dependent on the final layout and position of infrastructure associated with the project and will therefore be confirmed during the EIA Phase.

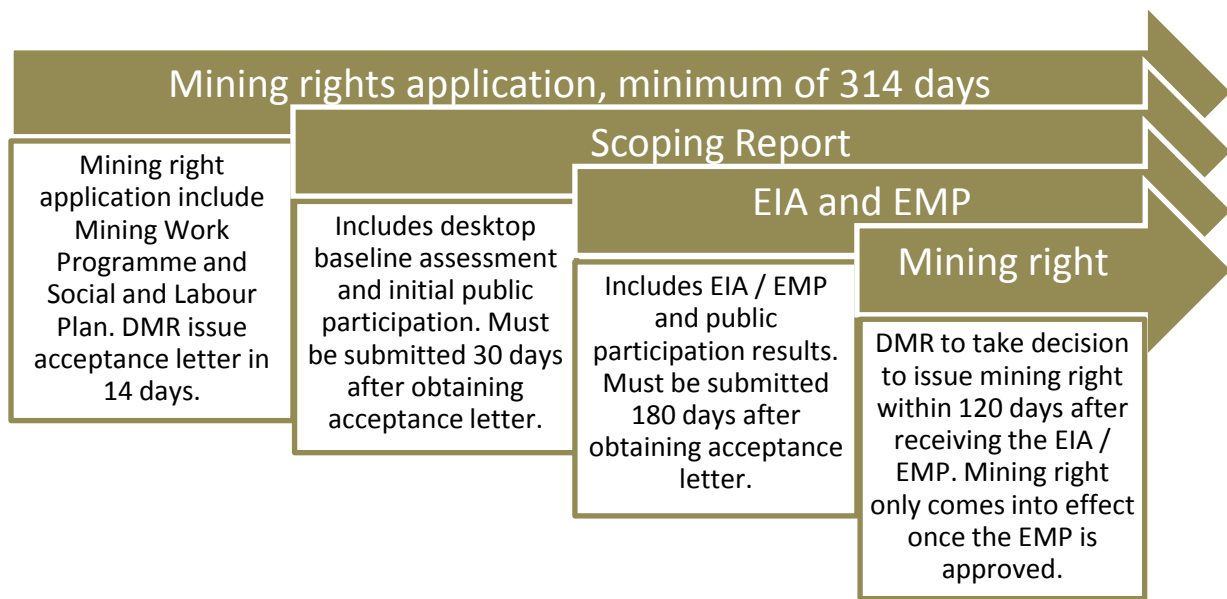
In addition to the NOMRA, application for Environmental Authorisation has been submitted to the Department of Agriculture and Environmental Affairs (DAEA) in terms of NEMA {**DAEA Ref: DC 28/0035/2013: KZN/EIA/0001371/2013**}. Application to the Department of Water Affairs (DWA) for an Integrated Water Use Licence (IWUL) will be made once the mining and infrastructure has been finalised.

It is important to note that the MPRDA and NEMA process will be **performed in parallel** and that an integrated Scoping Report, EIA and EMP will be submitted for the purpose of both applications. The public participation (stakeholder engagement) required in terms of the MPRDA, the NEMA and the NWA will also be conducted in parallel.

Given that no time frames are specified in the NEMA or the NWA for the Environmental Authorisation process, therefore the timeframes stipulated in the MPRDA will be applicable.

The dates for submission of the integrated Scoping Report and EIA/EMP report are directed by the acceptance letter from the DMR {**Ref: KZN 30/5/1/2/1/10045 MR**} and are as follow:

- Submission of Scoping Report : 6 March 2014
- Submission of EIA / EMP : 180 days from acceptance



2.3 SCOPING REPORT FRAMEWORK

The following reference documents were consulted to develop the framework of this Scoping Report, which is tabled overleaf (Table 4):

- MPRDA Scoping Requirements:
 - Regulation 49 of GN No R.527 of 23 April 2004: Mineral and Petroleum Resources Development Regulations
 - DMR Scoping Report Guideline and Template
- NEMA Scoping Requirements:
 - Regulation 28 of GN No R.543 of 18 June 2010: Environmental Impact Assessment Regulations

Table 3: Activity-based legal requirement assessment (high-level) for the Fuleni Project

ACTIVITY	MPRDA	NEMA	NWA
Mining Operation			
<ul style="list-style-type: none"> - Opencast pits 1-6 - Underground mining 	Mining Right Application	GNR545 – A15: <i>Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more.</i>	S21(c)&(i) – Impeding / altering of water courses S21(g) – Dust suppression
		GNR546 – A14: <i>The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation outside urban areas.</i>	
		GNR545 – A5: <i>The construction of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent and which is not identified in Notice No. 544 of 2010 or included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case that Act will apply.</i>	
<ul style="list-style-type: none"> - In-pit / underground water management - {sumps / pumping} 			S21(j) – Dewatering of pits S21(g) – Disposing of waste / water containing waste
<ul style="list-style-type: none"> - Storm water management - {river diversions / berms} 		GNR544 – A11: <i>The construction of (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more, where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.</i>	S21(c)&(i) – Impeding / altering of water courses
CHPP and Infrastructure Areas			
<ul style="list-style-type: none"> - Access / haul roads 		GNR544 – A22: <i>The construction of a road, outside urban areas, (i) with a reserve wider than 13.5 meters or, (ii) where no reserve exists where the road is wider than 8 metres, or (iii) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010.</i>	S21(g) – Dust suppression
<ul style="list-style-type: none"> - Stream crossings - {bridges, pipelines roads} 		GNR544 – A11: <i>The construction of (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more, where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.</i>	S21(c)&(i) – Impeding / altering of water courses
		GN544 – A18: <i>The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil,</i>	

ACTIVITY	MPRDA	NEMA	NWA
		<i>sand, shells, shell grit, pebbles or rock from (i) a watercourse; (ii) the sea; (iii) the seashore; (iv) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater.</i>	
- Infrastructure area, workshops		GNR545 – A15: <i>Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more.</i>	S21(g) – Disposing of waste / water containing waste
		GNR546 – A14: <i>The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation outside urban areas.</i>	
		GNR545 – A5: <i>The construction of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent and which is not identified in Notice No. 544 of 2010 or included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case that Act will apply.</i>	
		GNR546 – A1: <i>The construction of billboards exceeding 18 square metres in size outside urban or mining areas or outside industrial complexes in areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve.</i>	
		GNR546 – A3: <i>The construction of masts or towers of any material or type used for telecommunication broadcasting or radio transmission purposes where the mast: (a) is to be placed on a site not previously used for this purpose, and (b) will exceed 15 metres in height, but excluding attachments to existing buildings and masts on rooftops in areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve.</i>	
- Plant stockpiles		GNR545 – A5: <i>The construction of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent and which is not identified in Notice No. 544 of 2010 or included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case that Act will apply.</i>	S21(g) – Disposing of waste / water containing waste
- Clean water storage tanks		GNR544 – A12: <i>The construction of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50000 cubic metres or more.</i>	S21(b) – Storage of water
		GNR546 – A2: <i>The construction of reservoirs for bulk water supply with a capacity of more than 250 cubic meters in areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a</i>	

ACTIVITY	MPRDA	NEMA	NWA
		<i>biosphere reserve.</i>	
- Dirty water dams		GNR544 – A12: <i>The construction of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50000 cubic metres or more.</i>	S21(g) – Disposing of waste / water containing waste
- Bulk hydrocarbon facilities		GN545 – A3: <i>The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres.</i>	
- Sewage treatment plant			S21(g) – Disposing of waste / water containing waste
Conveyance / transport of ROM & product on site			
- Haul / service roads		GNR544 – A22: <i>The construction of a road, outside urban areas, (i) with a reserve wider than 13.5 metres or, (ii) where no reserve exists where the road is wider than 8 metres, or (iii) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010.</i>	S21(g) – Dust suppression
- {River crossings / culverts}		GNR544 – A11: <i>The construction of (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more, where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.</i>	S21(c)&(i) – Impeding / altering of water courses
Bulk Water Supply			
- Bulk water dam		GNR545 – A19: <i>The construction of a dam, where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the high-water mark of the dam covers an area of 10 hectares or more.</i>	S21(a) – Water abstraction S21(b) – Water storage S21(c)&(i) – Impeding / altering of water courses
-		GNR544 – A9: <i>The construction of facilities or infrastructure exceeding 1000 metres in length for the bulk transportation of water, sewage or storm water - (i) with an internal diameter of 0,36 metres or more; or (ii) with a peak throughput of 120 litres per second or more, excluding where:</i> <i>a. such facilities or infrastructure are for bulk transportation of water, sewage or storm water or storm water drainage inside a road reserve; or</i> <i>b. where such construction will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse.</i>	S21(c)&(i) – Impeding / altering of water courses
		GNR544 – A11: <i>The construction of (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more, where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where</i>	S21(c)&(i) – Impeding / altering of water courses

ACTIVITY	MPRDA	NEMA	NWA
		<i>such construction will occur behind the development setback line.</i>	
Mine residue management			
<ul style="list-style-type: none"> - Overburden stockpiles - Discards stockpile 		GNR545 – A15: <i>Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more.</i>	S21(g) – Disposing of waste / water containing waste
		GNR546 – A14: <i>The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation outside urban areas.</i>	
<ul style="list-style-type: none"> - In-pit disposal / rehabilitation - General / hazardous waste 		N/A – off-site disposal	S21(g) – Disposing of waste / water containing waste
Transport of product			
<ul style="list-style-type: none"> - Product haulage road 		GNR544 – A22: <i>The construction of a road, outside urban areas, (i) with a reserve wider than 13.5 meters or, (ii) where no reserve exists where the road is wider than 8 metres, or (iii) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010.</i>	
		GNR544 – A47: <i>The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre - (i) where the existing reserve is wider than 13,5 meters; or (ii) where no reserve exists, where the existing road is wider than 8 metres – excluding widening or lengthening occurring inside urban areas.</i>	
		GN544 – A11: <i>The construction of (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more, where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.</i>	S21(c)&(i) – Impeding / altering of water courses
-		GN544 – A18: <i>The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from (i) a watercourse; (ii) the sea; (iii) the seashore; (iv) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater.</i>	S21(c)&(i) – Impeding / altering of water courses
Bulk power / electrical reticulation			
<ul style="list-style-type: none"> - Construction / operational power 		GN544 – A10: <i>The construction of facilities or infrastructure for the transmission and distribution of electricity - (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or (ii) inside urban areas or industrial complexes with a capacity of 275 kilovolts or more.</i>	S21(c)&(i) – impeding / altering of water courses (To be confirmed)

Table 4: Scoping Report framework

MPRDA Scoping Requirement	NEMA Scoping Requirements	Scoping Report Framework
<p>1.1 Name the community, or explain why no such community was identified.</p> <p>1.2 Specifically state whether or not the Community is also the landowner.</p> <p>1.3 State whether or not the Department of Land Affairs been identified as an interested and affected party.</p> <p>1.4 State specifically whether or not a land claim is involved.</p> <p>1.5 Name the Traditional Authority identified by the applicant.</p> <p>1.6 List the landowners identified by the applicant. (Traditional and Title Deed owners).</p> <p>1.7 List the lawful occupiers of the land concerned.</p> <p>1.8 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.</p> <p>1.9 Name the Local Municipality identified by the applicant.</p> <p>1.10 Name the relevant Government Departments, agencies and institutions responsible for the various aspects of the environment, land and infrastructure which may be affected by the proposed project.</p>	<p>4. Description of the property on which the activity is to be undertaken and the location of the activity on the property, or if it is (i) a linear activity, a description of the route of the activity; or (ii) an ocean-based activity; the coordinates where the activity is to be undertaken.</p> <p>2. Description of the proposed activity.</p> <p>9. A description of the need and desirability of the proposed activity.</p> <p>1. Details of (i) the EAP who prepared the report; and (ii) the expertise of the EAP to carry out scoping procedures.</p>	<p>Project Background</p> <p>1.1 Introduction</p> <p>1.2 Project Location</p> <p>- Surface Ownership</p> <p>- Community Description</p> <p>1.3 Brief Project Description</p> <p>1.4 Motivation for the Project</p> <p>1.5 Environmental Specialist Team</p>
	<p>6. An identification of all legislation and guidelines that have been considered in the preparation of the scoping report.</p>	<p>2. Legal Framework</p> <p>2.1 Applicable legislation</p> <p>2.2 Approach to Environmental Authorisation and Stakeholder Engagement</p> <p>2.3 Scoping Report Framework</p> <p>2.4 Licensing requirements</p>
<p>2.2 A description of the existing status of the cultural environment that may be affected.</p> <p>2.3 A description of the existing status of any heritage environment that may be affected.</p> <p>2.4 A description of the existing status of any current land uses and the socio-economic environment that may be directly affected.</p> <p>2.5 A description of the existing status of any infrastructure that may be affected.</p> <p>2.6 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.</p>	<p>5. A description of the environment that may be affected by the activity and the manner in which activity may be affected by the environment.</p>	<p>3. Existing status of the cultural, socio-economic and biophysical environment</p> <p>3.1 Cultural & Heritage Resources</p> <p>3.2 Socio-economic Environment</p> <p>3.3 Biophysical Environment</p>
<p>3.1 Provide a description of the proposed project including a map showing the spatial locality of infrastructure, extraction area, and any associated activities.</p> <p>3.2 Describe any listed activities (in terms of the NEMA EIA regulations) which will be occurring within the proposed project.</p>	<p>2. Description of the proposed activity.</p>	<p>4. Detail Project Description</p> <p>4.1 Mining operations</p> <p>4.2 Processing Plant</p> <p>4.3 Materials Handling Requirements</p> <p>4.4 Infrastructure</p> <p>4.5 Bulk Power Supply</p> <p>4.6 Bulk Water Supply</p> <p>4.7 Mine Residue Management</p> <p>4.8 Closure Planning and Rehabilitation</p>

MPRDA Scoping Requirement	NEMA Scoping Requirements	Scoping Report Framework
<p>3 Identify the anticipated environmental, social or cultural impacts. (including the cumulative impacts)</p> <p>3.4 Provide a list of potential impacts on the cultural environment.</p> <p>3.5 Provide a list of potential impacts on the heritage environment, if applicable.</p> <p>3.6 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.</p> <p>3.7 Provide a list of potential impacts (positive & negative) on: Employment opportunities, community health, community proximity, and links to the Social and Labour Plan.</p> <p>3.8 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.</p> <p>3.9 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.</p>	<p>7. A description of environmental issues and potential impacts, including cumulative impacts, that have been identified</p>	<p>5. Description of potential impacts associated with the activity:</p> <p>5.1 Socio-economic and Cultural Aspects</p> <p>5.2 Biophysical Environment</p> <p>5.3 Concerns raised by IAPs</p>
<p>4. A description of any proposed land use or development alternatives:</p> <p>4.1 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.</p> <p>4.2 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.</p> <p>4.3 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.</p> <p>4.4 Provide information in relation to the consequences of not proceeding with proposed operation</p> <p>5.1 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.</p> <p>5.2 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.</p>	<p>3. Description of any feasible and reasonable alternatives that have been identified.</p> <p>10. A description of identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity</p>	<p>6. Land Use or Development Alternatives</p> <p>6.1 Land Use Alternatives</p> <p>6.2 Development Alternatives</p> <p>6.3 Proposals by IAPs on Alternative Options</p>
<p>6. A description of the process of engagement referred to above with identified communities, landowners and interested and affected parties: The applicant must;</p> <p>6.1 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;</p> <p>6.2 Provide a list of which of the identified communities, landowners, lawful occupiers, and other interested and affected parties were in fact consulted.</p>	<p>8. Details of the public participation process conducted in terms of regulation 27(a), including</p> <p>8.1 The steps that were taken to notify potentially interested and affected parties of the application;</p> <p>8.2 Proof that notice boards, advertisements and notices notifying potentially interested and affected parties of the application have been displayed, placed or given;</p> <p>8.3 A list of all persons or organisations that were identified and registered in terms of regulation 55 as interested and</p>	<p>7. Stakeholder Engagement</p>

MPRDA Scoping Requirement	NEMA Scoping Requirements	Scoping Report Framework
<p>6.3 Provide a list of their views in regard to the existing cultural, socioeconomic or biophysical environment, as the case may be,</p> <p>6.4 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;</p> <p>6.5 Provide a list of any other concerns raised by the aforesaid parties.</p> <p>6.6 Provide the applicable minutes and records of the consultations.</p> <p>6.7 Provide information with regard to any objections received.</p> <p>2.1 Confirmation that the identified and consulted interested and affected parties agree on the description of the existing status of the environment.</p> <p>3.3 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.</p> <p>1.11 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.</p>	<p>affected parties in relation to the application; and</p> <p>8.4 A summary of the issues raised by interested and affected parties, the date of receipt of and the response of the EAP to those issues.</p> <p>11. Copies of any representations, and comments received in connection with the application or the scoping report from interested and affected parties.</p> <p>12. 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 participant.</p> <p>13. Any responses by the EAP to those representations and comments and views.</p>	
<p>7. Describe the nature and extent of further investigations required in the environmental impact assessment report, including any specialist reports that may be required.</p>	<p>14. A plan of study for environmental impact assessment which sets out the proposed approach to the environmental impact assessment of the application, which must include—</p> <p>14.1 A description of the tasks that will be undertaken as part of the environmental impact assessment process, including any specialist reports or specialised processes, and the manner in which such tasks will be undertaken;</p> <p>14.2 An indication of the stages at which the competent authority will be consulted;</p> <p>14.3 A description of the proposed method of assessing the environmental issues and alternatives, including the option of not proceeding with the activity; and</p> <p>14.4 Particulars of the public participation process that will be conducted during the environmental impact assessment process.</p>	<p>8. Plan of Study for Environmental Impact Assessment</p> <p>8.1 Specialist studies</p> <p>8.2 Risk assessment methodology</p> <p>8.3 Public Participation Process</p>

2.4 LICENSING REQUIREMENTS

The following preliminary licencing requirements have been identified:

Legislation	Comment	Requirement
MPRDA	Ibutho Coal (Pty) Ltd to apply for a mining right, at which point the EMP process is triggered.	Scoping, EIA / EMP report for submission to KZN DMR
NEMA, EIA Regulations GN 544, 545, 546	A number of listed activities are applicable, the majority triggering the threshold limit for a Full EIA required in terms of GN545 (refer to Table 3 above).	Full EIA, including Scoping, EIA and EMP for submission to KZN DAEA
NWA, S21	Licences will be required for a number of water uses (refer to Table 3 above).	IWULA and IWWMP for submission to KZN DWA
NWA, S120	If any of the storage dams has a wall higher than 5m and a capacity larger than 50 000 m ³ , the dam must be registered at DWA. If classified as a category 2 dam, it must be designed and the construction monitored by an Approved Professional Person (APP).	Dam registration to National DWA
Forest Act	Permits required for the destruction and/or relocation of protected tree species.	Permit application to DAFF if applicable
NEM:BA, TOPS regulations	Permits required for the destruction and/or relocation of protected species.	Permit application to KZN DAEA if applicable
NHRA	Permits required for Phase 1B and Phase 2 studies.	Permit application to SAHRA / Amafa if applicable

This will be finalized during the EIA Phase as the specialist impact studies become available.

3 EXISTING STATUS OF THE CULTURAL, SOCIO-ECONOMIC AND BIOPHYSICAL ENVIRONMENT

The existing status as reflected in this Section is based on desk-top information sources by the specialists and published documents.

The above was supplemented by site visits performed during the latter part of 2013 and early 2014. During the EIA Phase further detail field surveys and additional literature reviews will be undertaken to verify the baseline information as well as the potential impacts identified in Section 5 of this report.

The specialist team that has been appointed to assist Jacana Environmentals with the EIA is:

- | | |
|----------------------------------|----------------------------------|
| • Soil and land use capacity | Rossouw Associates |
| • Surface water | WSM Leshika Consulting (Pty) Ltd |
| • Groundwater | Groundwater Complete |
| • Biodiversity / Aquatic systems | Scientific Aquatic Services |
| • Noise | Jongens Keet Associates |
| • Air Quality | Royal Haskoning DHV |
| • Heritage | eThembeni Cultural Heritage |
| • Socio- and Macro-Economic | Graham Muller Associates |

3.1 CULTURAL AND HERITAGE RESOURCES

Heritage assessments typically consider the following wide range of heritage resource types:

- Places, buildings, structures and equipment;
- Places associated with oral traditions or living heritage;
- Landscapes and natural features;
- Traditional burial places;
- Ecofacts;
- Geological sites of scientific or cultural importance;
- Archaeological sites;
- Historical settlements and townscapes;
- Public monuments and memorials; and
- Battlefields.

3.1.1 ARCHAEOLOGICAL CONTEXT OF THE STUDY AREA

In archaeological terms South Africa's prehistory has been divided into a series of phases based on broad patterns of technology. The primary distinction is between a reliance on chipped and flaked stone implements (the Stone Age), the ability to work iron (the Iron Age) and the Colonial Period, characterised by the advent of writing and in southern Africa primarily associated with the first European travellers (Mitchell 2002). Spanning a large proportion of human history, the Stone Age in Southern Africa is further divided into the Early Stone Age, or Paleolithic Period (about 2 500 000–150 000 years ago), the Middle Stone Age, or Mesolithic Period (about 500 000–30 000 years ago), and the Late Stone Age, or Neolithic Period (about 30 000–2 000 years ago). The simple stone tools found with australopithecine fossil bones fall into the earliest part of the Early Stone Age.

3.1.1.1 The Stone Age

3.1.1.1.1 Early Stone Age

Most Early Stone Age sites in South Africa can probably be connected with the hominin species known as *Homo erectus*. Simply modified stones, hand axes, scraping tools, and other bifacial artifacts had a wide variety of purposes, including butchering animal carcasses, scraping hides, and digging for plant foods. Most South African archaeological sites from this period are the remains of open camps, often by the sides of rivers and lakes, although some are rock shelters, such as Montagu Cave in the Cape region.

3.1.1.1.2 Middle Stone Age

The long episode of cultural and physical evolution gave way to a period of more rapid change about 120 000 years ago. Hand axes and large bifacial stone tools were replaced by stone flakes and blades that were fashioned into scrapers, spear points, and parts for hafted, composite implements. This technological stage, now known as the Middle Stone Age, is represented by numerous sites in South Africa.

Open camps and rock overhangs were used for shelter. Day-to-day debris has survived to provide some evidence of early ways of life, although plant foods have rarely been preserved. Middle Stone Age bands hunted medium-sized and large prey, including antelope and zebra, although they tended to avoid the largest and most dangerous animals, such as the elephant and the rhinoceros. They also ate seabirds and marine mammals that could be found along the shore and sometimes collected tortoises and ostrich eggs in large quantities.

The Middle Stone Age is perhaps most significant as the time period during which the first modern humans, *Homo sapiens sapiens*, emerged between 120 000 and 30 000 years ago. The Klasies River cave complex, located on the southern Cape coast contains the oldest remains of anatomically modern humans in the world, dating to around 110 000 years ago (Singer & Wymer 1982; Rightmire & Deacon 1991). Humans were anatomically modern by 110 000 years ago but only developed into culturally modern behaving humans between 80 000 and 70 000 years ago, during cultural phases known as the Still Bay and Howieson's Poort time periods or stone tool traditions.

3.1.1.1.3 The Late Stone Age

Basic toolmaking techniques began to undergo additional change about 40 000 years ago. Small finely worked stone implements known as microliths became more common, while the heavier scrapers and points of the Middle Stone Age appeared less frequently. Archaeologists refer to this technological stage as the Later Stone Age or LSA, which can be divided into four broad temporal units directly associated with climatic, technological and subsistence changes (Deacon 1984):

- Late Pleistocene microlithic assemblages (40-12 000 years ago);
- Terminal Pleistocene / early Holocene non-microlithic (macrolithic) assemblages (12-8 000 years ago);
- Holocene microlithic assemblages (8 000 years ago to the Colonial Period); and
- Holocene assemblages with pottery (2 000 years ago to the Historic Period) closely associated with the arrival of pastoralist communities into South Africa (Mitchell 1997; 2002).

Animals were trapped and hunted with spears and arrows on which were mounted well-crafted stone blades. Bands moved with the seasons as they followed game into higher lands in the spring and early summer months, when plant foods could also be found. When available, rock overhangs became shelters; otherwise, windbreaks were built. Shellfish, crayfish, seals, and seabirds were also important sources of food, as were fish caught on lines, with spears, in traps, and possibly with nets.

Elements of material culture characteristic of the LSA that reflect cultural modernity have been summarised as follows (Deacon 1984):

- Symbolic and representational art (paintings and engravings);
- Items of personal adornment such as decorated ostrich eggshell, decorated bone tools and beads, pendants and amulets of ostrich eggshell, marine and freshwater shells;
- Specialized hunting and fishing equipment in the form of bows and arrows, fish hooks and sinkers;
- A greater variety of specialized tools including bone needles and awls and bone skin-working tools;
- Specialized food gathering tools and containers such as bored stone digging stick weights, carrying bags of leather and netting, ostrich eggshell water containers, tortoiseshell bowls and scoops and later pottery and stone bowls;
- Formal burial of the dead in graves, sometimes covered with painted stones or grindstones and accompanied by grave goods;
- The miniaturization of selected stone tools linked to the practice of hafting for composite tools production; and
- A characteristic range of specialized tools designed for making some of the items listed above.

3.1.1.2 The Iron Age

Archaeological evidence shows that Bantu-speaking agriculturists first settled in southern Africa around AD 300. Bantu-speakers originated in the vicinity of modern Cameroon from where they began to move eastwards and southwards, sometime after 400 BC, skirting around the equatorial

forest. An extremely rapid spread throughout much of sub-equatorial Africa followed: dating shows that the earliest communities in Tanzania and South Africa are separated in time by only 200 years, despite the 3 000 km distance between the two regions. It seems likely that the speed of the spread was a consequence of agriculturists deliberately seeking iron ore sources and particular combinations of soil and climate suitable for the cultivation of their crops.

The earliest agricultural sites in KwaZulu-Natal date to between AD 400 and 550. All are situated close to sources of iron ore, and within 15 km of the coast. Current evidence suggests it may have been too dry further inland at this time for successful cultivation. From 650 onwards, however, climatic conditions improved and agriculturists expanded into the valleys of KwaZulu-Natal, where they settled close to rivers in savanna or bushveld environments. There is a considerable body of information available about these early agriculturists.

Seed remains show that they cultivated finger millet, bulrush millet, sorghum and probably the African melon. It seems likely that they also planted African groundnuts and cowpeas, though direct evidence for these plants is lacking from the earlier periods. Faunal remains indicate that they kept sheep, cattle, goats, chickens and dogs, with cattle and sheep providing most of the meat. Men hunted, perhaps with dogs, but hunted animals made only a limited contribution to the diet in the region.

Metal production was a key activity since it provided the tools of cultivation and hunting. The evidence indicates that people who worked metal lived in almost every village, even those that were considerable distances from ore sources.

Large-scale excavations in recent years have provided data indicating that first-millennium agriculturist society was patrilineal and that men used cattle as bridewealth in exchange for wives. On a political level, society was organised into chiefdoms that, in our region, may have had up to three hierarchical levels. The villages of chiefs tended to be larger than others, with several livestock enclosures, and some were occupied continuously for lengthy periods. Social forces of the time resulted in the concentration of unusual items on these sites. These include artefacts that originated from great distances, ivory items (which as early as AD 700 appear to have been a symbol of chieftainship), and initiation paraphernalia.

This particular way of life came to an end around AD 1000, for reasons that we do not yet fully understand. There was a radical change in the decorative style of agriculturist ceramics at this time, while the preferred village locations of the last four centuries were abandoned in favour of sites along the coastal littoral. In general, sites dating to between 1050 and 1250 are smaller than most earlier agriculturist settlements. It is tempting to see in this change the origin of the Nguni settlement pattern. Indeed, some archaeologists have suggested that the changes were a result of the movement into the region of people who were directly ancestral to the Nguni-speakers of today. Others prefer to see the change as the product of social and cultural restructuring within resident agriculturist communities.

Whatever the case, it seems likely that this new pattern of settlement was in some way influenced by a changing climate, for there is evidence of increasing aridity from about AD 900. A new pattern of economic inter-dependence evolved that is substantially different from that of earlier centuries, and is one that continued into the colonial period nearly 500 years later.

3.1.2 INITIAL ASSESSMENT OF SITES IN THE STUDY AREA

Heritage impact assessments (HIA) at past and current mining activities, such as those at the adjacent Somkhele Mine, and literature and database reviews indicate that the following heritage resource types are likely to be present in the study area and will require mitigation before and possibly during mining operations:

3.1.2.1 Places Associated with Oral Traditions or Living Heritage

Communal areas in southern Africa typically include places (such as mountains, river pools and forests) that are associated with cultural tradition; oral history; performance; ritual; popular memory; traditional skills and techniques; indigenous knowledge systems; and the holistic approach to nature, society and social relationships.

Such places may be known to and utilised by entire communities, or only certain individuals, such as traditional healers. They may be visited regularly or only periodically, and their heritage significance could vary from low to high along a local to a national scale.

Extensive developments such as mining activities potentially damage or destroy such places, with little or no opportunities for restitution and concomitant community disruption. Accordingly, it is imperative that alteration to such places is avoided by changing the development footprint if necessary, or negotiating appropriate offsets with affected communities.

3.1.2.2 Landscapes and Natural Features

The project area is largely undeveloped and rural with low-density dispersed settlements and associated subsistence agriculture. Dwellings are grouped as small family-sized homesteads located in undulating terrain.

Visual impacts would result from the construction, operation and closure phase of the proposed project. Specifically, impacts would result from the discard dump, open cast pits and ancillary surface infrastructure being seen from sensitive viewpoints (especially tourists) and the negative effects (relating primarily to visibility and visual absorption capability) on the scenic quality and sense of place of the landscape of the proposed site.

At least two main areas in the vicinity of the project are considered to be sensitive landscapes and are described below.

3.1.2.2.1 Hluhluwe-iMfolozi Park

Hluhluwe–iMfolozi Park, formerly known as Hluhluwe–Umfolozi Game Reserve, is the oldest proclaimed natural park in Africa and lies west of the project area. It consists of 960 km² (96 000 ha) of hilly topography located 280 km north of Durban in central Zululand, KwaZulu-Natal and is known for its rich wildlife and conservation efforts. The park is the only state-run conservation area in KwaZulu-Natal where all the big five game animals occur. Due to conservation efforts, the park now has the largest population of white rhino in the world. Hluhluwe–iMfolozi was originally three separate reserves that joined under its current title in 1989.

Throughout the park there are many signs of Stone Age archaeological sites. The area was originally a royal hunting ground for the Zulu kingdom, but was established as a park in 1895. The Umfolozi and Hluhluwe reserves were established primarily to protect the white rhinoceros, then on the endangered species list. The area has always been a haven for animals as tsetse flies carrying the nagana disease are common, which protected the area from hunters in the colonial era. However, as the Zululand areas was settled by European farmers the game was blamed for the prevalence of the tsetse fly and the reserves became experimental areas in the efforts to eradicate the fly. Farmers called for the slaughter of game and about 100 000 animals were killed in the reserve before the introduction of DDT spraying in 1945 solved the problem. However, white rhinoceros were not targeted and today a population of about 1000 is maintained.

Potential impacts of mining on the park are likely to be indirect, including visual and noise pollution, and could affect its aesthetic and economic heritage significance negatively for the duration of construction and operation of the mine (Table 5).

3.1.2.2.2 Mfolozi River

The Mfolozi River lies adjacent to the mining site and is formed by the confluence of the Black (Imfolozi emnyama) and White Mfolozi (Imfolozi emhlope) Rivers near the southeastern boundary of the Hluhluwe-iMfolozi Park. The isiZulu name imFolozu is generally considered to describe the zigzag course followed by both tributaries, though other explanations have been given.

The river flows in an easterly direction to the Indian Ocean at Maphelana, a coastal resort just south of the St Lucia River mouth. It originally meandered over the Monzi Flats, where it split into numerous slow-flowing channels before entering the St. Lucia Estuary at Honeymoon Bend. The slow-moving water and reed beds in channels operated as a natural filtering system that removed silt from the Mfolozi floodwaters and created a rich habitat for numerous species.

During the 1950s, the Umfolozi Landowners Association contained and artificially channeled the river through the Monzi Flats to develop sugarcane farms. The new Mfolozi canal resulted in the unfiltered water depositing its silt load after entering the slower moving St. Lucia Estuary. This caused the estuary mouth to rapidly silt up. There had only been one record of this occurring until that time, during the sustained drought during the 1930s.

The government started a costly dredging operation in the estuary mouth area, but it proved ineffective. After years of dredging, the next plan was to prevent the Mfolozi River from entering the St Lucia estuary. The Mfolozi River was canalized straight out to sea at Maphelana. The impact of this decision continues; the silt plume from the river is often blown by strong south winds as far north as Sodwana Bay, 100 km away. The changes threaten the coral reefs, which provide fish habitat and protect the shore. In addition, it jeopardizes the associated good snorkeling available at Cape Vidal, part of iSimangaliso Wetland Park, a UNESCO World Heritage Site.

Potential impacts of mining on the river are likely to be direct and indirect and could affect its aesthetic, scientific (including biodiversity and ecology) and economic (including drinking and irrigation) heritage significance negatively for the duration of construction and operation of the mine and beyond.

3.1.2.3 Traditional Burial Places

Numerous traditional burial places are known to occur within and adjacent to the project area. Such burials comprise one or more ancestral graves, typically located within or close to homestead precincts, rather than in formal cemeteries managed by a local authority. Graves usually comprise stone-packed mounds, with or without a headstone, although older graves may be less readily identifiable due to the deflation of the mound and scattering of the stone covering.

All human remains have high heritage significance at all levels due to their spiritual, social and cultural values and may not be altered in any way without the permission of the next-of-kin and a permit from Amafa aKwaZulu-Natali, the Provincial Heritage Resources Authority.

Potential impacts on traditional burial places range from indirect (next-of-kin cannot access graves during mining activities for health and safety reasons) to direct alteration or destruction.

3.1.2.4 Archaeological Sites

Numerous archaeological sites are known to occur close to the project area (for example Anderson 1998, 1999; Hall 1981). Iron Age and historical sites are common in valley bottoms, on hill slopes and the tops of hills, ridges and spurs. If undisturbed, archaeological may have medium to high heritage significance for their historical and scientific values at various levels.

Potential impacts on archaeological sites usually comprise alteration or destruction of the resource. Appropriate mitigation for sites with low heritage significance may be limited to basic recording and application for a destruction permit from Amafa; whereas more significant sites may require extensive recording, artefact sampling and/or excavation, all of which actions would require a permit from Amafa.

3.2 SOCIO-ECONOMIC ENVIRONMENT

The proposed mine is located in Mfolozi Local Municipality and uThungulu District Municipality in KwaZulu-Natal. It is located on the northern boundary of the municipality with the Mfolozi River limiting linkages to the neighbouring municipality to the north. Almost all the impact footprint of the mine falls within Wards 13 and 10 of the municipality with Wards 15 and 12 also being impacted, but to a lesser degree.

The proposed mine is on land owned by the Ingonyama Trust, on Mhlana Traditional Authority land. Due to limited access and no roads or bridges crossing the Mfolozi River nearby it is unlikely that the mine will attract or impact on economic activity in Umkhanyakude District Municipality to the north of the mine site.

3.2.1 SETTLEMENTS

3.2.1.1 Urban Settlements

The district has within its boundaries the large industrial towns of Richards Bay and Empangeni, both home to skills and expertise in the mining industry which is just 55km from the site. The nearest urban settlement within the Mfolozi Municipality is Kwambonambi, 30 km from the site.

3.2.1.2 Rural Settlements

The majority of residents in the municipality and at the proposed mine site are scattered rural settlements with low population density and low skill levels.

3.2.1.3 Settlement Patterns

As indicated on the map below there is a large amount of vacant land (previously not developed due to a Dept. of Agriculture cattle policy in the ward) where much of the mine is proposed; however, there are a number of households in the immediate vicinity. The population near the proposed mine site also has significantly more females than males possibly due to migrant labour patterns.

The topography of North Western Mfolozi has many steep hills and valleys with many sparsely located homesteads and villages. This poses a challenge to service delivery and infrastructure investment. It can be extremely costly and time consuming to deliver basic services to these residents.

Mfolozi Municipality is home to the poorest of the poor, which is evident by the fact that about 52190 of the people within the municipality have no income. The population settlement trend is that people are generally settled in Traditional Authority areas and there is a high level of absentee household members who are migrant workers. A mine in the area would help address this imbalance.

The area along the N2 in the Municipality is characterized by commercial agricultural/plantations and small game reserves.

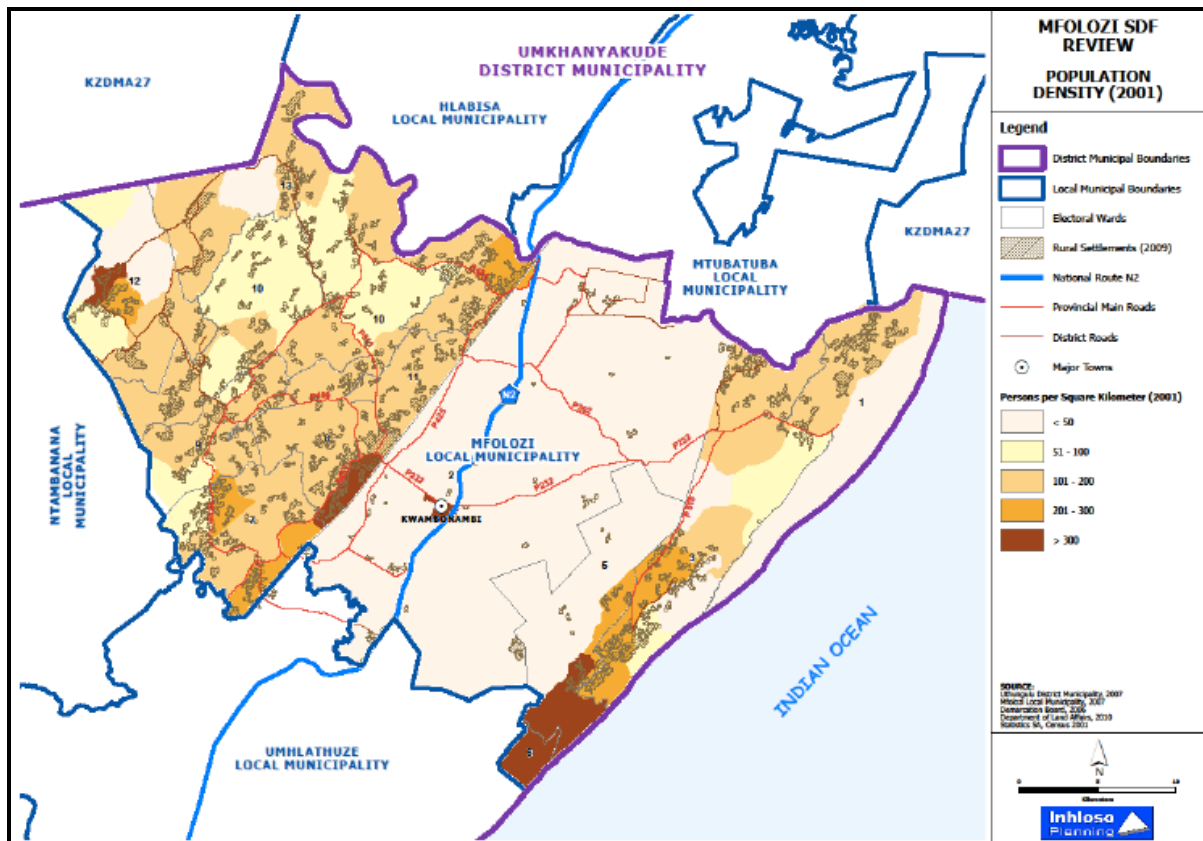


Figure 4: Mfolozi Local Municipality population density

3.2.2 LAND USE

In the municipality as a whole there are six land tenure categories:

- Kwambonambi – proclaimed urban settlement within the centre of the municipality
- Sobukwe – informal settlement,
- Privately owned land around Kwambonambi
- Lake Teza– formal conservation area under Ezemvelo KZN wildlife management
- The Ingonyama Trust land – east and west of the privately owned land
- Proclaimed mine lease

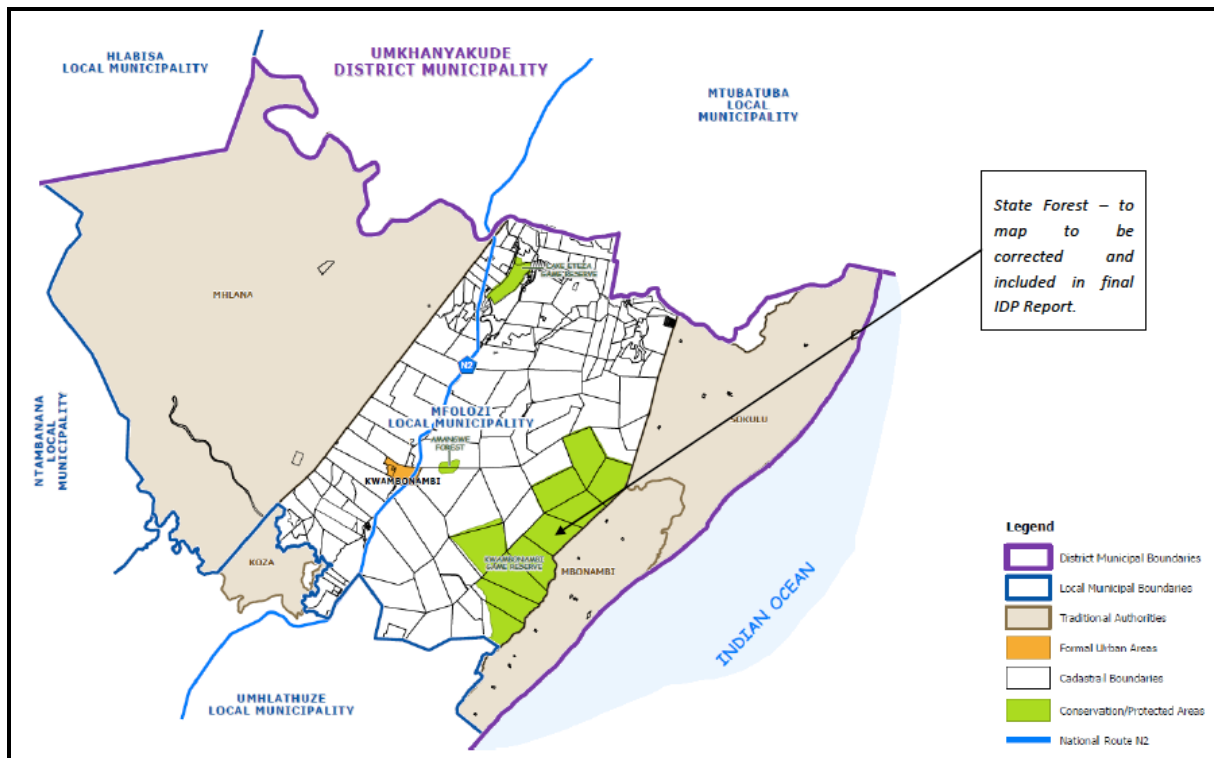


Figure 5: Mfolozi Local Municipality land use map

3.2.3 DEMOGRAPHICS

The Mfolozi Municipality's population has risen by 13% between the two censuses (2001 & 2011) and now is approximately 122 889 and 25 584 households with an average size of 5 make this up. 47% of these are men (Census 2011). 22% of households have a member who has temporarily left the municipality for work purposes. Most of the population is exceptionally young with 48% under the age of 19 and 68% under 30. This poses serious challenges for development in the district and for the types of jobs that the mine will be able to offer. Interestingly during the 2005-2011 period where Mfolozi's population was growing, uThungulu's population of which Mfolozi is a part was shrinking.

In 2009 56% of households were pensioner headed in Mfolozi Municipality. This is up from 22.3% in 2007, a worrying increase. The dependency ratio was above 50% in the settlements near the proposed mining area in Ward 13.

3.2.3.1 Women, Disability and the Aged

The municipality has a Women, Disabled and Aged Plan which needs to be reviewed during the EIA Phase.

3.2.3.2 The Poverty Index

The municipal poverty index found that the households in the north-west corner of the local municipality, adjacent to where the proposed mine is located were the poorest residents of the entire municipality with the least economic activity occurring in this area.

3.2.3.3 Languages

The vast majority of residents of the municipality and all residents in the area surrounding the proposed mine site are isiZulu speakers.

3.2.3.4 Literacy Rates and Education

Since the municipality has such a young population, education levels are expected to be low. Only 6.77% of adults had some form of tertiary education (Census 2011), however 87% had received some form of ordinary schooling and only 143 persons had on schooling at all.

Literacy rates for the uThungulu District as a whole are at 60%, which is lower than the provincial and national averages.

3.2.3.5 HIV/AIDS

The incidence of HIV/Aids in the Mfolozi Municipality has reached its highest level in 2004 (Global Insight) and now sits at approximately 12% of the Mfolozi population. HIV/AIDS affects productivity, dependency ratios and company costs for developers in the area.

According to the Municipal IDP “The impact of HIV/Aids is very serious issue and should be incorporated into whatever strategies or developments are undertaken in an area.”

3.2.4 BASIC SERVICES AND HOUSING

3.2.4.1 Community Facilities

GIS data from the Mfolozi Municipal IDP gives us insight into community facilities in the municipality and near the proposed mine site.

Table 5: Community facilities

Facility	Municipal Assessment	Located near Mine
Cemeteries	Lacking in some areas	4, but quite a drive for some residents
Tribal Courts	Good access for coastal TA but not for the Mhlana TA	More than 60 minutes from mining area
Crèches	Good throughout municipality	5 near mining effected communities
Schools	Good throughout municipality	A primary and high school within mining effected communities
Community Halls	Some areas are well served but not all	Ocilwane Hall within mining effected communities
Clinic	Some gap in the North West areas of the Mhlana TA	Ocilwane Clinic within mining effected communities
Pension Payouts	Good throughout municipality	3 within mining effected communities
Sports Facilities	Poor in the North West of the Mhlana TA	1 Facility up to 90 minutes from mining effected communities

3.2.4.2 Water and Sanitation

uThungulu District Municipality (UDM), in terms of the Water Services Act, is the Water Services Authority in respect of its area of jurisdiction, apart from the City of uMhlatuze. The latest UDM WSDP was completed in 2009. However, it is currently under review.

The table below indicates the sources of water within the Mfolozi Municipality it indicates that about 64.7% of the population accesses potable water. Water supply backlogs in 2001 when the District was created stood at 81%.

Table 6: Sources of water (Mfolozi Municipality Census 2011)

SOURCE	HOUSEHOLD NUMBERS	%
Regional Water Scheme (operated by Municipality or other water services provided)	16 549	64.7%
Borehole	3 127	12.2%
Spring	298	1.2%
Rain water tank	472	1.8%
Dam/pool/stagnant water	880	3.4%
River/stream	1 607	6.3%
Water vendor	276	1.1%
Water tanker	1 807	7.1%
Other	567	2.2%
	-	
TOTAL:	25 583	100%

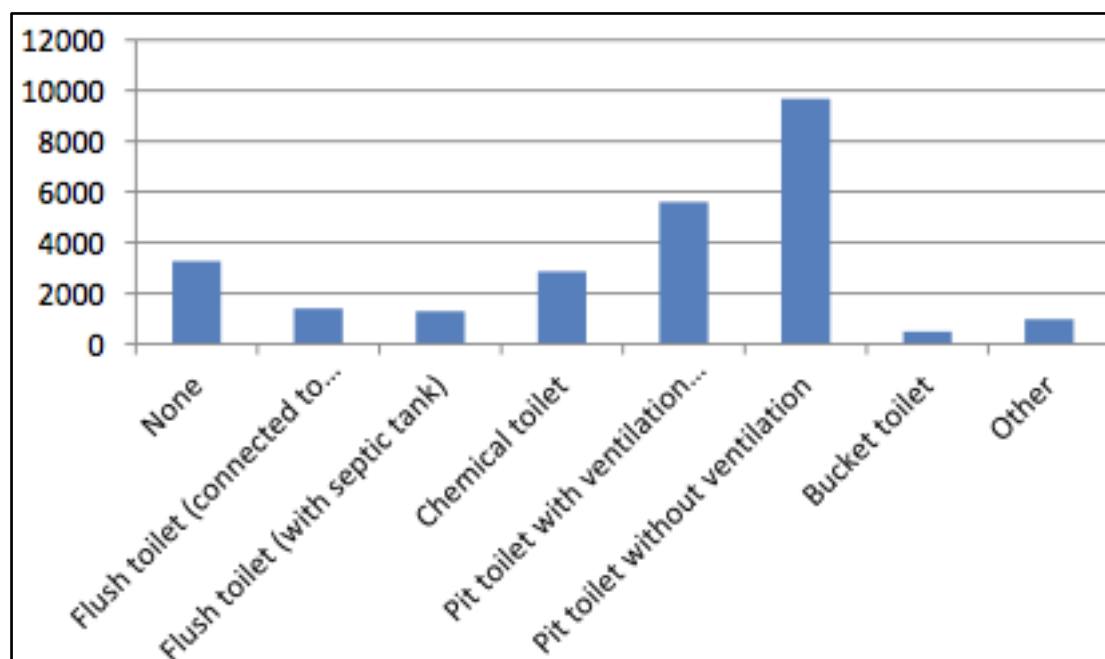


Figure 6: Sanitation types

Table 7: Water Supply Backlog in uThungulu District

Municipality	2009 / 2010 Estimated number of house- holds	House- holds with water	House- holds without water	2011/ 2012 % backlog	Estimated cost per capita including VAT (Rand)	Estimated capital cost including VAT (Rands)
Mfolozi	20,615	13,087	7,528	37 %	2,703	288,737,860
uThungulu	115,046	67,727	47,319	41 %	5,042	3,335,205,595

Note: Number of households and backlogs based on 2001 Stats and 2009 WSDP. Source: WSDP Review 2011

As evident from the above table, Mfolozi Municipality has a water-provisioning backlog of 37%. Additionally Mfolozi Municipality has a sanitation-provisioning backlog of 49%, which is less than the 55% backlog in the uThungulu District Municipal area.

3.2.4.3 Energy

Eskom, the national electricity supplier, supplies electricity in bulk to areas within the Mfolozi Municipal Area.

Table 8: Energy for lighting (uThungulu)

Energy Source: Lighting	Census 2001	Community Survey 2007
Electricity	50.2%	69.8%
Gas	1.1%	0.0%
Paraffin	1.1%	2.0%
Candles	46.4%	27.7%
Solar	0.5%	0.0%
Other	0.7%	0.5%
TOTAL	100.0%	100.0%

Between 2001 and 2007, there has been a significant increase in the use of electricity as a source for lighting, i.e. from 50.2% to 69.8%. Further, and not unexpected, there has also been a dramatic decrease in the use of candles for lighting purposes, i.e. from 46.4% in 2001 to 27.7% in 2007.

3.2.4.4 Housing

Table 9: Formal and Informal Dwellings (2007)

Statistical Source	% Formal Dwellings	% Informal Dwellings
Census 2001	53.6	4.6
Community Survey 2007	55.6	11.1

The 2011 census survey indicates that 65% of the population of Mfolozi Municipality has access to formal dwelling. The backlog is 27% in terms of access to formal structures.

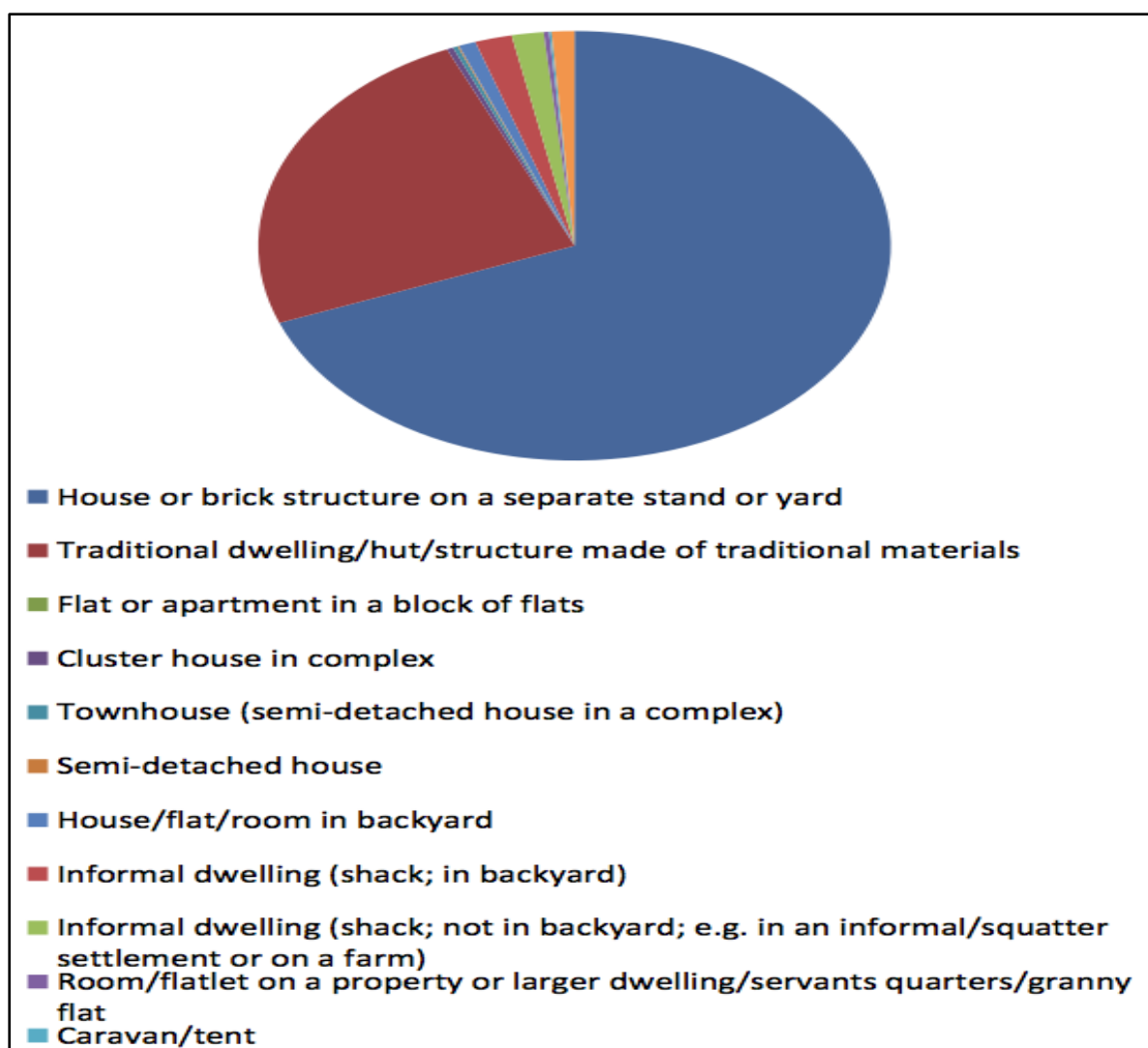


Figure 7: Type of Dwelling

The following table depicts the Mfolozi Housing Project Plan for the proposed mining area:

Table 10: Mfolozi Housing Project Plan for Wards affected by proposed mine

WARD	PROJECT NAME	NUMBER OF HOUSING UNITS	PROJECT PROGRESS	BUDGET
Ward 10	Mvamanzi Rural Housing Project	1000	Stage 01 Approved	As per Current Subsidy and or amended as per the applicable annual escalation
Ward 12	Nomuwa/Makhwezini Rural Housing Project	1000	Project Packaging Stage 01	As per Current Subsidy and or amended as per the applicable annual escalation
Ward 13	Ocilwane Rural Housing Project	1000	Project Packaging Stage 01	As per Current Subsidy and or amended as per the applicable annual escalation
Ward 15	Phathane Rural Housing Projects	1000	DOHS Agreed to fund this from 2013/2012 Financial Year	

3.2.4.5 Access to Refuse Disposal

Table 11: Refuse Removal

Refuse Removal	Census 2001	Community Survey 2007
Removed by Local Authority at least once a week	6.80%	7.30%
Removed by Local Authority less often	2.30%	1.30%
Communal Refuse Dump	4.10%	6.60%
Own Refuse Dump	71.00%	76.10%
No Rubbish Disposal	15.80%	8.20%
Not Applicable	0.00%	0.60%
TOTAL	100.00%	100.00%

The percentage of households who have their own refuse dumps have increased from 71% to 76.1% between 2001 and 2007. The uThungulu QOLS provides the following insights into refuse removal in the Mfolozi Municipal area:

Table 12: Census 2011 refuse removal for Mfolozi Municipality

REFUSE REMOVAL	Census 2011
Removed by local authority/private company once a week	1837
Removed by local authority/private company less often	435
Communal refuse dump	556
Own refuse dump	20536
No rubbish disposal	2068
Other	153
Unspecified	-
Not applicable	-
	25585

Source: StatsSA Census 2001 & Community Survey 2007

The concerning fact from the above table is the high percentage of households in the Mfolozi Local Municipality (as well as the district) that burn/bury household refuse near their properties or have their own refuse dumps. This would be the case for all the households affected by the mining process.

3.2.4.6 Safety and Security

Revived Crime Awareness Campaigns, through the Community Policing Forums with co-operation of the local SAPS and the Regional Security Cluster, are being undertaken.

3.2.4.7 Communication (Landline, Mobile, Post Services, E-mail and Internet)

Table 13: Household Access to Communication Devices

Household Access to Communication Devices	Census 2001	Community Survey 2007
Access to Radio	68.70%	66.60%
Access to Landline Telephone	7.90%	2.90%
Access to Cellphone	21.50%	71.70%
Access to Computer	1.80%	3.10%
Access to Internet	0.00%	0.90%

3.2.5 HOUSEHOLD INCOMES

Other than one small formal town most of Mfolozi Municipality is rural and associated with a lack of development, poverty and poor service provision.

The economy of Mfolozi makes up 12% of the economy of uThungulu Mfolozi is the 3rd largest in the district being exceeded by uMhlathuze and Umlalazi.

The Table Below indicates that the per capita GVA of the Mfolozi Municipality is the second highest in the district.

Table 14: GVA per Capita per municipality, R per person, 2005 values, 2005 to 2010

Year	2005	2006	2007	2008	2009	2010
Mfolozi Local Municipality	14642	15883	17572	19168	19074	19589
uMhlathuze Local Municipality	40281	40744	41869	41749	37926	39364
Ntambanana Local Municipality	8111	8741	9489	10286	10326	10476
Umlalazi Local Municipality	9360	10391	11589	12759	12693	13006
Mthonjaneni Local Municipality	10402	10399	10628	10989	10436	10553
Nkandla Local Municipality	3505	3759	4071	4372	4499	4571
uThungulu Total	19608	20474	21711	22487	21159	21889

Source: Quantec, 2012

Mfolozi municipality is home to the poorest of the poor, which is evident in the average annual household income, which is R4,800 to R9,600 (compared to an average annual household income of R19,200 to R38,400 in the EThekweni Metro).

3.2.5.1 Sectors of Employment and Sources of Income

The Gross Value Added or GDP of the economic sectors in Mfolozi LM show that the manufacturing sector is by far the largest and has also increased at the fastest rate (from 26,9% in 1995 to 34,1% in 2010. This can be seen in the table below. The second and third largest sectors in the municipality are transport and the retail, wholesale and trade sectors. The finance and business services sector and the agricultural and forestry sectors follow as the fourth and fifth largest sectors.

Table 15: Mfolozi Local Municipality, Gross value added at basic prices, R millions, constant 2005 prices

Year	1995	2000	2005	2010
O: Total	1061.3	1230.8	1661.9	2373.5
PA: Agriculture, forestry and fishing [SIC: 1]	151.1	214.1	222.9	224.2
PB: Mining and quarrying [SIC: 2]	137.5	242.5	200.2	132.2
SC: Manufacturing [SIC: 3]	285.9	262.1	455	808.3
SD: Electricity, gas and water [SIC: 4]	21	17.5	24.8	37.4
SE: Construction [SIC: 5]	48.5	31	48.8	86.9
TF: Wholesale and retail trade, catering and accommodation [SIC: 6]	128.5	121.8	212.4	348.2
TG: Transport, storage and communication [SIC: 7]	117.8	119.7	221.4	371.5
TH: Finance, insurance, real estate and business services [SIC: 8]	102.2	104.5	152.6	247.7
TI: Community, social and personal services [SIC: 92, 95-6, 99, 0]	23.6	42.8	47.5	43.7
TJ: General government [SIC: 91, 94]	45.2	74.8	76.4	73.3

3.2.5.2 GDP per Sector in Mfolozi

Table: Mbonambi Local Municipality, Gross value added at basic prices, % Compounded Growth over 5 years, 1995 to 2010

Year	1995 to 2000	2000 to 2005	2005 to 2010
O: Total	3	6.2	7.4
PA: Agriculture, forestry and fishing [SIC: 1]	7.2	0.8	0.1
PB: Mining and quarrying [SIC: 2]	12	-3.8	-8
SC: Manufacturing [SIC: 3]	-1.7	11.7	12.2
SD: Electricity, gas and water [SIC: 4]	-3.6	7.2	8.5
SE: Construction [SIC: 5]	-8.6	9.5	12.3
TF: Wholesale and retail trade, catering and accommodation [SIC: 6]	-1.1	11.8	10.4
TG: Transport, storage and communication [SIC: 7]	0.3	13.1	10.9
TH: Finance, insurance, real estate and business services [SIC: 8]	0.5	7.9	10.2
TI: Community, social and personal services [SIC: 92, 95-6, 99, 0]	12.7	2.1	-1.7
TJ: General government [SIC: 91, 94]	10.6	0.4	-0.8

Some of the sectors experienced negative growth rates in the 1995 to 2000 period such as manufacturing, electricity and construction. This however changed later so that only the mining sector experienced a decline in the 2000 to 2010 period in the municipality.

3.2.6 NATURE OF THE MFOLOZI ECONOMY

Mfolozi is in close proximity to the City of Richards Bay, which includes an industrial area that consists of heavy industry, shipping and logistics and manufacturing. Richards Bay provides many jobs to residents from nearby municipalities. The levels of unemployment in the district as a whole and in Mfolozi are high and there are very few employment opportunities for locals to work near their homes. The majority of people in the municipality do not have any income and a large portion of those earning enjoy incomes in the range of R800 – R2500 per month.

Agricultural Sector: The forestry and timber sectors are currently the major economic sectors in the area. Despite the fact that some areas in Mfolozi have a decent agricultural potential, land in the Ingonyama Trust areas such as where the mine is proposed are not farmed to the extent that they could be. They are mainly used at a subsistence or traditional agricultural level. Agriculture is regarded as a potential growth sector and as a means of alleviating poverty. The lowest earners tend to be involved in agricultural activities.

Tourism Sector: Whilst there is no current tourism in the mining area and very little in the local municipality as a whole, there is a lot of potential. With the Hluhluwe-iMfolozi Nature Reserve adjacent to the site and a steady stream of tourists travelling up the N2 the opportunities are vast and need to be explored.

Local Business Sector at Mfolozi: There are a few small to medium size businesses operating in the town of Mbonambi. A survey of some of the commercial businesses showed that a substantial number of SMMEs are engaged in the manufacturing sector and in industries such as carpentry, sewing, baking.

Transport Sector: The area of Mfolozi is well serviced with the N2 National Road and several primary roads traversing the local municipality. However, the local road network is problematic, the road infrastructure needs to be upgraded and certain roads need to be constructed. The lack of adequate roads also has implications for access to transport, local economic development opportunities, access to education, and the like. The need for new mining roads could greatly improve access to certain rural areas.

Mining Developments in the Region: Other than the Somkhele Mine located to the north of the site on the northern bank of the Mfolozi River, there is limited mining nearby. Currently Tronox and Richards Bay Minerals operate dune mining on the coastal strip of the district.

3.3 BIOPHYSICAL ENVIRONMENT

3.3.1 GEOLOGY

The Fuleni Project area is underlain predominantly by rocks of the Karoo Supergroup. The coal measures occur approximately 100 meters above the base of the Emakwezini Formation. Karoo dolerites intrude the stratigraphic sequence and dykes and sills are common in the area.

Four coal seams exist in the area of the proposed Fuleni project; Lower, Main, Upper Seam 1 and Upper Seam 2 (also known as A, B, C and D coal zones). The B-zone or Main seam is generally the only seam of economical importance and has an average thickness of 10 to 11 meters.

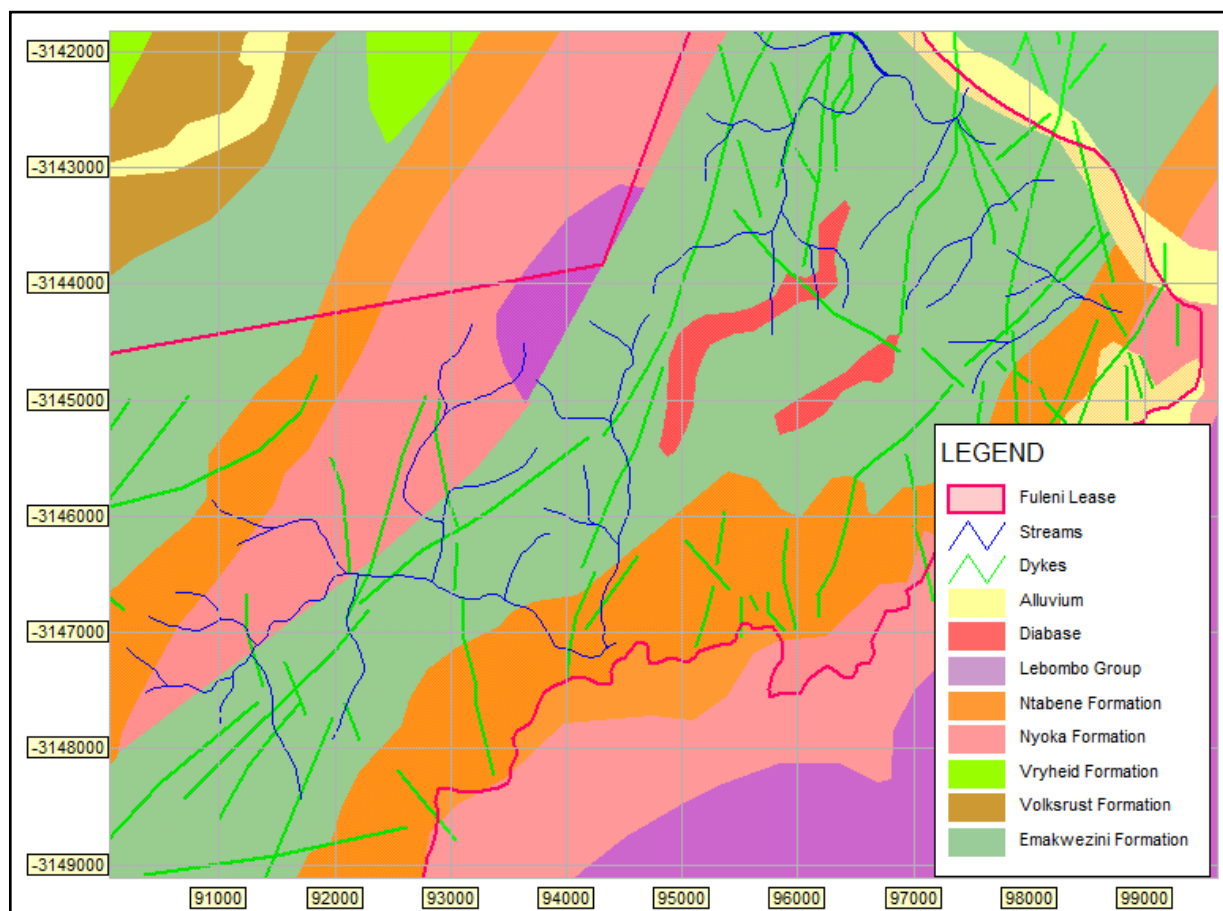


Figure 8: Simplified geological map (1:250 000 scale) of the proposed Fuleni mining project

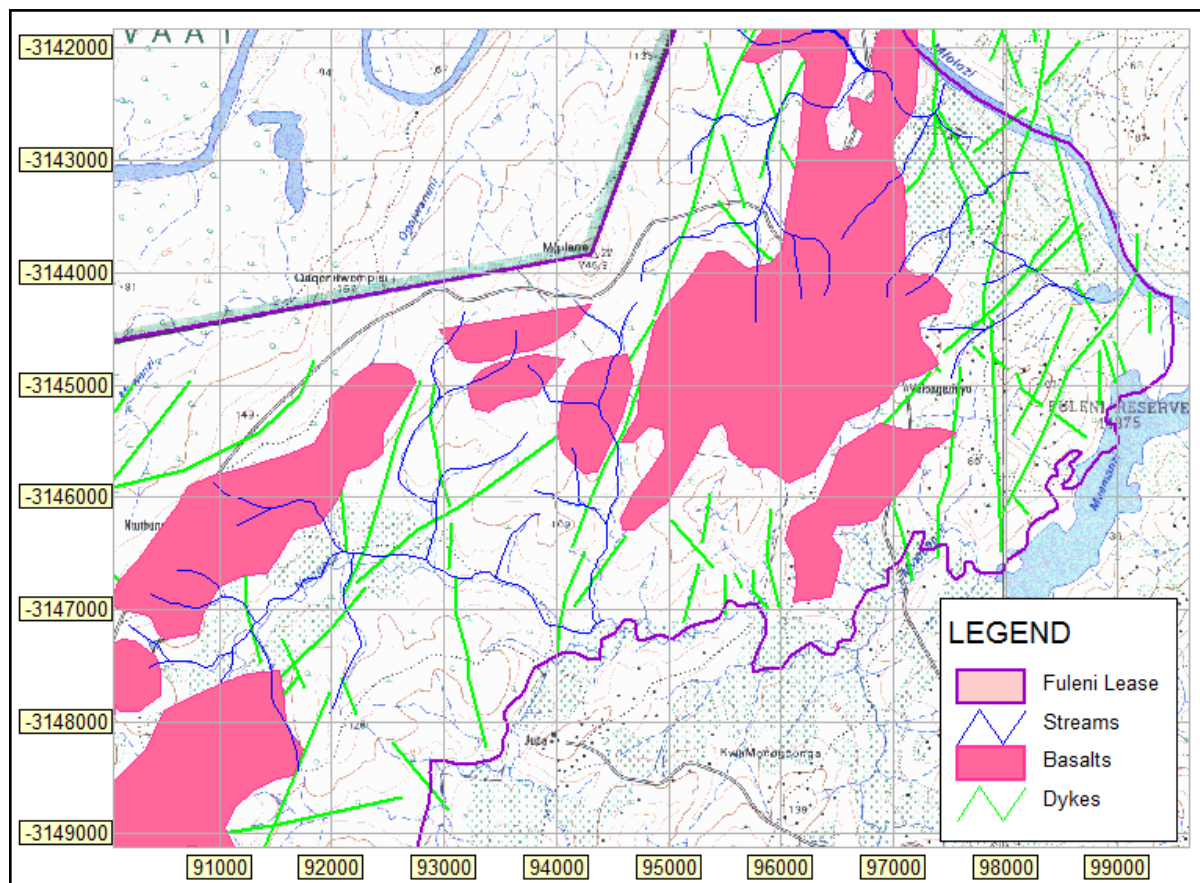


Figure 9: Dykes and basalts mapped in the Fuleni area

3.3.2 CLIMATIC DATA

3.3.2.1 Climate zone

3.3.2.1.1 Mfolozi WMA

The Mfolozi secondary catchment area is characterized by Warm-temperate climate conditions as classified by the 2012 CSIR Köppen-Geiger map for South Africa (Conradie and Kumirai, 2012).

The climate for the region varies from warm summers with dry winters (Cwa&Cwb) in the north west of the catchment area near the towns of Vryheid and Emondlo; to warm and humid conditions (Cfb) near the middle of the catchment area; to hot and humid conditions (Cfa) towards the mid to lower parts of the catchment area in the south east near the site as shown in Figure 10 below.

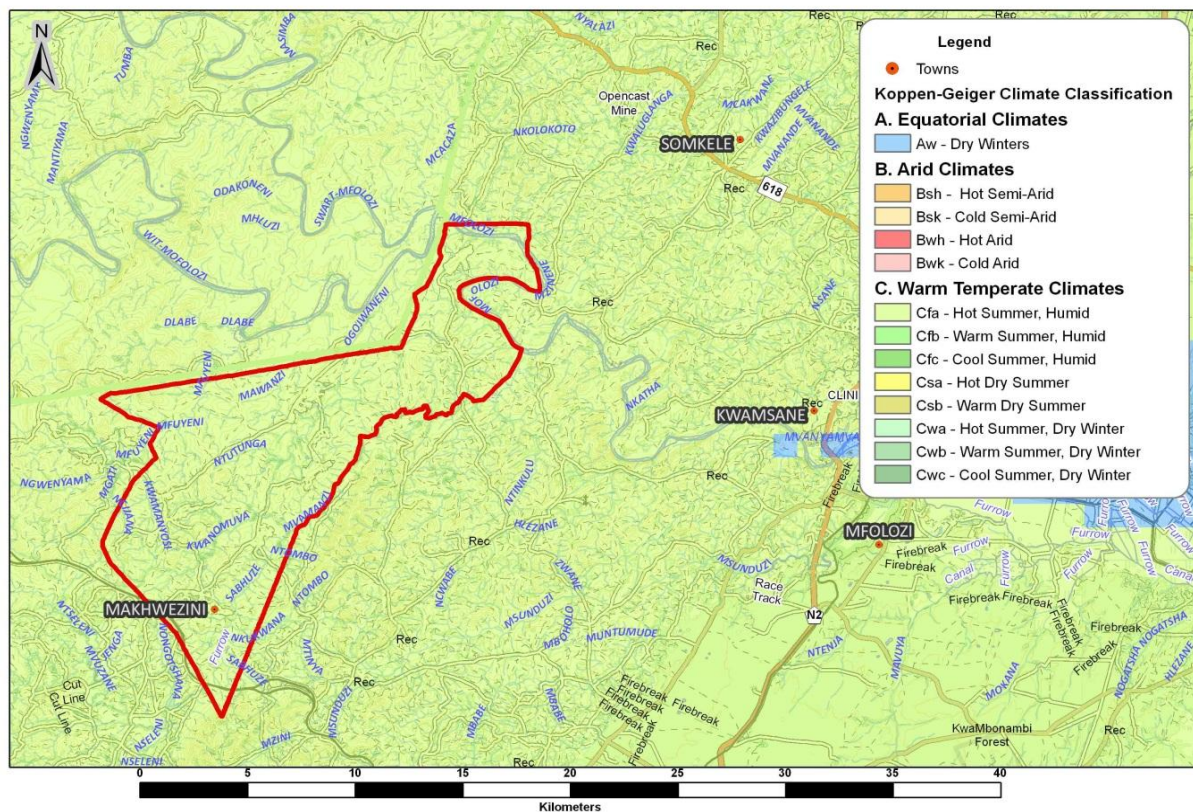


Figure 11: Koppen Climate Classification

3.3.2.2 Topography

3.3.2.2.1 Mfolozi WMA

The Basin's altitude, shown in Figure 12, drops rapidly from 1 600 mamsl to 300 mamsl over a distance of about 125 km (as measured in a straight line from the river's exit from quaternary catchment W23A up to the highest portion of the divide, northwest of Vryheid). The last 75 km is only at 300 mamsl to 0 mamsl. The topography of the catchment area can be described as four main topographic types, namely the mountainous areas where the rivers originate; the hilly terrain towards the confluence of the Black and White Mfolozi rivers; the undulating terrain downstream of the confluence and the Mfolozi flats.

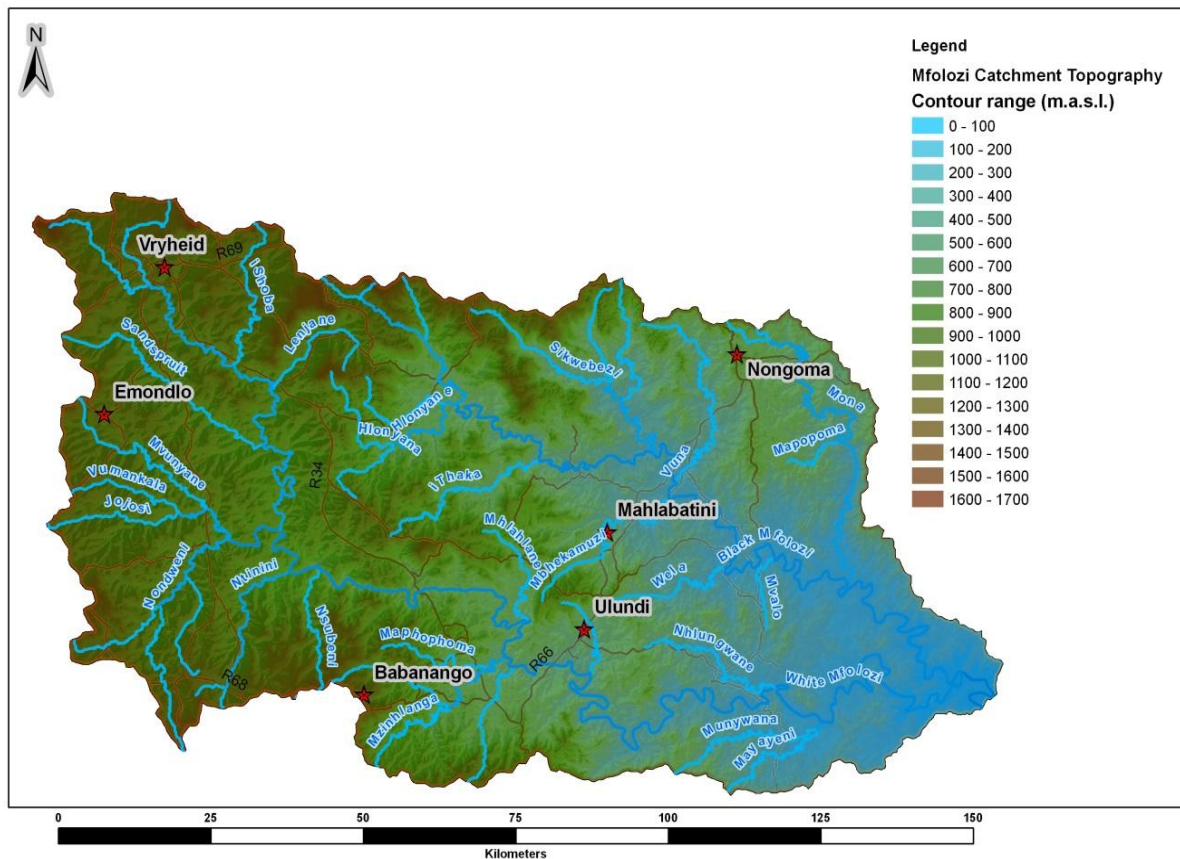


Figure 12: Mfolozi WMA Topography

3.3.2.2.2 Local catchment in relation to NOMRA area

The highest points in and around the study area include peaks at around 350m, while the lower portions of the areas are between 0 to 5m above sea level. Higher run-offs can be expected from the mountainous areas than from the drier plains. The mountain flanks are characterized by numerous incised streams. The general elevation in the region of the proposed development is shown in Figure 13.

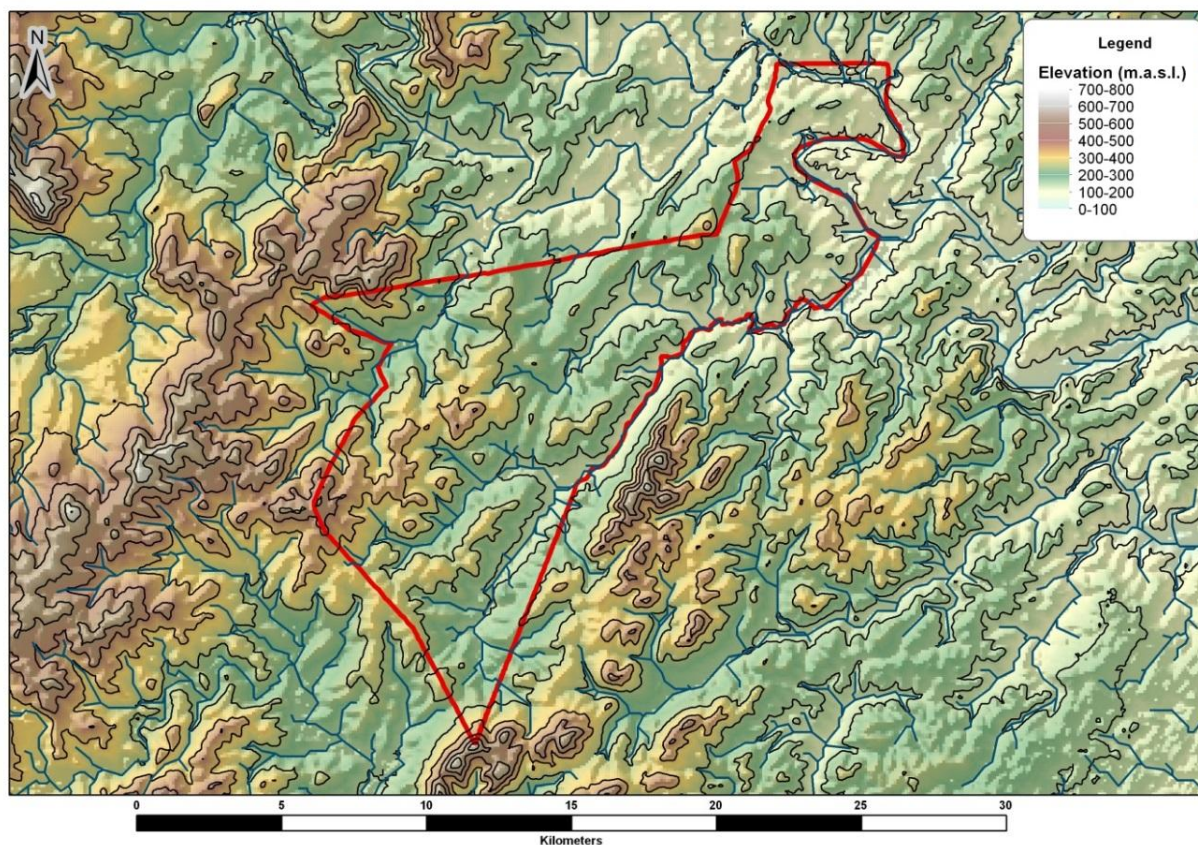


Figure 13: Topography of NOMRA area

3.3.2.3 Temperature

3.3.2.3.1 Mfolozi WMA

The Department of Agriculture's "Agricultural Geo-referenced Information System" (AGIS) hosts a wide spectrum of spatial information maps for public use. Figure 14 and Figure 15 indicate the maximum and minimum annual temperature for the region that was obtained from their natural resources atlas on climate.

Mean minimum temperatures for the region ranges from 0°C to more than 8°C and the mean maximum temperatures ranges from 25°C to 33°C with some parts even reaching a mean maximum of 35°C.

3.3.2.3.2 Local catchment in relation to NOMRA area

The mean maximum temperatures ranges from 29°C to 33°C and the mean minimum temperatures for the site are more than 8°C as shown in Figure 16 and Figure 17 respectively.

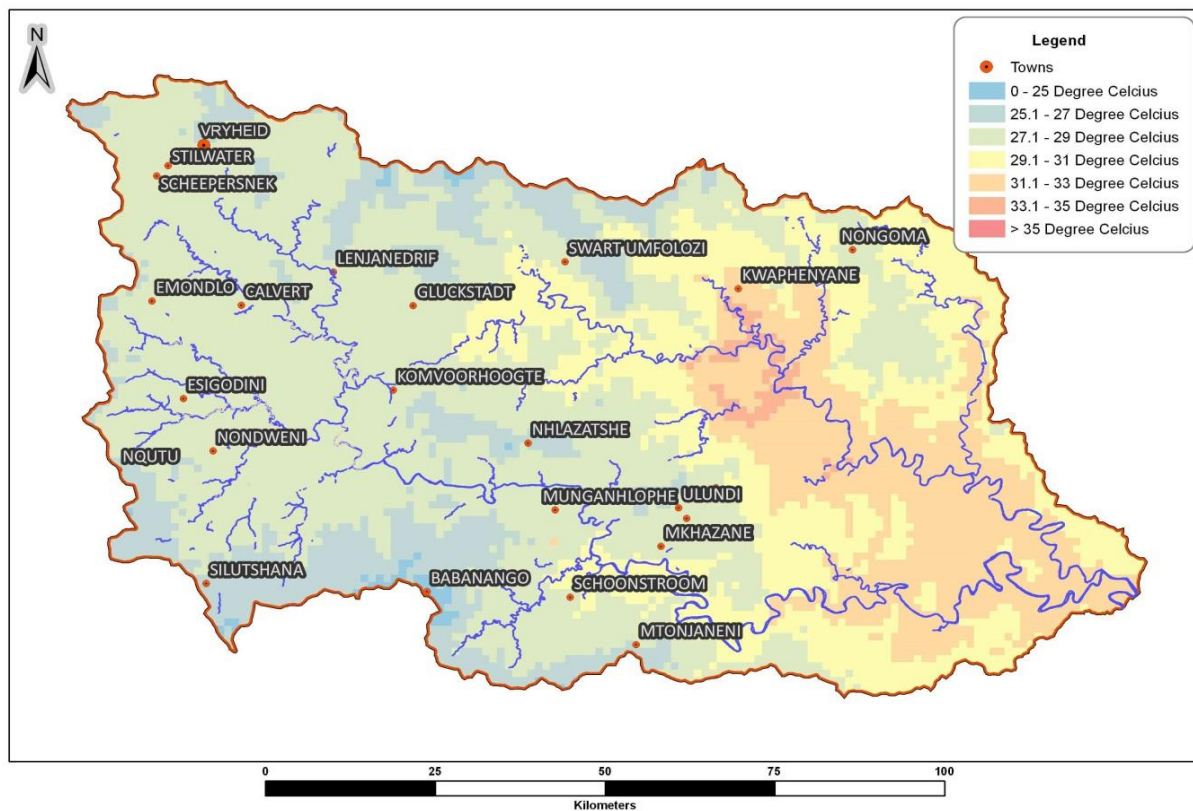


Figure 14: Mean Annual Maximum Temperature

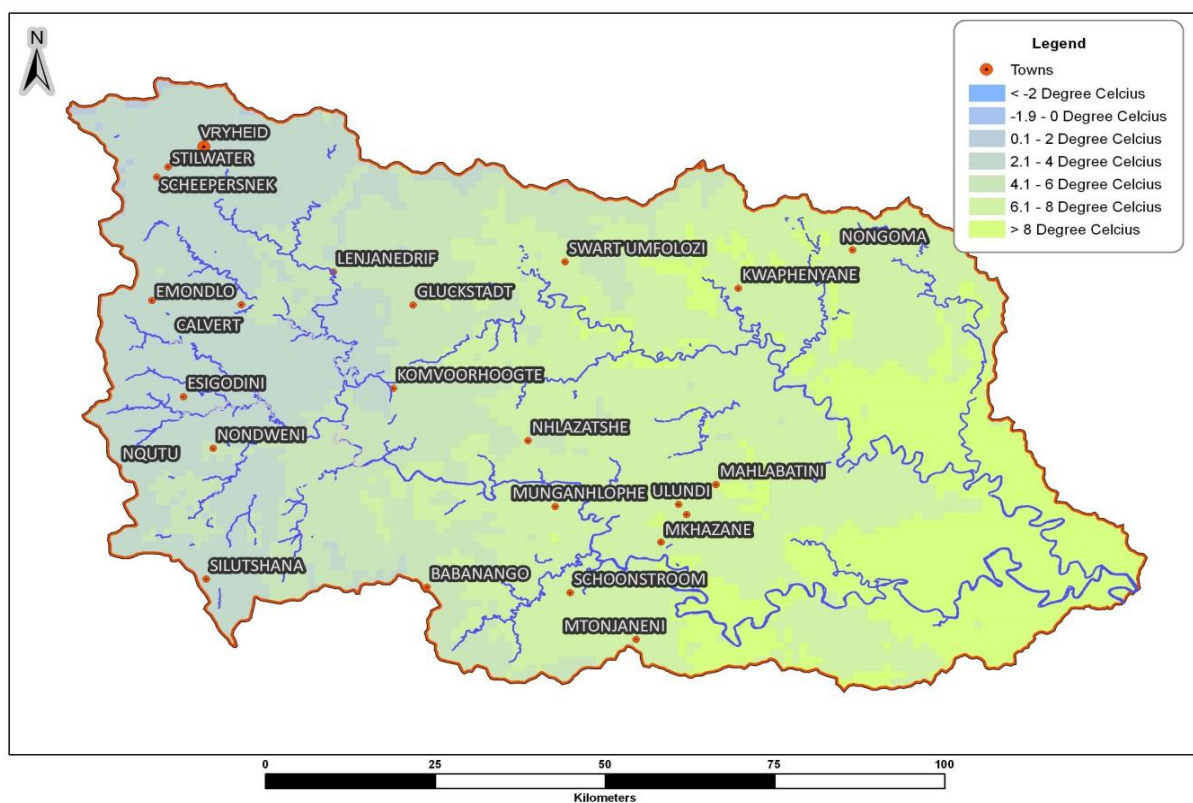


Figure 15: Mean Annual Minimum Temperature

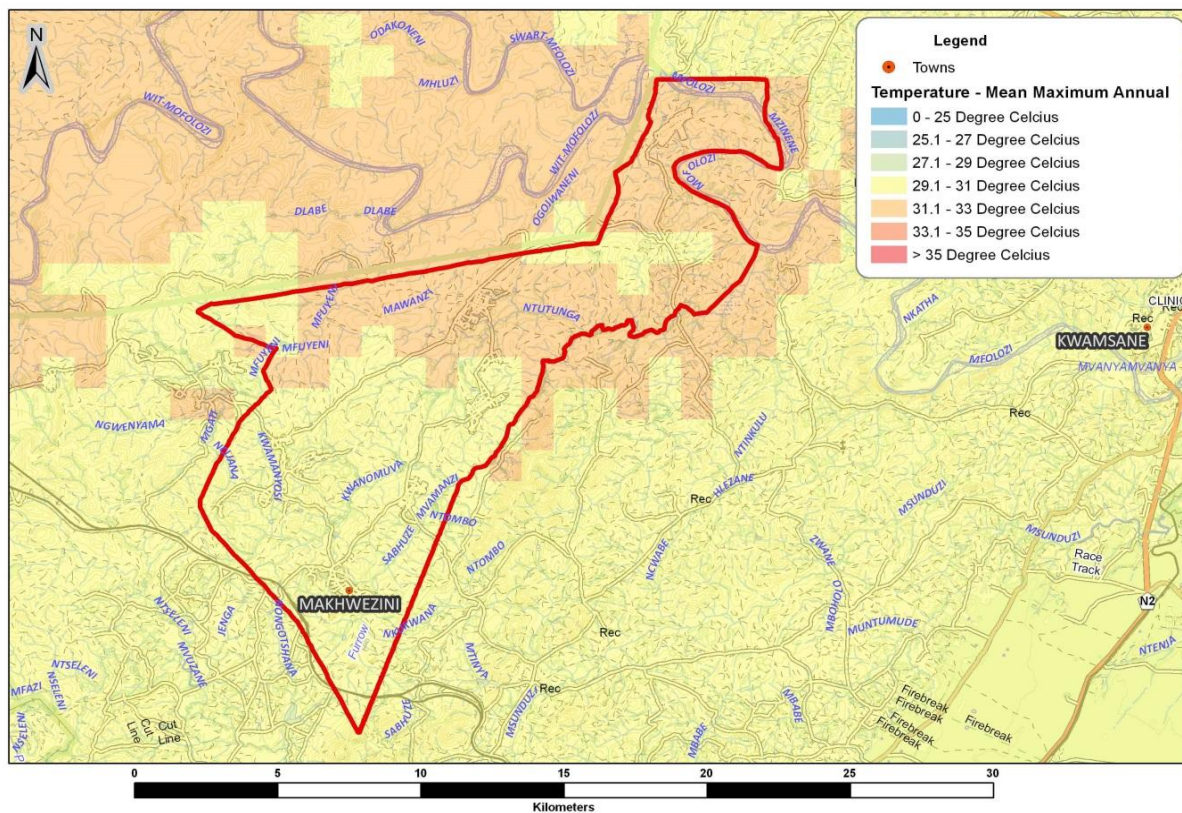


Figure 16: Mean Annual Maximum Temperature of NOMRA area

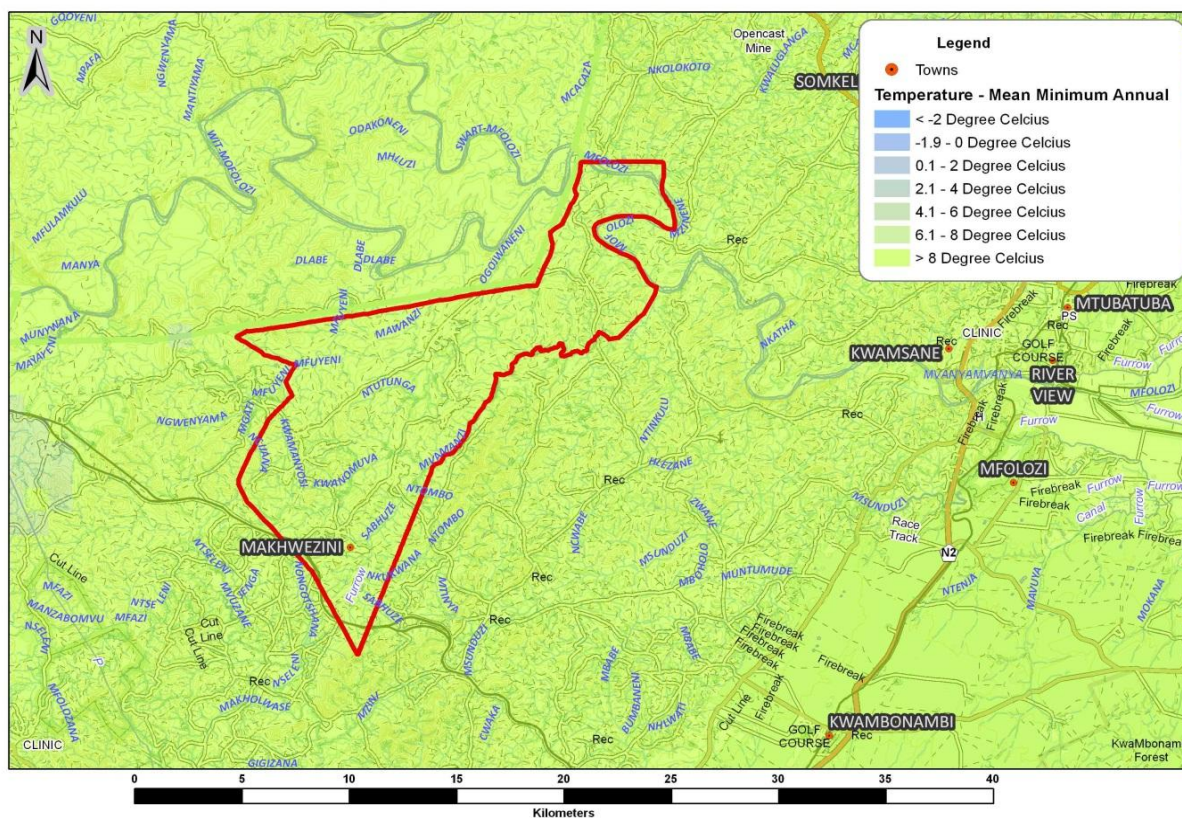


Figure 17: Mean Annual Minimum Temperature of NOMRA area

3.3.2.4 Winds

The meteorological data was gathered from the South African Weather Services' Riverview Station (28°26'39.12''S; 32°10'54.84''E). The station recorded hourly data for the following parameters from 2010 to the end of 2012.

Figure 18 illustrate the series of annual and seasonal wind roses (2010-2012) that was recorded at the SAWS Riverview station. The percentage of calm conditions recorded at the station is low (19.9%), indicating that the annual wind speed at the site is substantial (2.15 m/s). The dominant wind direction through the year blows from two directions, majority from the north north-east (17%) and from the south-west (13%). The strongest winds also blow from the south-west. The wind patterns from 2010 to 2012 do not change and the same is the case for the seasonal wind pattern.

3.3.2.4.1 Atmospheric Stability

Atmospheric stability is commonly categorised into six stability classes these are briefly described in the table in Figure 19. The atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of solar radiation, increasing in size gradually from sunrise to reach a maximum at about 5-6 hours after sunrise.

The degree of thermal turbulence is increased on clear warm days with light winds. During the night-time a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral.

Based on the graphs presented in Figure 19 it can be seen that the region is subject to high winds (blowing from the south-west) and day and night-time cloud formations, these conditions (Class D) is classified as Neutral conditions and occurs for 27.4% (2010-2012). The second highest stability class for the region is Unstable conditions, where the wind speeds are lower (moderate wind speed blowing from the north-east) overcast conditions occur during the daytime, this occurs only for 12.5% (2010-2012).

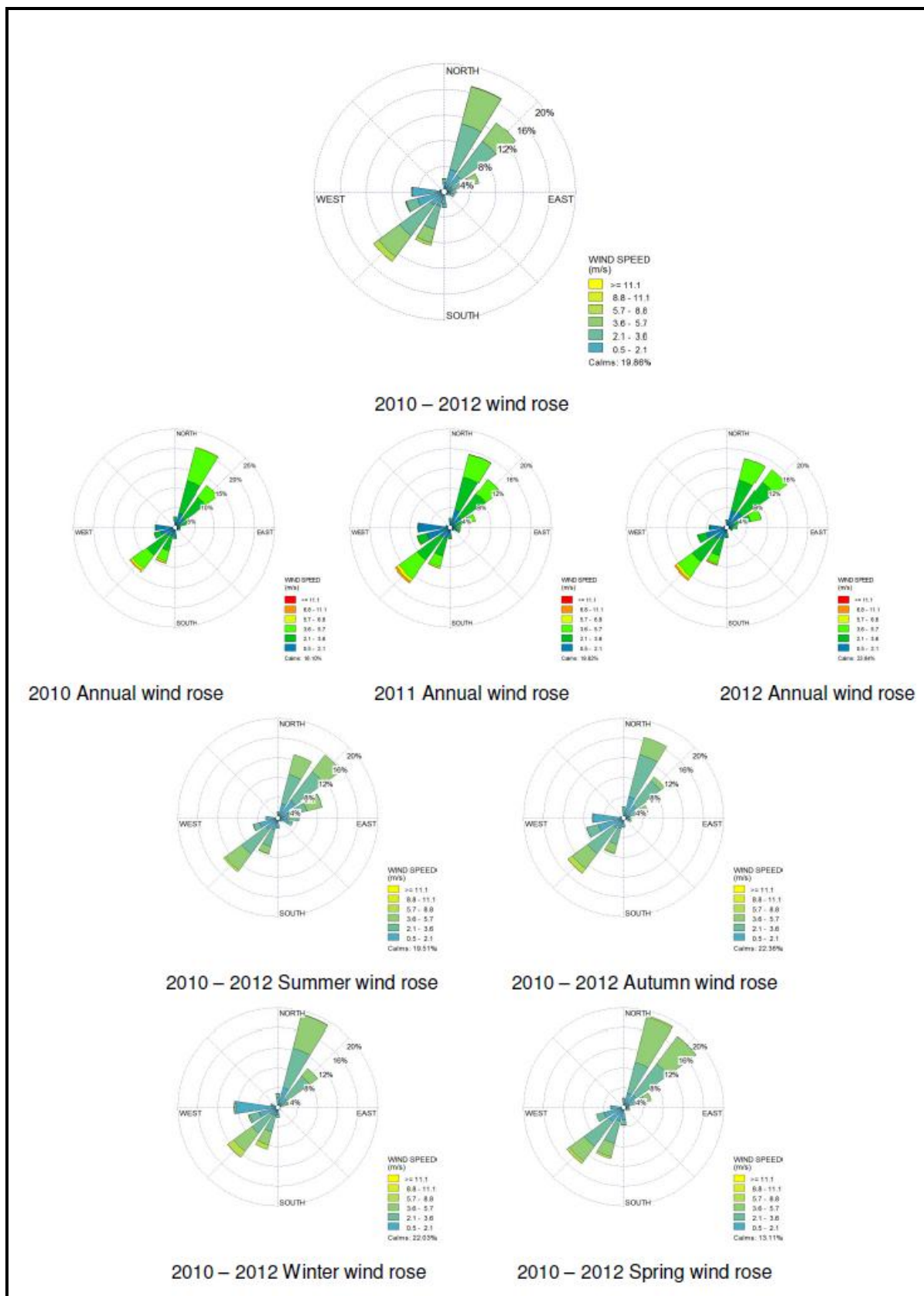


Figure 18: Riverview wind roses

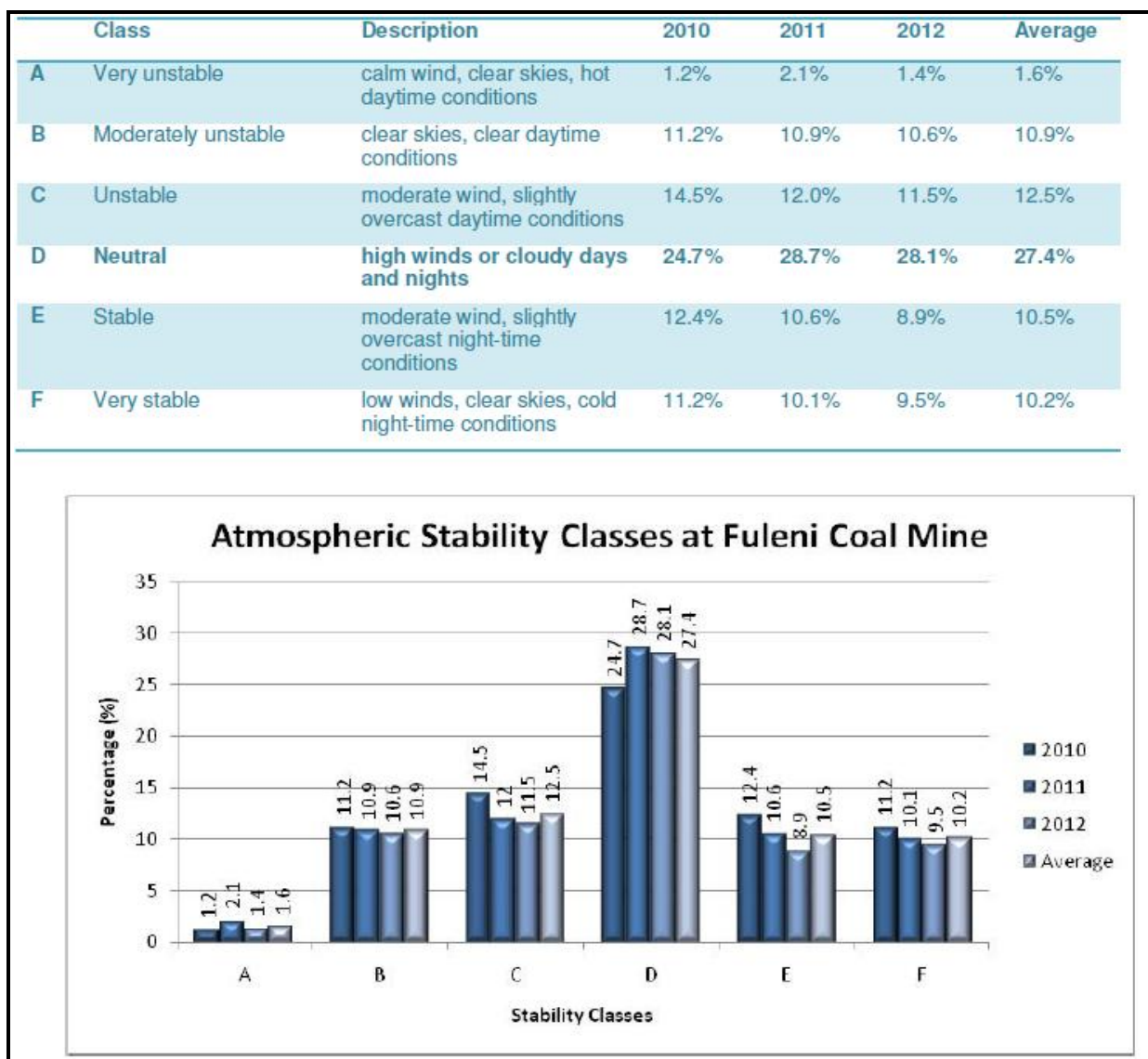


Figure 19: Atmospheric stability classes at Fuleni NOMRA area

3.3.2.5 Mean Annual Precipitation (MAP) and Mean Monthly Rainfall

3.3.2.5.1 Mfolozi WMA

The average MAP for the whole of the Mfolozi River basin is 803 mm/annum with a maximum value of 1 055 mm/annum in the mountainous area (upstream quaternary catchment W22E) and a minimum value of 708 mm/annum (inland quaternary catchment W21F, some 40 km south of Vryheid) (Middleton and Bailey, 2009). The general trend is that the rainfall decreases moving inland, with some high-lying areas receiving more rainfall. Rainfall distributions are influenced by the topographic features in the area. The precipitation range is shown in Figure 20.

Note that the region is also within the impact zone of tropical cyclones occurring in the Indian Ocean which may cause high-intensity rainfalls leading to peak runoff events. The most notable of these was the cyclone Domoina of January/February 1984, the only known cyclone to date which penetrated inland and caused extreme rainfall (up to 924 mm in the upper Black Mfolozi River, DWA 1985) with resultant severe flooding.

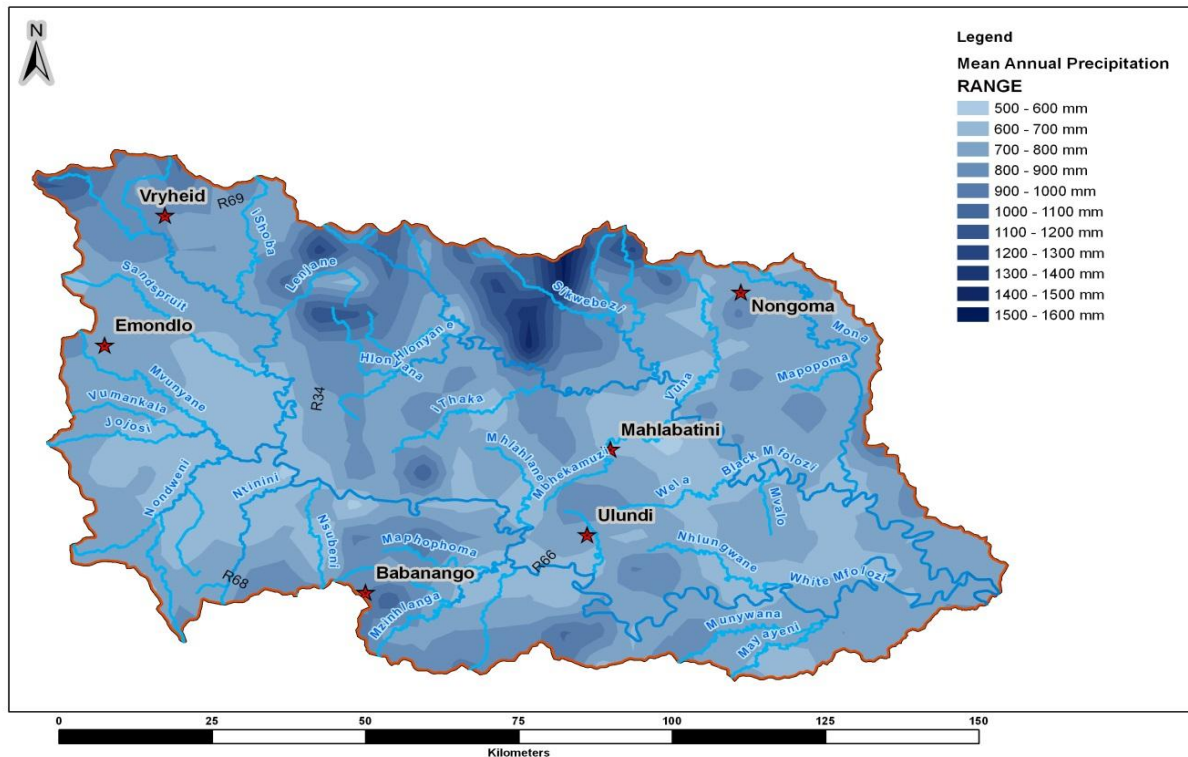


Figure 20: Mean Annual Precipitation

3.3.2.5.2 Local catchment in relation to NOMRA area

The Fuleni Project is located within quaternary catchment W23A, as defined in the WR2005 Study (Middleton and Bailey, 2009).

The project falls within a hot and humid climatic zone with a mean annual precipitation (MAP) for the quaternary catchment W23A of 833mm. The MAP range is shown in Figure 21.

The quaternary catchment is located in Rainfall Zone W2F. The mean monthly precipitation values are given in Table 16. The maximum monthly rainfall of 12.82% occurs in February and the lowest of 3.71% in August. The monthly distribution pattern of rainfall in the quaternary catchment is shown in Figure 22.

Table 16: Mean Monthly Rainfall Distribution of Site Rainfall (Zone W2F)

Rainfall Zone	Mean Monthly Precipitation (% Distribution)											
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
W2F	9.24	10.41	10.44	11.96	12.82	12.61	7.25	5.64	4.43	4.16	3.71	6.50

(Source: Middleton, B.J. and A.K. Bailey (2009). Water Resources of South Africa, 2005 Study. WRC Rep No TT381. Pretoria)

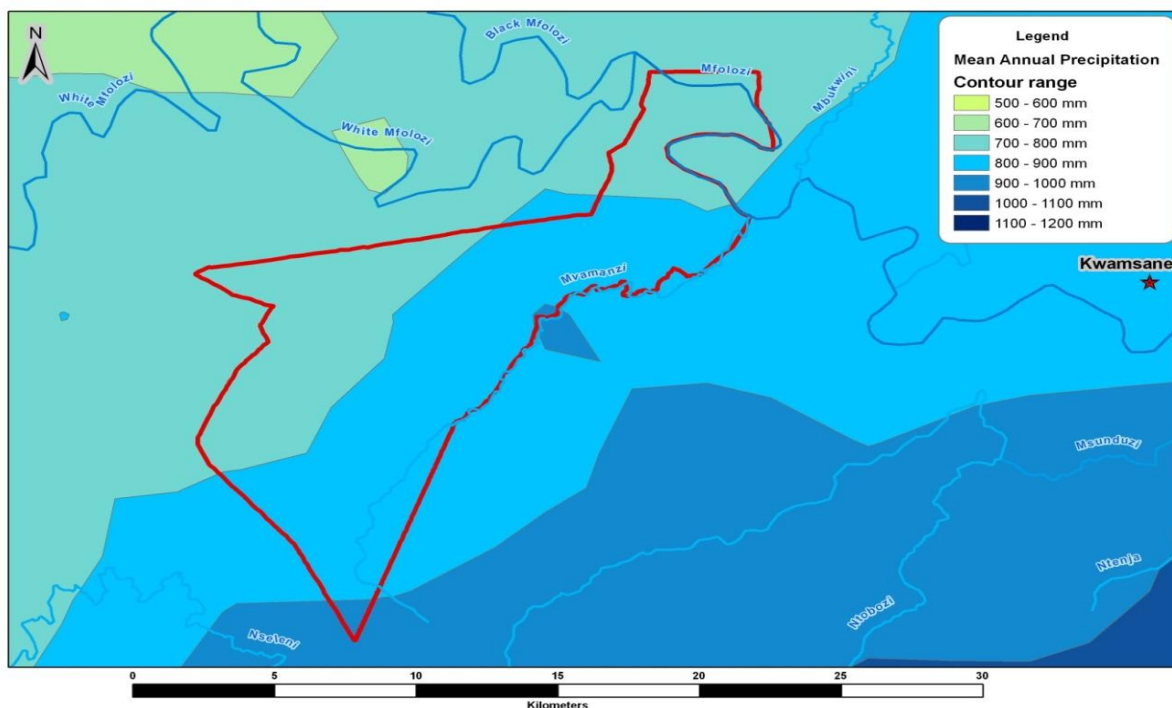


Figure 21: Mean Annual Precipitation of NOMRA area

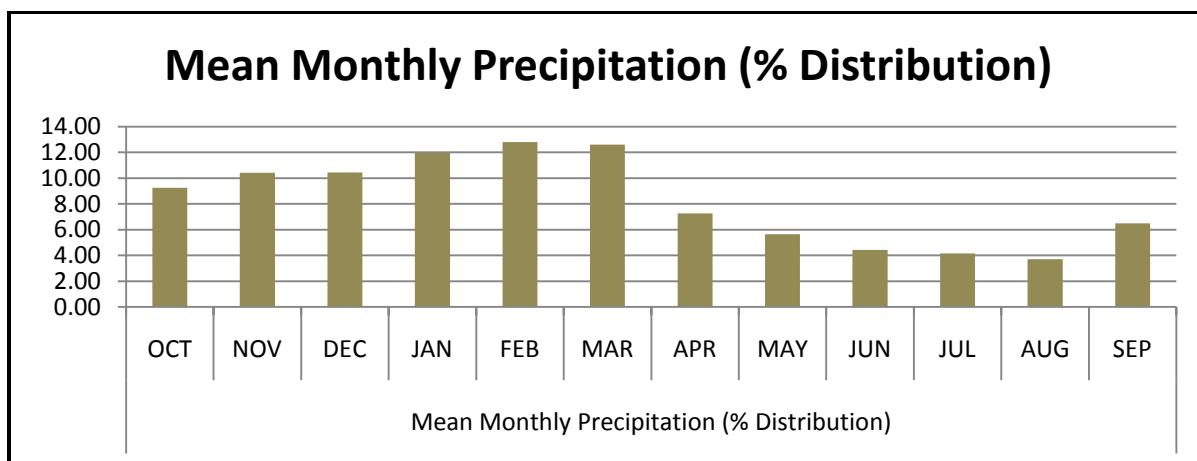


Figure 22: Mean Monthly Precipitation as a % of the distribution

The absolute monthly rainfall (% distribution x MAP) of the quaternary catchment is shown in Table 17. The average rainfall for the catchment was determined and the maximum rainfall of 107mm occurs in February and the lowest of 31mm in August. The data in the table is shown in the bar chart below (Figure 23).

Table 17: Mean Monthly Quaternary Rainfall (mm)

Quaternary Catchment	Mean Annual Precipitation (mm)	Rainfall Zone	Mean Monthly Precipitation (mm)											
			OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
W23A	833	W2F	77	87	87	100	107	105	60	47	37	35	31	54

(Source: Middleton, B.J. and A.K. Bailey (2009). Water Resources of South Africa, 2005 Study. WRC Rep No TT381. Pretoria)

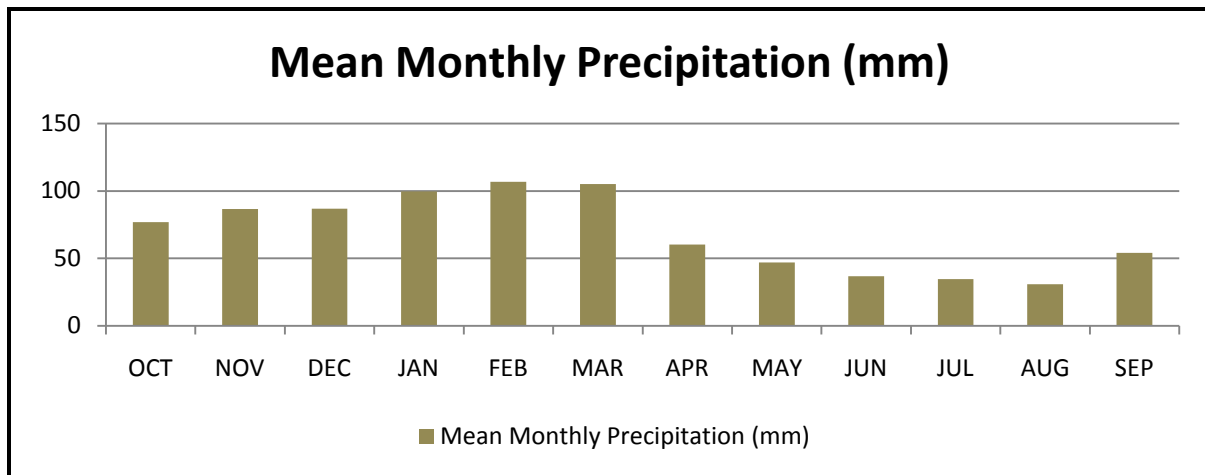


Figure 23: Mean Monthly Precipitation in mm

3.3.2.6 Mean Annual Runoff and Evaporation

3.3.2.6.1 Mfolozi WMA

The naturalized runoff in the Mfolozi River at the outlet of quaternary catchment W23A which is located just downstream of the site, have been compiled from data in WR2005 and the resultant MAR is 794 million m³/a as shown in Table 18. The naturalized unit runoff based on the net catchment area of 9 254 km² at the outlet of quaternary catchment area W23A amounts to 85.8 mm. Note that this unit runoff for the Mfolozi River is based on naturalised conditions, i.e. it excludes any abstractions or other water uses, i.e. by afforestation.

Table 18: Mfolozi River Naturalised Runoff

Quaternary Catchment	Net Catchment Area (km ²)	River(s)	Naturalized MAR (million m ³ /a)	Naturalized MAR (mm/a)
W21A	340	White Mfolozi	34.51	101.48
W21B	580		42.60	73.45
W21C	370		22.63	61.16
W21D	469		28.30	60.34
W21E	416		26.62	63.99
W21F	243		12.68	52.17
W21G	563		33.52	59.54
W21H	433		32.05	74.02
W21J	530		47.01	88.71
W21K	797		75.33	94.52
W21L	533		49.45	92.78
W22A	239	Black Mfolozi	39.45	165.06
W22B	332		32.92	99.15
W22C	186		17.72	95.24
W22D	197		12.01	60.97
W22E	385		69.05	179.35
W22F	312		21.42	68.64
W22G	249		23.19	93.12
W22H	306		24.93	81.46
W22J	605		44.44	73.45
W22K	476		42.26	88.78
W22L	279		24.71	88.58
W23A	414	Lower Mfolozi	37.20	89.85
Total Net Catchment Area (km²)	9 254	Total MAR (million m³/a)	794.0	-

Mean Annual Evaporation (MAE) varies from 1 400 mm/a for quaternaries W21L and W23A which are closest to the coast, to 1 500 mm/a for the mountainous areas. Except for quaternary catchment 23A which is in Evaporation Zone 22C, the upstream catchments are all within evaporation Zone 22B. The monthly evaporation pattern (as percentages of the total) is given in Table 19 below. The range of MAE is also shown in Figure 24.

Table 19: Monthly Evaporation Distribution (Symons Pan)

Month	Evaporation (%)
October	10.66
November	9.75
December	10.78
January	10.63
February	8.84
March	8.76
April	6.67
May	6.03
June	5.16
July	5.63
August	7.90
September	9.19

Source: WR90, evaporation zone 22B, based on data from the Vryheid station

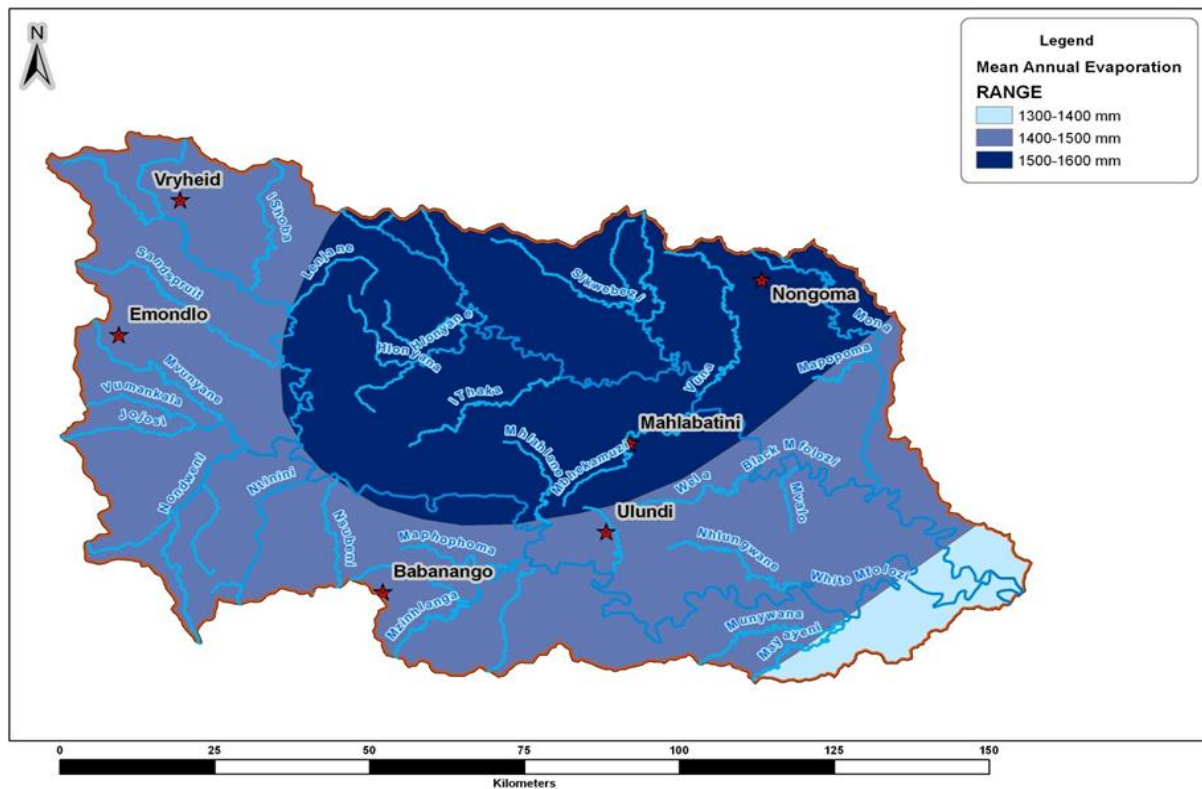


Figure 24: Mean Annual Evaporation

3.3.2.6.2 Local catchment in relation to NOMRA area

The catchment hydrological data of this summer rainfall region are summarized in Table 20 below.

Runoff data were generated on a quaternary catchment area scale in the WRSM2000 model, an enhanced version of the original Pitman rainfall-runoff model, since there are no reliable long term measured flow data. Note that the present MAR in the Mfolozi River is not reflected in the table since it shows the naturalized runoff generated within the catchment. To obtain the present runoff, all surface water uses in the catchment area must be subtracted.

Table 20: Catchment Data (from WR2005)

Quaternary catchment	Net area (km ²) A	Mean Annual Precipitation (mm) MAP	Mean Annual Runoff (mm) MAR	Mean Annual (gross) Evaporation (mm) MAE (Zone 1B)	Irrigation area (ha)	Forest area (ha)
W23A	414	833	89.85	1400	0	0

The mean monthly naturalized runoff data for the catchment W23A, is shown in Table 21. Mean Annual Evaporation (MAE) for the site varies between 1300mm and 1400mm as shown in Figure 25. The monthly evaporation pattern (as percentages of the total) is given in Table 22.

Table 21: Simulated Average Naturalized Monthly Runoff for Quaternary Catchment W23A

Quaternary Catchment	Area (km ²)	Mean Monthly Natural Runoff (mm)												Mean Annual Natural Runoff (mm)
		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	
W23A	414	6.81	5.75	4.75	5.98	10.39	13.03	9.07	7.32	6.20	7.15	5.12	8.28	89.85

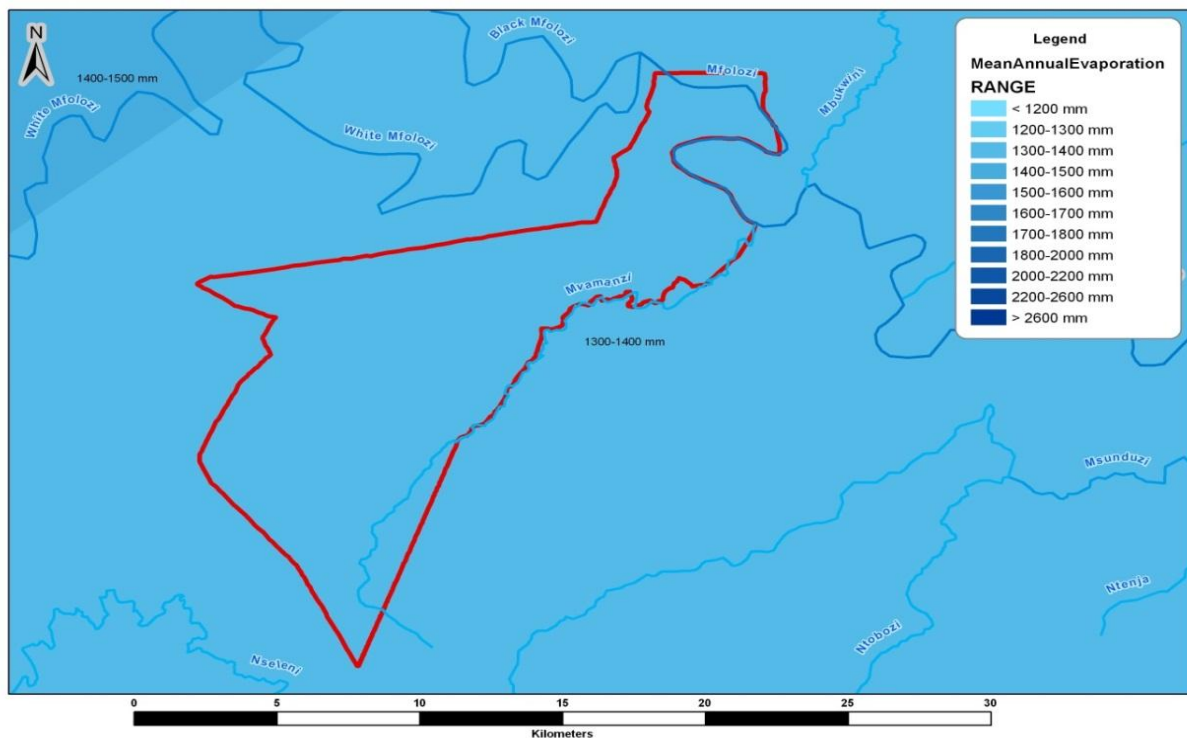


Figure 25: Mean Annual Evaporation of NOMRA area

Table 22: Monthly Evaporation Distribution (Symons Pan)

Month	Evaporation (%)
November	10.24
December	11.71
January	12.46
February	10.73
March	10.13
April	7.12
May	5.63
June	4.40
July	4.67
August	6.10
September	7.59
October	9.22

Source: WR90, evaporation zone 22C, based on data from the Charters Creek station

3.3.3 SOILS

3.3.3.1 Soil Form and Morphological Features

Figure 26 illustrates the major soil forms found in the surveyed area. The following soil forms were identified:

- The **Arcadia soil form** (Ar) comprises a vertic A-horizon that overlies unspecified material. The vertic A-horizon has strongly developed structure and exhibits clearly visible, regularly occurring slickensides in some part of the horizon or in the transition to an underlying layer. The horizon has a high clay content, is dominated by smectite clay minerals and possess the capacity to swell and shrink markedly in response to moisture changes. Swell-shrink potential is manifested typically by the formation of conspicuous vertical cracks in the dry state and the presence, at some depth, of slickensides (polished or grooved glide planes produced by internal movement). The lower lying (adjacent stream flow channels and preferential water flow channels) soils of the Arcadia soil are deep (in many cases more than two meters deep) and underlain by saprolitic material that is derived from what seems to be dolerite and sandstone. In the higher lying areas these soils overlie hard rock and ranges in depth from 25 cm to 50 cm. Note: Where the soil form is indicated with Ar on the soil map, the soil is deeper than 50 cm and where the soil is grouped with shallower soils, for instance Gs/Ar which indicates an area where a Glenrosa and Arcadia soil form complex are encountered, the Arcadia soil is shallower than 50 cm.
- The **Glenrosa soil form** (Gs) comprises an orthic A-horizon overlying a lithocutanic B-horizon. The lithocutanic B-horizon is a pedologically young horizon where clay illuviation has occurred. Soil depth ranges from 10 to 50 cm. In many cases the A-horizon of the Glenrosa soil form exhibits blocky structure, but no slickensides, pressure faces or cracking as is associated with the vertic A-horizon. It is possible that these soils will, over hundreds or thousands of years, weather to become soils of the Arcadia soil form.
- The **Mispah soil form** (Ms) comprises an orthic A-horizon that overlies hard rock. These soils are mostly found between rock outcrops and soils of the Glenrosa soil form. Note: The soils of the Mispah soil form are grouped with soils of the Glenrosa soils form (Ms/Gs) and rock outcrops (R/Ms or R/Gs/Ms) on the soil map because no clear pattern in the occurrence of these soils were noticed. These areas are shallow and sometimes described as soil/rock complexes.
- The **Clovelly soil form** (Cv) comprises an orthic A-horizon that overlies a yellow brown apedal B-horizon and unspecified material. The yellow brown apedal B-horizon has macroscopically weakly developed structure or is altogether without structure and reflects weathering under well drained, oxidised conditions. The clay fraction is dominated by non-swelling 1:1 clay minerals. The yellow colour that is encountered in these soils is attributed to Al substituted goethite dominating the iron oxide fraction. These soils range in depth from 60 to 150 cm. The soils marked Cv on the soil map are deeper and exhibits crusting on the soil surface. This area is extremely hard and water infiltration is slow. These soils are situated towards the Mfolozi River and the influence of windblown or washed in sand is evident.
- The **Tukulu soil form** (Tu) comprises an orthic A-horizon that overlies a neocutanic B-horizon and a horizon that exhibits signs of wetness. The neocutanic B-horizon is characterised by

colour variation due to clay movement and accumulation and exhibits an apedal or weakly developed structure. Unspecified material with signs of wetness is a lower profile horizon that has suffered the effects of intermittent or prolonged saturation with water. Signs of wetness are ascribed to conditions of reduction that leads to iron movement. Iron mobilises, moving from areas of reduction to precipitate in pockets that exhibit a higher state of oxidation. This leads to a bleached colouration in the soil matrix which is referred to as signs of wetness. The soils of the area are very sandy in nature and the accumulation of Fe at a depth of approximately 60 cm is diffuse in nature. This is typical of low clay content soils. A case can be made for rather classifying these soils as that of the Pinedine soil form (orthic A/yellow brown apedal B/unspecified material with signs of wetness) as the colour variation is not pronounced. It was decided the Tukulu soil form communicates the essence of these soils more clearly as these soils exhibit more pronounced colour variation and clay illuviation than any of the other soils encountered on the site. These soils border the floodplain of the Mfolozi River and are therefore pedologically younger soils. It is very possible that material will be deposited onto these soils when the Mfolozi is in flood. In fact, sandy material have been deposited onto the Arcadia soil forms found just north of these soils.

- The ***Oakleaf soil form*** (Oa) comprises an orthic A-horizon that overlies a neocutanic B-horizon and unspecified material. These soils are encountered towards the Mfolozi River in the less steep areas.
- The ***Dundee soil form*** (Du) comprises an orthic A-horizon that overlies stratified alluvium. The latter horizon shows stratification which is the result of alluvial or colluvial deposition. In the case of the study area, these soils fall in the floodplain of the Mfolozi River. Note: The material found adjacent and in the Mfolozi River is marked alluvial sand owing to an orthic A-horizon not being present.

3.3.3.2 Soil Fertility Status

The soils of the study area predominantly show alkaline or near neutral pH values. This is to be expected in an area where dolerite is the dominant parent material. Especially the vertic A-horizon is known to exhibit slightly alkaline pH values and contains, in many (also in the investigated area) limestone nodules. The phosphate for all the soil form is low and should be in the order of 20 mg/kg (Bray 1) for adequate crop nutrition. The phosphate values are even low in the Tukulu soil form which are used for vegetable production and should have been fertilised - the vegetable garden is sponsored by the Department of Agriculture. The cation exchange capacity (CEC) of the Tukulu soil form is, however, high enough for adequate nutrient retention. As expected, the Arcadia soil form exhibits the highest CEC while the more sandy soils exhibit relatively low CEC values. Organic matter content is low in all the soils, except the Arcadia soil form.

Of concern is the extremely high Cl levels in soil samples taken from an Arcadia soil which occurs in one of the stream flow channels. In fact, elevated levels of Cl are found in all soil samples and may be owing to mist or wind being blown in from the sea – although the ocean is quite some distance from the site. Adequate levels of K and Ca are encountered in most soil samples.

Any deficiencies in soil fertility status can easily be rectified through the application of soil ameliorants. The more important factor to consider is therefore the soil salinity status.

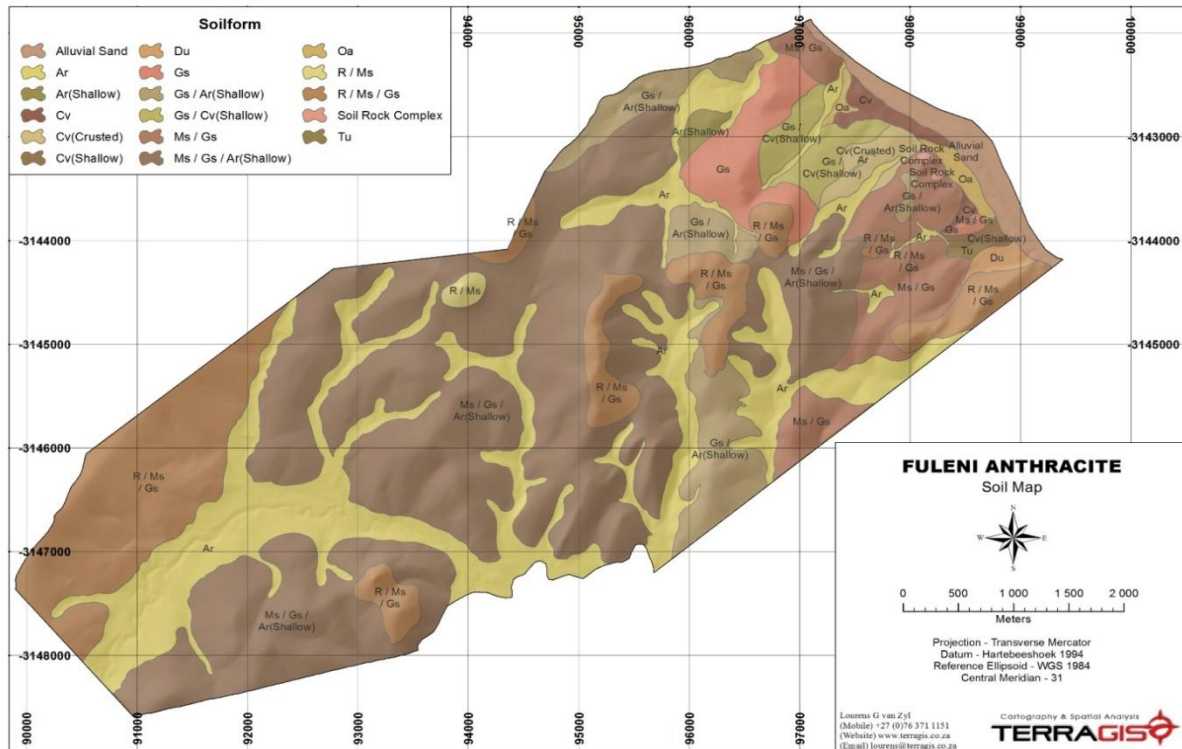


Figure 26: Major soil forms of the study area

3.3.3.3 Soil Salinity Status

The presence of excessive amounts of exchangeable sodium and magnesium reverses the process of aggregation and causes soil aggregates to disperse into individual soil particles.

Soils with an exchangeable sodium percentage (ESP) of approximately six and higher is regarded as sodic soils. The Oakleaf soil form falls into this category. Although samples of the crusted Clovelly soil form were not collected it can be assumed that this soil would also exhibit high levels of exchangeable Na, thus leading to soil particle dispersion and crusting.

The sodium adsorption ration (SAR) is the ratio of sodium to calcium and magnesium. Sodium can lead to soil dispersion and this hampers water infiltration. Internationally, a SAR value of six is accepted as a level above which soil permeability and structural stability may be negatively affected. Some researcher, however, suggest that soil dispersion may occur at levels as low as three. The effects of high SAR values are more dramatic at low electrical conductivity (EC) levels and one method of overcoming the detrimental effects of high SAR is to increase the EC of the soil solution. This can be achieved by either adding gypsum or lime. The level at which the increasing EC nullifies the SAR is called the threshold electrolyte concentration.

3.3.3.4 Pedohydrology

The soils of the surveyed area are mainly discharge soils. Meaning that these contribute minimally, if at all, to underground aquifers which might be located in the phreatic zone. After a rainfall event, water infiltration in the vertic A-horizon will be very high. Water will rush into the cracks

encountered on the surface of these soils at a rate that could be as high as 10 m/day (measured as saturated hydraulic conductivity). As soon as the soils become moist, the smectite clay minerals will start to swell and the cracks will close. In the moist and wet state these soils exhibit a very low infiltration capacity and a saturated hydraulic conductivity that may be as low as a few mm/day. In this state water rushes from the soil surface as surface runoff. The surface runoff follows the path of least resistance towards lower lying areas. These are areas where the landscape converge. Erosion resulted in the formation of many of the ephemeral stream flow channels. These soils do, however, exhibit a high unsaturated hydraulic conductivity and will be conduits for unsaturated water flow.

The water that infiltrated the cracks prior to swelling of the smectite type clays seem to flow laterally towards lower lying areas at depths below the vertic A-horizon as indicated by the accumulation of CaCO_3 nodules in the saprolitic material which underlies many of the soils of the Arcadia soil form. The saprolitic material exhibits a higher saturated hydraulic conductivity than the overlying vertic A-horizon and would therefore be a more energy efficient route of travel for the soil water. The soil water exits the Arcadia soil form to feed the ephemeral streams, as well as the more significant rivers such as the Mfolozi. Surface runoff from the soils of the Arcadia soil form, as well as the Mispah, Glenrosa and shallow Clovelly soil form remain the main contributor to water in the ephemeral streams and the more significant rivers such as the Mfolozi.

The more sandy soils found towards the Umfolozi River act as conduit for water flow when water flow is saturated. Water will infiltrate these soils at a relatively high rate and may even contribute to a water table. The water table should not be very deep close to the Mfolozi River. These soils are recharge soils and feed the underground water table, as well as the Mfolozi River. These soils are not conducive to the unsaturated flow of water and exhibits a poor water holding capacity. The Tukululu soil form suggest that a fluctuating water table occurs at a depth of approximately 60 cm in the areas closer to the Mfolozi River. The exception to these soils are the soils of crusted Clovelly soil form. Infiltration into these soils are extremely slow and ponding occurs. The area where these soils are encountered is relatively flat and surface runoff is low. The water therefore simply evaporates. Evidence was found that suggest that ponding can occur for significant periods. Figure 29 shows Fe accumulation on root surfaces in these areas where ponding is evident. This relates to alternating conditions of reduction and oxidation. Trivalent Fe is reduced to Fe(II) which is mobile and precipitates along the root surfaces. This phenomenon disappears after a depth of five centimetres to leave the underlying soil unbleached and without any signs of wetness. These hydromorphic characteristics are therefore induced by crusting and not by wetland conditions

3.3.4 LAND CAPABILITY

3.3.4.1 Agricultural Potential linked to Land Capability

Table 23 summarises the land capability of each major soil group, as well as the area that each group comprises. The data is illustrated in Figure 27. The only arable land is that of the Tukululu soil form. These soils are deep and although sandy, exhibit a fluctuating water table at a depth of approximately 60 cm. The latter is ideal for vegetable production. The area marked arable on the map in Figure 27 was, at the time of the site visit, under cultivation.

Table 23: Total hectares that each of the soil forms encountered in the study area comprise

Abbreviation	Soil form	Area (Ha)	Land Capability
Alluvial Sand	Alluvial Sand	64,06905	Wetland
Du	Dundee	12,045746	Wetland
Tu	Tukulu	3,866707	Arable
Ar	Arcadia	658,208847	Grazing
Gs	Glenrosa	96,518607	Grazing
Cv(Crusted)	Clovelly (crusted)	29,090275	Grazing
Oa	Oaklands	18,991948	Grazing
Gs / Cv(Shallow)	Glenrosa/shallow Clovelly complex	56,63111	Grazing
Ms / Gs	Mispah/Glenrosa complex	182,046474	Grazing
Cv(Shallow)	Shallow Clovelly	8,000296	Grazing
R / Ms	Rock/Mispah complex	10,04558	Grazing
Cv	Clovelly	23,014784	Grazing
Ar(Shallow)	Shallow Arcadia	12,135248	Grazing
R / Ms / Gs	Rock/Mispah?Glenrosa complex	456,146979	Grazing
Ms / Gs / Ar(Shallow)	Mispah/Glenrosa/shallow Arcadia complex	1239,766901	Grazing
Gs / Ar(Shallow)	Glenrosa/shallow Arcadia	175,590228	Grazing
Soil Rock Complex	Soil Rock Complex	2,139553	Grazing

*Associated with stream flow channels, but does not exhibit hydromorphic characteristics.

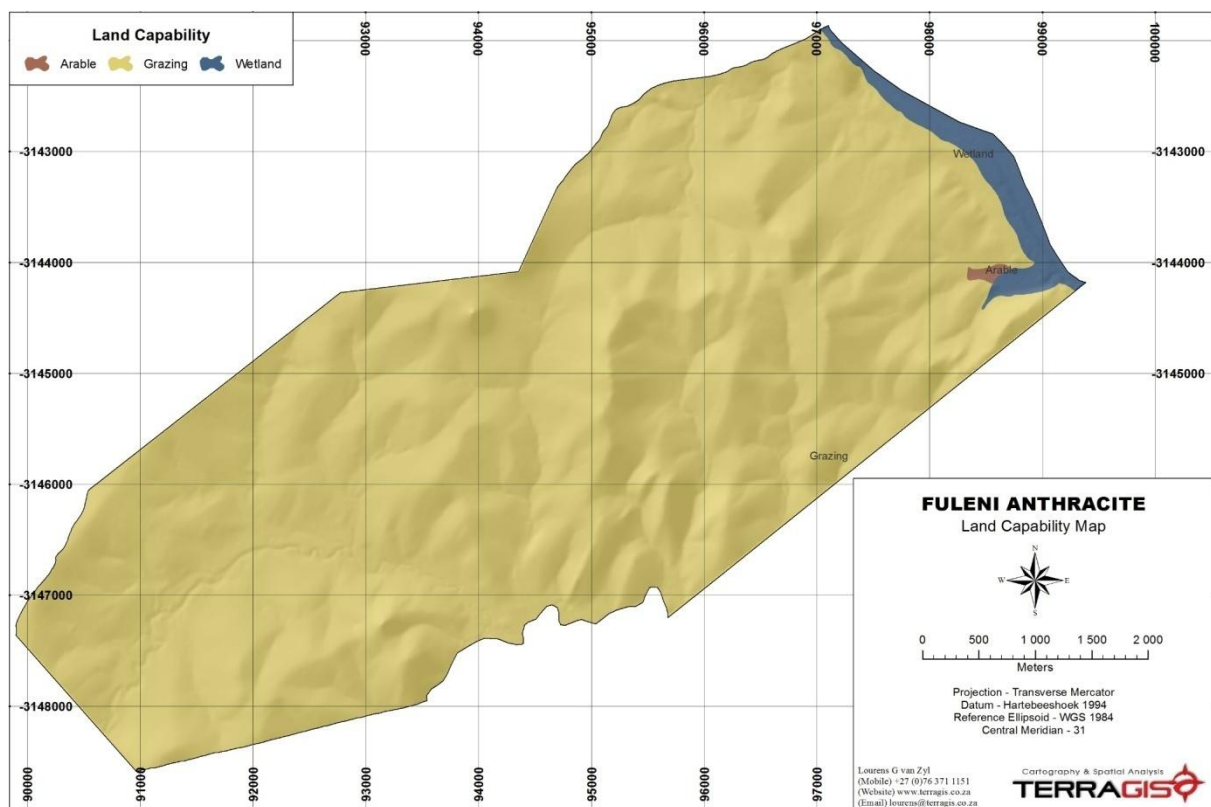


Figure 27: Land capability classes of the area

Many attempts have been made to establish crops in other areas and relics of cultivated land are encountered in the areas marked Clovelly (crusted), Oakleaf, Clovelly and Arcadia soil forms on the soil map. In the case of the latter, cultivation was attempted near the western border of the surveyed area, close to the Ntutunga River. These areas are deemed to be of low agricultural potential. In the case of the Arcadia soil form, the soils are high in clay and swells when wet, but cracks when dry. Root pruning is therefore a problem, as is the high levels of Cl and Na in the soil samples taken from the area where cultivation was attempted. The crusting encountered on some of the soils of the Clovelly soil forms will hamper root development and inhibits water infiltration. Water ponds on the surface of these soils while the subsoil is dry. Soils of the Oakleaf soil form exhibits sodic characteristics and the soils of the Clovelly soil which does not exhibit crusting are very sandy, exhibit a poor nutrient holding capacity and shows no sign of a fluctuating water table within the top 150 cm.

The only soils that exhibit so-called hydromorphic characteristics are that of the Dundee soil form and the alluvial sand found in the Mfolozi River. Many stream flow channels were encountered on site, but these are all lined by soils of the Arcadia soil form. The Arcadia soil form is not a wetland soil. These streams are therefore ephemeral streams and represent watercourses with a distinct channel that is continuous, contains regular or intermittent surface flows, and supports woody riparian habitat along its banks. These watercourses lack base flow and wetland features as they only support surface flow for a short period of time after sufficient rainfall events.

When considering whether or not a soil of the Arcadia soil form show signs of wetness, the material underlying the vertic A-horizon is examined as the vertic A-horizon masks mottling and other morphological features which are indicative of wetland system. No signs of wetness were encountered in any of the Arcadia soil forms. Note: This is not to say that these systems will not be regarded as wetland areas from a vegetative and biodiversity perspective. Merely that these soils exhibit no hydromorphic character.

Many of the stream flow channels where the Arcadia soil form dominate represents proximal or lateral head-cuts. It would seem that these systems are continuously eroding the landscape and migrating towards the higher lying areas.

The majority of the area therefore represents grazing land and is currently used as such. This holds true for the areas which were not surveyed but which are envisaged to be impacted by infrastructure and mining as well.

3.3.5 BIODIVERSITY (FLORA AND FAUNA)

3.3.5.1 Faunal Assessment

3.3.5.1.1 Threatened faunal species

Protected faunal species listed in Schedule 4 and 5 for the KwaZulu-Natal Province are included in Appendix 2 which has been originated from the KwaZulu-Natal Nature Conservation Management Act (Act No 5 of 1999).

3.3.5.1.2 Mammals

A list of mammal species of South Africa that is likely to inhabit the study area within the northern KwaZulu-Natal territory is included in Appendix 2.

3.3.5.1.3 Avifauna

A list of avifaunal species of South Africa that are likely to inhabit the study area within the northern KwaZulu-Natal territory is included in Appendix 2. The complete list of bird species expected for the QDS 2831BD, 2831DB and 2832AC (South African Bird Atlas Project 2) is included in Appendix 2 (www.sabap2.org).

3.3.5.1.4 Reptiles

A list of reptile species of South Africa that are likely to inhabit the study area within the northern KwaZulu-Natal territory is included in Appendix 2. Reptile species encountered will be identified. Specific attention will be paid to priority areas which may provide habitat for RDL reptile species such as rocky outcrops.

3.3.5.1.5 Amphibians

A list of amphibian species of South Africa that are likely to inhabit the site area within the northern KwaZulu-Natal territory are included in Appendix 2. Amphibian species flourish in and around wetland and riparian areas. Priority areas most suited for amphibian species will be investigated. During the field assessment stage, visual identification along with other identification aids such as call identification will be used. Any habitat encountered that may provide suitable habitat for RDL amphibian species will be noted.

3.3.5.1.6 Invertebrates, scorpions and spiders

A list of invertebrate species of South Africa that are likely to inhabit the site area within the northern KwaZulu-Natal territory is included in Appendix 2. A list of observed invertebrate species will be compiled during the field surveys.

3.3.5.2 Floral Assessment

3.3.5.2.1 Biome and bioregion

Biomes are broad ecological units that represent major life zones extending over large natural areas (Rutherford 1997). The Fuleni Project area falls within the Savanna Biome (Mucina and Rutherford, 2006).

Biomes are further divided into bioregions, which are spatial terrestrial units possessing similar biotic and physical features, and processes at a regional scale. This assessment site is situated within the Lowveld Bioregion (Mucina & Rutherford, 2006).

3.3.5.2.2 Vegetation type and landscape characteristics

While biomes and bioregions are valuable as they describe broad ecological patterns, they provide limited information on the actual species that are expected to be found in an area. Knowing which

vegetation type an area belongs to provides an indication of the floral composition that would be found if the assessment site was in a pristine condition, which can then be compared to the observed floral list and so give an accurate and timely description of the ecological integrity of the assessment site. When the boundary of the mining rights area is superimposed on the vegetation types of the surrounding area it can be seen that it falls within the Northern Zululand Sourveld, the Zululand Coastal Thornveld, the Zululand Lowveld and the Scarp Forest vegetation types, however, the mining and infrastructure areas fall within the Northern Zululand Sourveld and the Zululand Lowveld vegetation types only (Figure 28).

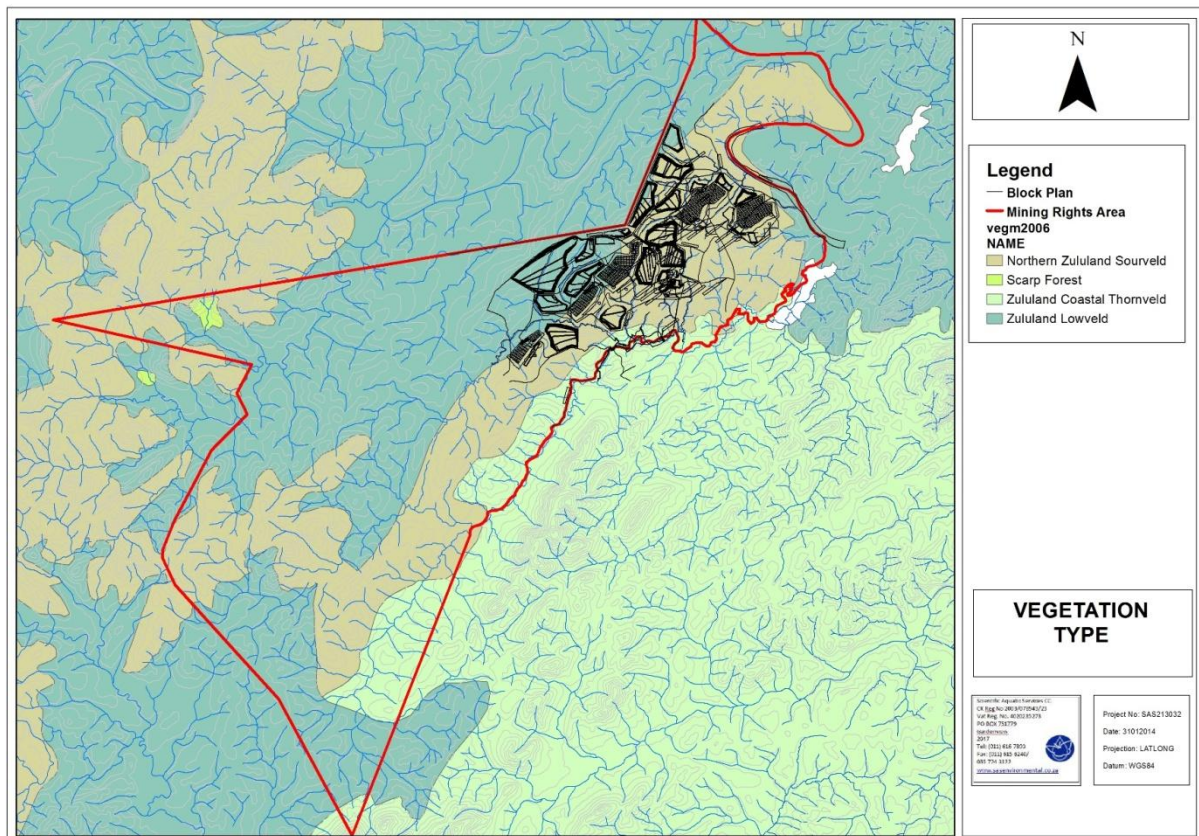


Figure 28: Vegetation type associated with the Fuleni Project area (Mucina & Rutherford, 2006)

Northern Zululand Sourveld

Northern Zululand Sourveld occurs within the KwaZulu-Natal Province and in Swaziland. It extends from the Lusthof area in Swaziland southwards with scattered patches in northern Zululand in the surrounds of Hlomohlomo, east of Louwsburg, Nongoma and the vicinity of Ulundi including Nkandla. In the Hluhluwe-iMfolozi Park it occurs at highest altitudes in the park. Altitude mainly 450-900m (Mucina & Rutherford, 2006).

The Northern Zululand Sourveld is considered *vulnerable* with a conservation target of 19%. Only 4% is statutorily conserved, mainly in Hluhluwe-iMfolozi Park and Ithala Game Reserve. Some 22% has already been transformed, mainly by cultivation and plantations. Erosion is generally moderate to high (Mucina & Rutherford, 2006).

In terms of recent vegetation classifications, the assessed area occurs within the Northern Zululand Sourveld vegetation type (Mucina & Rutherford, 2006). The dominant structural vegetation type is wooded grassland, in places pure sour grasslands and rarely also dense bushveld thickets. Terrain is mainly low, undulating mountains, sometimes highly dissected, and also some moderately undulating plains and hills.

Key indicator species of this vegetation type include:

- Small trees: *Acacia sieberiana* var. *woodii* (d), *A. natalitia*, *A. nilotica*, *A. tortilis* subsp. *heteracantha*, *Plectroniella armata*;
- Tall shrubs: *Gardenia volkensii*, *Gnidia caffra*, *G. kraussiana*;
- Low shrubs: *Agathisanthemum bojeri*, *Chaetacanthus burchellii*, *Crassandra fruticulosa*, *C. greenstockii*, *Diospyros galpinii*, *Phyllanthus glaucophyllus*, *Ruellia cordata*, *Syncolostemon argenteus*, *Tetraselago natalensis*;
- Succulent shrubs: *Aloe vanbalenii*;
- Woody climber: *Cryptolepis oblongifolia*;
- Herbaceous climbers: *Cyphostemma schlechteri*;
- Graminoids: *Eragrostis curvula* (d), *Hyparrhenia hirta* (d), *Microchloa caffra* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Alloteropsis semialata* subsp. *semialata*, *Digitaria argyrograpta*, *D. tricholaenoides*, *Diheteropogon amplexans*, *Elionurus muticus*, *Loudetia simplex*, *Trachypogon spicatus*;
- Herbs: *Alepidea longifolia*, *Argyrolobium adscendens*, *Aster bakerianus*, *Berkheya speciosa*, *Chascanum hederaceum*, *Crabbea hirsute*, *Gazania krebsiana* subsp. *serrulata*, *Berbera ambigua*, *Helichrysum mixtum*, *H. nudifolium* var. *pilosellum*, *Hemizygia pretoriae* subsp. *pretoriae*, *Hermannia grandistipula*, *Hypericum aethiopicum*, *Lichtensteinia interrupta*, *Pimpinella caffra*, *Senecio glaberrimus*, *S. latifolius*, *Stachys nigricans*, *Vernonia galpinii*, *V. oligocephalus*;
- Geophytic herbs: *Hypoxis hemerocallidea*, *Pachycarpus concolor*;
- Succulent herbs: *Aloe minima*, *A. parvibracteata*, *Senecio oxyriifolius*;
- Geoxylic suffrutex: *Salacia kraussii*

*(d) = dominant species)

Zululand Lowveld

Zululand Lowveld occurs within the KwaZulu-Natal Province, Swaziland and the Mpumalanga Province. The main extent of the vegetation type is from around Big Bend south to Mkuze, Hluhluwe. Ulundi to just north of the Ongoye Forest. An isolated patch is also found on the Swaziland-Mpumalanga border. Altitude is about 50-450m (Mucina & Rutherford, 2006).

The Zululand Lowveld is considered Vulnerable with a conservation target of 19%. Some 11% of the vegetation type is statutorily conserved, mainly in the Hluhluwe-iMfolozi Park and Phongolapoort Nature Reserve. Almost 1% is protected in the private Masibekela Wetland. Much of the area between Magudu, Mkuze and Nongoma is managed as private game farms and lodges. About 26% of the area has been transformed, mostly by cultivation. Erosion is variable from low to high (Mucina & Rutherford, 2006).

The Zululand Lowveld vegetation type occurs on extensive flat or only slightly undulating landscapes supporting a complex of various bushveld units ranging from dense thickets of *Dichrostachys cinerea* and *Acacia* species, through park-like savanna with flat-topped *A. tortilis* to tree dominated woodland with broad leaved open bushveld with *Sclerocarya birrea* subsp. *caffra* and *A. nigrescens*. Tall grassveld types with sparsely scattered solitary trees and shrubs form a mosaic with the typical savannah thornveld, bushveld and thicket patches. .

Key indicator species of this vegetation type include:

- Tall trees: *Acacia burkei* (d), *A. nigrescens* (d), *Sclerocarya birrea* subsp. *caffra* (d);
- Small trees: *Acacia tortilis* subsp. *heteracantha* (d), *A. gerrardii*, *A. natalitia*, *A. nilotica*, *A. senegal* var. *rostrata*, *A. welwitschii* subsp. *welwitschii*, *Boscia albitrunca*, *Compretum apiculatum*, *C. molle*, *Ozoroa paniculosa*, *Phoenix reclinata*, *Schotia brachypetala*, *Spirostachys africana*, *Teclea gerrardii*, *Ziziphus mucronata*;
- Succulent trees: *Aloe marlothii* subsp. *marlothii*, *Euphorbia grandidens*, *E. ingens*;
- Tall shrubs: *Dichrostachys cinerea* (d), *Euclea divinorum* (d), *Coptosperma supra-axillare*, *Crotalaria monteiri*, *Euclea crispa* subsp. *crispa*, *E. schimperi*, *Galpinia transvaalica*, *Gardenis volkensii*, *Gymnosporia maranguensis*, *G. senegalensis*, *Jatropha zeyheri*, *Lycium acutifolium*, *Olea europaea* subsp. *africana*, *Tarchonanthus parvicapitulatus*, *Tephrosia polystachya*, *Triumfetta pilosa* var. *tomentosa*;
- Low shrubs: *Barleria obtusa*, *Crossandra greenstockii*, *Felicia muricata*, *Gymnosporia heterophylla*, *Indigofera trita* subsp. *subulata*, *Justicia flava*, *J. protracta* subsp. *protracta*, *Malhania didyma*, *Orthosiphon serratus*, *Pearsonia sessilifolia*, *Ruellia cordata*, *Sida serratifolia*, *Tetraselago natalensis*;
- Succulent shrubs: *Euphorbia grandicornis*, *E. trichadenia*, *E. vandermerwei*;
- Soft shrub: *Pavonia columella*;
- Herbaceous climbers: *Fockea angustifolia*;
- Graminoids: *Dactyloctenium austral* (d), *Enteropogon monostachus* (d), *Eragrostis capensis* (d), *E. curvula* (d), *E. racemosa* (d) *Heteropogon contortus* (d) *Panicum maximum* (d) *Sporobolus pyramidalis* (d), *Themeda triandra* (d), *Aristida bipartite*, *A. congesta*, *Bothriochloa insculpta*, *Chloris mossambicensis*, *Cymbopogon caesius*, *Digitaria natalensis*, *Leptochloa eleusine*, *Panicum deustum*, *Schizachyrium sanguineum*, *Setaria incrassate*, *Sporobolus nitens*, *Trachypogon spicatus*, *Tristachya leucothrix*;
- Herbs: *Acrotome hispida*, *Argyrolobium rupestre*, *Aspilia mossambicensis*, *Chamaecrista biensis*, *C. mimosoides*, *Corchorus asplenifolius*, *Felicia massamedensis*, *Gerbera ambigua*, *Helichrysum rugulosum*, *Hibiscus pusillus*, *Kohautia virgata*, *Lotononis eriantha*, *Senecia latifolius*, *Stachys aethiopica*, *Tragia meyeriana*, *Vernonia capensis*;
- Succulent herb: *Aloe parvibracteata*.

*(d = dominant species)

3.3.5.2.3 RDL floral assessments

An assessment considering the presence of any plant species of concern, as well as suitable habitat to support any such species, was undertaken. The complete PRECIS (Pretoria Computer Information Systems) red data plant lists for the grid references (2831BD, 2831DB and 2832AC) were acquired

from SANBI (South African National Biodiversity Institute). The following red data species were listed for the area.

Table 24: IUCN Red Data List Categories – Version 3.1 as supplied by SANBI

Category	Definition
EX	Extinct
EW	Extinct in the wild
CR	Critically endangered
EN	Endangered
VU	Vulnerable
NT	Near threatened
LC	Least concern
DD	Data deficient
NE	Not evaluated

Table 25: PRECIS RDL plant list for the QDS 2831BD (Raimondo *et al.*, 2009; SANBI, www.sanbi.org)

Family	Species	Threat status	Growth forms
ACANTHACEAE	<i>Salpinctium natalense</i> (C.B. Clarke) T.J. Edwards	Rare	Herb
CELASTRACEAE	<i>Elaeodendron transvaalense</i> (Burt Davy) R.H. Archer	NT	Shrub, tree
MALVACEAE	<i>Melhania polygama</i> I. Verd.	Rare	Dwarf shrub

Table 26: PRECIS RDL plant list for the QDS 2831DB (Raimondo *et al.*, 2009; SANBI, www.sanbi.org)

Family	Species	Threat status	Growth forms
CELASTRACEAE	<i>Elaeodendron transvaalense</i> (Burt Davy) R.H. Archer	NT	Shrub, tree

Table 27: PRECIS RDL plant list for the QDS 2832AC (Raimondo *et al.*, 2009; SANBI, www.sanbi.org)

Family	Species	Threat status	Growth forms
AMARYLLIDACEAE	<i>Crinum acaule</i> Baker	NT	Geophyte
AMARYLLIDACEAE	<i>Crinum stuhlmannii</i> Baker	Declining	Geophyte
APOCYNACEAE	<i>Pachycarpus concolor</i> E. Mey. subsp. <i>arenicola</i> Goyder	VU	[No lifeform defined]
ASPHODELACEAE	<i>Kniphofia littoralis</i> Codd	NT	Herb
HYPOXIDACEAE	<i>Hypoxis hemerocallidea</i> Fisch., C.A. Mey. & Avé-Lall.	Declining	Geophyte
ORCHIDACEAE	<i>Eulophia speciosa</i> (R.Br. ex Lindl.) Bolus	Declining	Geophyte, herb, succulent
PASSIFLORACEAE	<i>Adenia gummifera</i> (Harv.) Harms var. <i>gummifera</i>	Declining	Climber, succulent

Past disturbance due to the surrounding agricultural activities caused degradation in natural habitat. Thus no RDL floral species were identified during the assessment of the subject property and it is deemed doubtful that the subject property presently provides suitable habitat for these species. Only one Orange listed species was found namely *Hypoxis hemerocallidea* with a declining status according to SANBI PRECIS. This species was found within wetland 3 - 5 areas. It was recommended that relocation of these species take place if it is to be disturbed during the proposed mining activities.

During the detailed site assessments, the species listed above will be specifically searched for. A high probability exists that the RDL species listed above will be present on the study area, especially within the Montane Grassland, Wetland and Northern Afrotemperate forest Habitat Units.

In addition, various floral species which are protected under the Kwazulu-Natal Nature Conservation Management Amendment Act, 1999 No. 5 of 1999, were encountered during a brief site visit. Furthermore, the protected tree species, *Sclerocarya birrea* and *Boscia albitrunca*, occur throughout the study area. These tree species are protected under the National Forests Act of 1998 (Act 84 of 1998). Thus, the study area is likely to be highly important in terms of RDL and protected floral species conservation.

3.3.5.2.4 Alien and invasive plant species

Alien invaders are plants that are of exotic origin and are invading previously pristine areas or ecological niches (Bromilow, 2001). Not all weeds are exotic in origin but, as these exotic plant species have very limited natural “check” mechanisms within the natural environment, they are often the most opportunistic and aggressively growing species within the ecosystem. Therefore, they are often the most dominant and noticeable within an area. Disturbances of the ground through trampling, excavations or landscaping often leads to the dominance of exotic pioneer species that rapidly dominate the area. Under natural conditions, these pioneer species are overtaken by sub-climax and climax species through natural veld succession. This process however takes many years to occur, with the natural vegetation never reaching the balanced, pristine species composition prior to the disturbance. There are many species of indigenous pioneer plants, but very few indigenous species can out-compete their more aggressively growing exotic counterparts.

Alien vegetation invasion causes degradation of the ecological integrity of an area, causing (Bromilow, 2001):

- A decline in species diversity;
- Local extinction of indigenous species;
- Ecological imbalance;
- Decreased productivity of grazing pastures; and
- Increased agricultural input costs.

All alien and invasive floral species will be recorded during the detailed assessment, and significant communities will be mapped. In addition, brief mitigation measures will be presented which will aim to guide the management of alien floral species on the study area, should the proposed mining development be authorised.

3.3.5.2.5 Medicinal plant species

Medicinal plant species are not necessarily indigenous species, with many of them regarded as alien invasive weeds. All medicinal species encountered within the study area will be recorded and their uses presented. In addition, should any significant medicinal plant species be identified, measures to preserve or relocate such species will be prescribed.

3.3.6 SURFACE WATER

3.3.6.1 Locality and Background Information

The proposed mining areas are located within the Usutu to Mhlatuze Water Management Area as demarcated by the Department of Water Affairs and are in quaternary catchment W23A, shown in Figure 29. The NOMRA area adjoins and spans to the south of the Hluhluwe-iMfolozi Park. The area is characterized by incised valleys where smaller tributaries drain towards the Mfolozi River. From Figure 29, it is clear that the Hluhluwe-iMfolozi Park is outside of the proposed mining area's drainage system, i.e. surface water emanating from the mining activities would not impact on the Park which is situated upstream in quaternary catchment areas W21L and W22L.

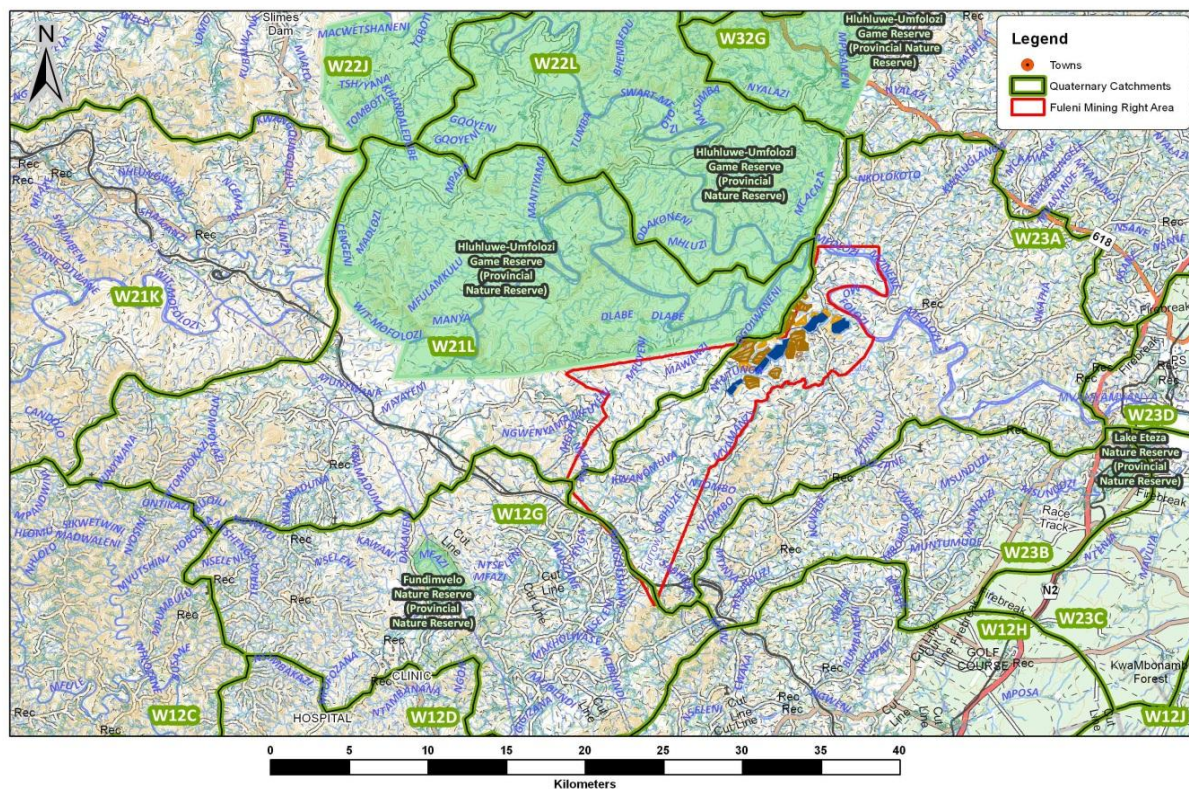


Figure 29: Quaternary Catchment Areas

The streams in the vicinity of the mining area generally drain in a south-eastwards direction towards the Mvamanzi River, a tributary of the Mfolozi River, or to the east directly towards the Mfolozi River. To the south the perennial Ntutunga River flows into the Mvamanzi River. A large wetland

occurs on the Mvamanzi River's floodplain close to the Mfolozi River. Smaller wetlands occur to the north between the proposed mining development and the Mfolozi River.

The catchment bordering to the south on the mining prospecting area, W12G, is within the Mhlatuze River catchment area. This river basin provides most of the water used in Richards Bay and surrounding urban and industrial complexes ("City of uMhlatuze"), through the Mhlatuze Water utility company.

The Mfolozi River mouth has recently been reinstated to its natural outlet, namely the St. Lucia wetland system. This implies that flow in the Mfolozi River discharges into a highly sensitive environment and pollution from coal mining (or any other source) should be prevented. The development and operation of the mine should thus comply in all aspects with the requirements of the DWA and other authorities, as applicable.

3.3.6.2 Ecoregion

The NOMRA area falls within the Lowveld and the North Eastern Uplands Ecoregion and is located within the W21L, the W12G and the W23A quaternary catchments. However, the Fuleni Project area is located within the North Eastern Uplands Ecoregion only and is located within the W23A quaternary catchment.

Studies undertaken by the Institute for Water Quality Studies assessed all quaternary catchments as part of the Resource Directed Measures for Protection of Water Resources. In these assessments, the Ecological Importance and Sensitivity (EIS), Present Ecological Management Class (PEMC) and Desired Ecological Management Class (DEMC) were defined and serve as a useful guideline in determining the importance and sensitivity of aquatic ecosystems, prior to assessment or as part of a desktop assessment.

This database was searched for the catchment of concern in order to define the EIS, PEMC and DEMC. The results of the assessment are summarised in the table below.

Catchment	Resource	EIS	PESC	DEMC
W23A	Mfolozi	VERY HIGH	CLASS A	A: Highly Sensitive System

According to the ecological importance classification for the quaternary catchment, the system can be classified as a Highly Sensitive system which, in its present state, can be considered a Class A (unmodified, natural) stream.

The points below summarise the impacts on the aquatic resources in the quaternary catchment W23A (Kleynhans 1999):

- The aquatic resources within this quaternary catchment have been marginally affected by bed modification.
- Marginal flow modifications occur within the quaternary catchment.
- Impacts as a result of introduced aquatic biota are very low.

- Impact as a result of inundation is very low.
- Riparian zones and stream bank conditions are considered to be moderately impacted upon by goats and human activity.
- Very few impacts have been created as a result of water quality modification.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in this catchment:

- The riverine systems in this catchment have a very high diversity of habitat types which include wetlands and pans.
- The quaternary catchment has a moderate importance in terms of conservation and natural areas with special mention of flood plain lakes.
- Species within the quaternary catchment have a moderate intolerance to changes in flow and flow related water quality with special mention of invertebrate species.
- The quaternary catchment is regarded as having a very high importance for rare and endangered species conservation with special mention of *Hippopotamus amphibious* (Hippopotamus), *Crocodylinae* (Crocodiles), *Brycinus lateralis* (Striped Robber) and *Clarias theodora* (Snake Catfish).
- The quaternary catchment is considered of very high importance in terms of provision of migration routes for species in the in-stream and riparian environments.
- The quaternary catchment has a very high importance in terms of providing refugia for aquatic community members within lakes and river channels.
- The quaternary catchment can be considered to have a high sensitivity to changes in water quality as re-aeration of the system is poor.
- The quaternary catchment can be considered to have a moderate sensitivity to changes in water flow with special mention of lakes.
- The quaternary catchment is of very high importance in terms of species richness with riparian zones, lakes and floodplains providing habitat to a large number of species, specifically bird species.
- The quaternary catchment is of moderate importance in terms of endemic and isolated species with special mention of *Barbus natalensis* (Scaly).

3.3.6.3 General Importance with regards to Watercourse Conservation

The SANBI Wetland Inventory (2006) and National Freshwater Ecosystem Priority Areas (NFEPA) (2011), databases was consulted to define the aquatic ecology of the wetland or river systems close to or within the mining rights area and the study area that may be of ecological importance. Aspects applicable to the mining rights area and the study area and surroundings are discussed below:

- The NOMRA area falls within the Usuthu to Mhlathuze Water Management Area (WMA). Each Water Management Area is divided into several sub-Water Management Areas (subWMA), where catchment or watershed is defined as a topographically defined area which is drained by a stream or river network. The Sub-Water management unit indicated for the mining rights area and the study area is the Mfolozi sub-WMA.
- The subWMA is not regarded important in terms of fish sanctuaries, rehabilitation or corridors.

- The subWMA is not considered important in terms of translocation and relocation zones for fish.
- The subWMA is not listed as a fish Freshwater Ecosystem Priority Areas (FEPA).
- The Mfolozi River extends along the northern border of the mining rights area and tributaries of the river are located to the north of the mining rights area and the study area.
- The Mfolozi River is a perennial river classified as a Class A (unmodified, natural) river. It is indicated as a free flowing river and is classified as a flagship river; however, the Mfolozi River is not a FEPA River.
- The Mvumazi River extends along the eastern border of the mining rights area and tributaries of the river are located within the eastern portion of the mining rights area as well as within the study area.
- The Mvumazi River is a perennial river classified as a Class A (unmodified, natural) river. It is not indicated as a free flowing river and is not classified as a flagship river or a FEPA River.
- Tributaries of the White Mfolozi River are located within the western portion of the mining rights area.
- The White Mfolozi River is a perennial river classified as a Class A (unmodified, natural) river. It is not indicated as a free flowing river and is not classified as a flagship river; however, the White Mfolozi River is classified as a FEPA River. River FEPAs achieve biodiversity targets for river ecosystems and threatened fish species, and were identified in rivers that are currently in a good condition (A or B ecological category). Their FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources.
- Although FEPA status applies to the actual river reach within a sub-quaternary catchment. The surrounding land and smaller stream networks within the sub-quaternary catchment need to be managed in a way that maintains the good condition (A or B ecological category) of the river reach.
- Tributaries of the Nseleni River are located within the southern portion of the mining rights area.
- The Nseleni River is a perennial river classified as a Class A (unmodified, natural) river. It is not indicated as a free flowing river and is not classified as a flagship river; however, the Nseleni River is located within an Upstream Management Area.
- Upstream Management areas are subquaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas.
- A wetland cluster area is located within the southern portion of the mining rights area. Wetland clusters are groups of wetlands embedded in a relatively natural landscape. This allows for important ecological processes such as migration of frogs and insects between wetlands. In many areas of the country, wetland clusters no longer exist because the surrounding land has become too fragmented by human impacts.
- Numerous wetland features are associated with the mining rights area. However, for the purpose of this assessment only the wetland features associated with the mining and infrastructure areas are discussed.
- All wetland features associated with the study area are indicated as valley floor wetlands.

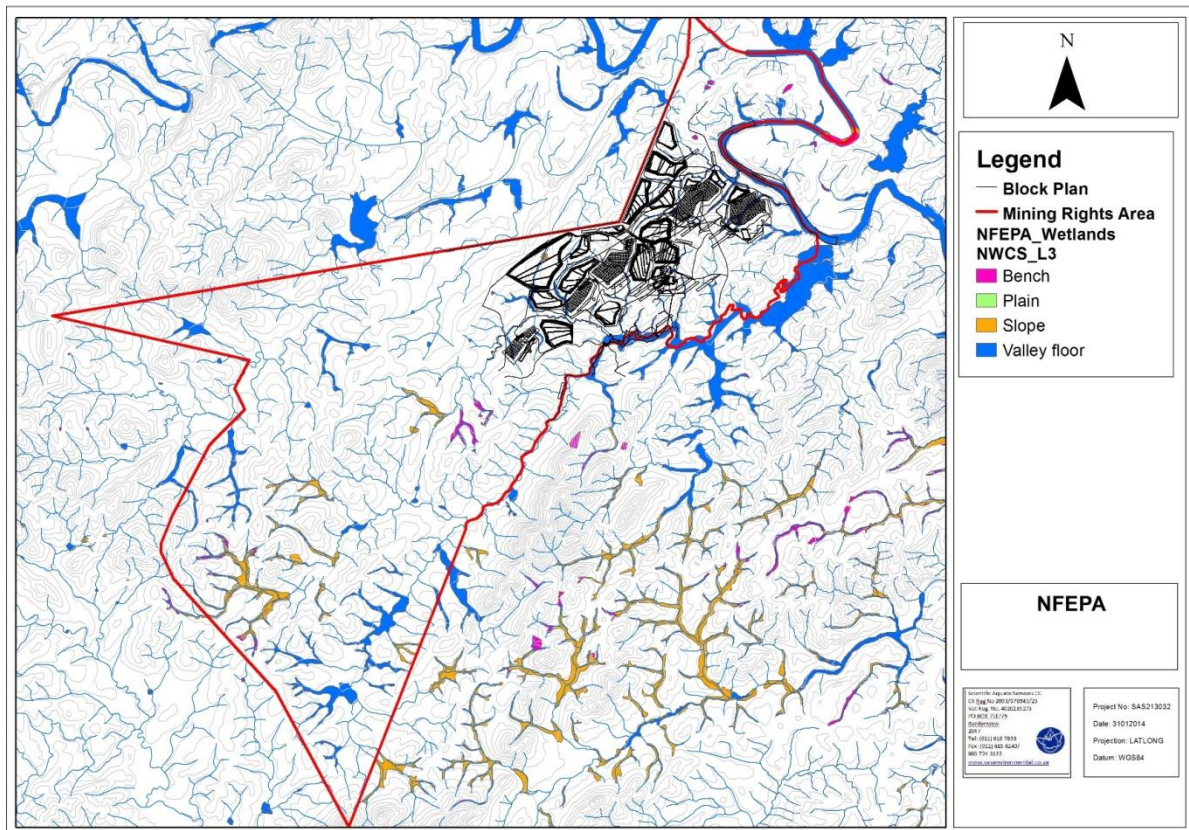


Figure 30: NFEPA wetland types within the study area

- The conditions of wetland features within the study area is depicted in Figure 31 and includes:
 - Category AB (Percentage natural land cover >75%). Includes wetland features to the north east and and to the south of the study area.
 - Category C (Percentage natural land cover between 25% and 75%). Includes wetland features to the north east and to the north of the study area.
 - Category Z3 (Percentage natural land cover <25%). Includes a wetland feature to the west of the study area.
- The wetland within the mining rights area and the study area was ranked according to general importance depicted in Figure 32.
 - Rank 2 – Wetlands with a sub-quaternary catchment recognised by experts at the regional review workshops as containing wetlands that are good, intact examples from which to choose.

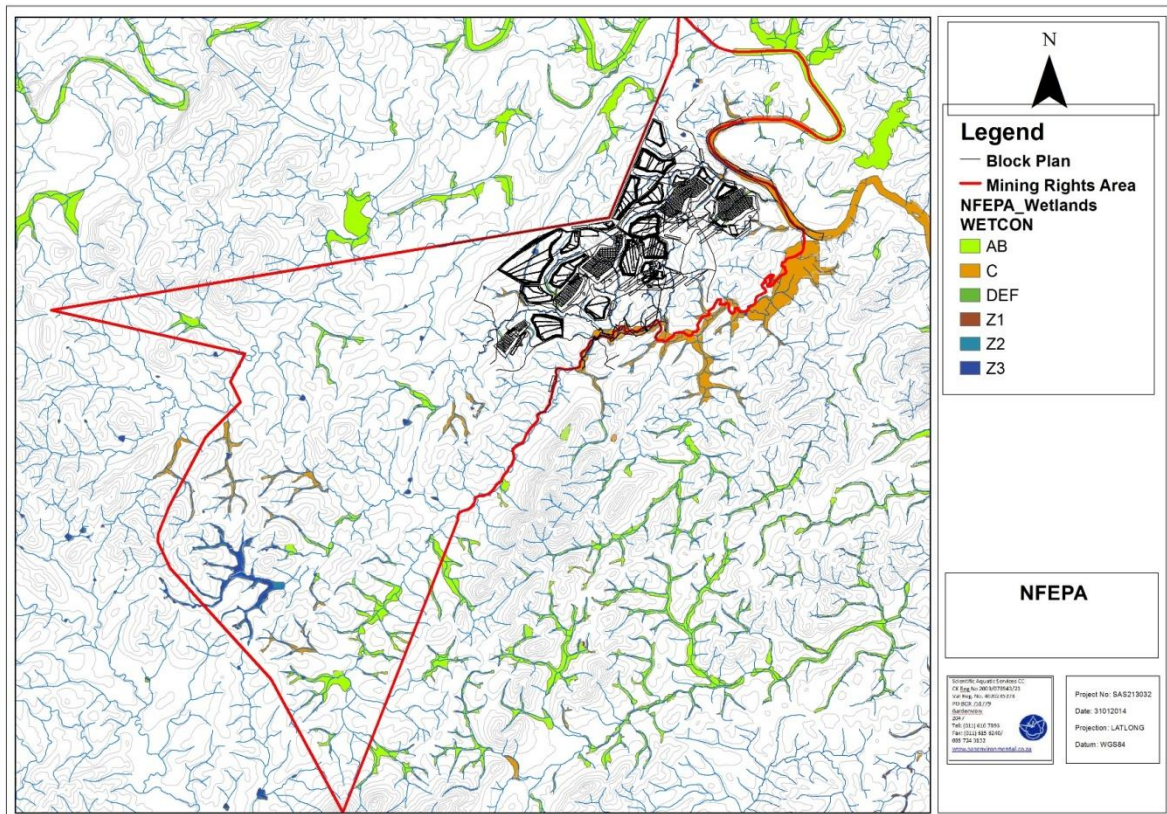


Figure 31: Wetland conditions as defined by the NFEPA wetland map

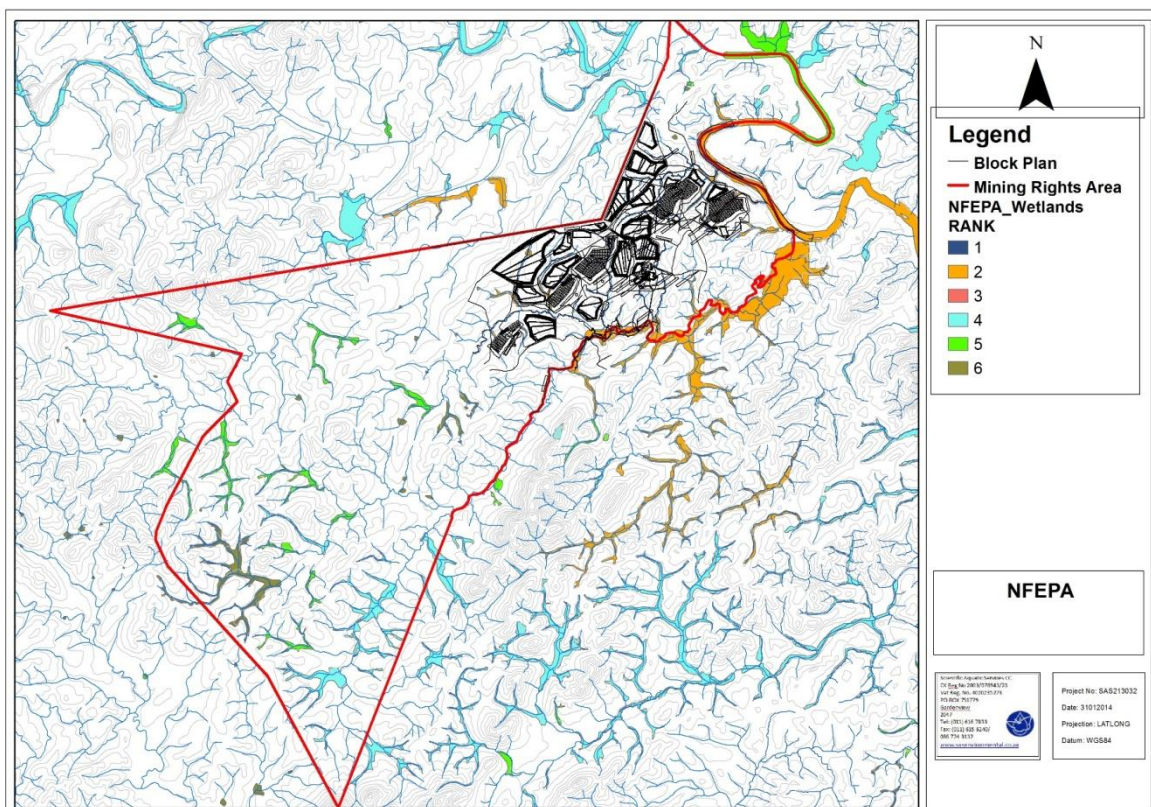


Figure 32: Ranks according to general importance

- The wetland features within the study area are not considered important with regards the conservation of biodiversity. Expertid = 0; No importance

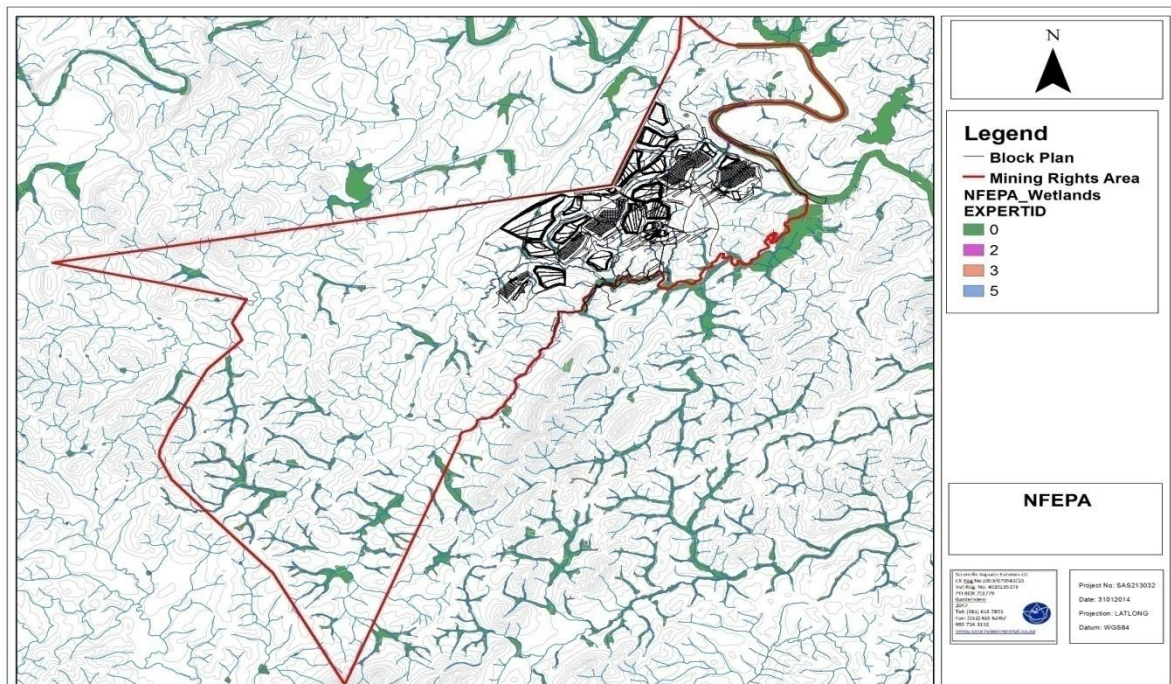


Figure 33: Wetlands indicated to be of importance towards biodiversity conservation (0 = no importance)

- Wetland features to the south of the study area are indicated to be FEPA wetlands. {Wetfepa = 0: Not a wetland FEPA; Wetfepa = 1: Wetland FEPA}

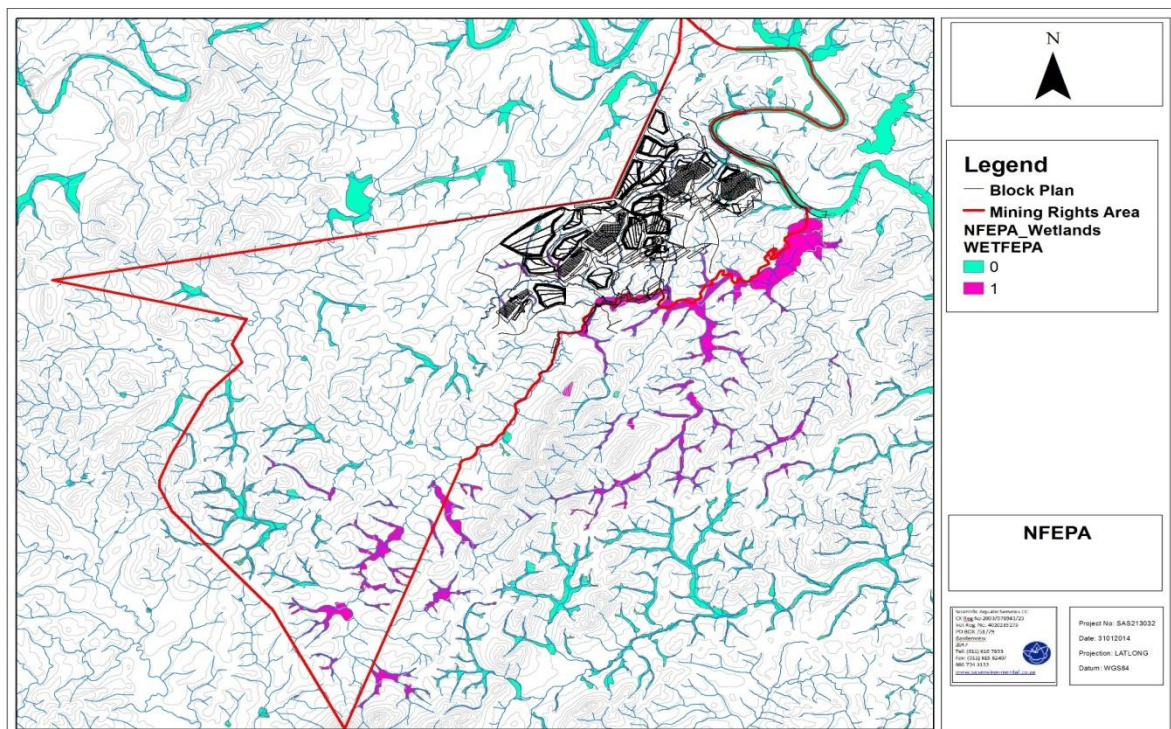


Figure 34: FEPA wetlands indicated for the study area (1 = FEPA wetland)

- The wetland features located within the study area are not shown to have sighting or breeding areas for cranes.
- The wetland features are not indicated as RAMSAR wetlands.
- The wetland features are not indicated to fall within 500m of an IUCN threatened frog point locality.

3.3.6.4 Water Quality

3.3.6.4.1 *Mfolozi WMA*

According to DWA's Internal Strategic Perspective Document (DWA, 2004), the Mfolozi catchment is one of the few areas in the Usutu to Mhlathuze WMA in which there is a **definite and serious** water quality problem, as opposed to mostly **potential problems** in other catchments. This problem is due to municipal return flows from Vryheid and settlements on State Land upstream of the dam which results in unacceptably poor water quality in the Klipfontein Dam. Eutrophication is a serious problem with the likelihood of toxic blooms threatening both human health and the ecology of the dam and the river. The Municipality has plans, but no funds, to build a facility to resolve this problem.

Coal mining in the upper reaches of the catchment also impacts severely on the water quality by decreasing the pH and salinity. This is a problem throughout much of the northern and north-western WMA.

Water Quality Management is a serious issue in the Mfolozi catchment. The problems span urban pollution (sewage), mining (acid leaching from the mostly-abandoned coal mines) and agricultural pollution.

The ISP study concluded as follows:

- Non-point source pollution needs to be assessed and strategies developed to curb this. This requires national, WMA and catchment level approaches to over-irrigation and excessive fertilisation.
- Mine licensing, operation and closure policies need to be very carefully considered and tightly managed. Staff and resources need to be allocated to achieve this.

Major storm events

Cyclone Domoina, which was the most catastrophic flood to have occurred in the Mfolozi catchment, occurred in late January and February 1984 and was documented by Kovačs et al (DWA, 1985). The flood peaks in the river reach was determined at control structures such as bridges and by using the so-called slope-area method. The latter method was applied at river sites close to the proposed Fuleni Mine and the estimated flood peak was 16 000 m³/s.

As summarized by Ramokgopa (1996), the estimated total flood damage to the catchment was in excess of R100 million and included three washed away bridges, destroyed buildings, roads and tourist facilities. Power supply and telephone communications were also severely disrupted. This flood deposited 80 x 10⁶ m³ of sediment on the Mfolozi Flats. The amount of sediment deposited on

the flats is 30 times more than the natural ability of the Mfolozi Flats to absorb sediment to maintain base level. This resulted in a sugar cane production loss of R57 million.

Erosion and sediment load

Intensive grazing in the rolling hill topographical areas, coupled to deforestation that has taken place over the years, lead to increased risk of local erosion. During high rainfall events, such as described above, the streams and rivers carry a high sediment load which settles out when the flow velocity decreases, for example in wetlands or upper reaches of impoundments.

From the study by Ramakgopa (1996) it appears that the canalization of the floodplain in the Mfolozi Flats region and its settlement by farmers commenced in 1918 and was completed about 1950. Prior to the commencement of farming on the flood plain, most of the river sediment load was absorbed by the plain. The water that consequently reached the coast was sediment free and thus assisted in keeping the estuary mouth open. Now, instead of the floodplain absorbing huge silt and water loads during flood periods, the waters are carried down the canalized Mfolozi River and deposited in the estuary. The consequent siltation and closure of the mouth has contributed significantly to the increased incidence and severity of flooding, particularly in the lower reaches of the river.

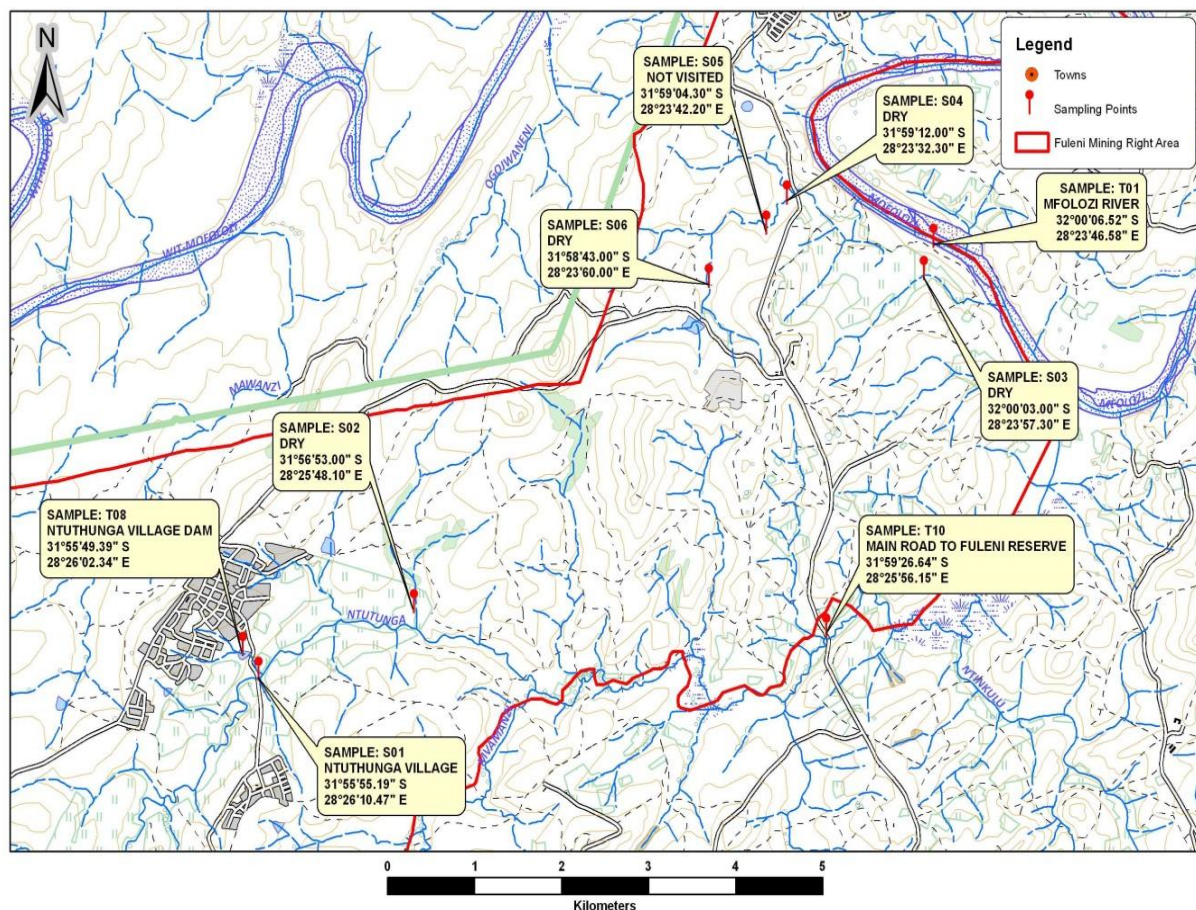


Figure 35: Water Quality Sampling Points

3.3.6.4.2 Local catchment in relation to NOMRA area

Figure 35 shows the planned water quality monitoring points. During the team site visit conducted on 31 July, samples were only collected at four of the locations. Due to the ephemeral nature of stream flow, the other streams were all dry. The results of the water quality tests for the samples collected are shown in Table 28.

The water quality records obtained from the Department of Water Affairs' long-term water quality monitoring points W2H010 and W2H032 as shown in Figure 36 was also analyzed and the test results are included along with those of the site samples in Table 28.

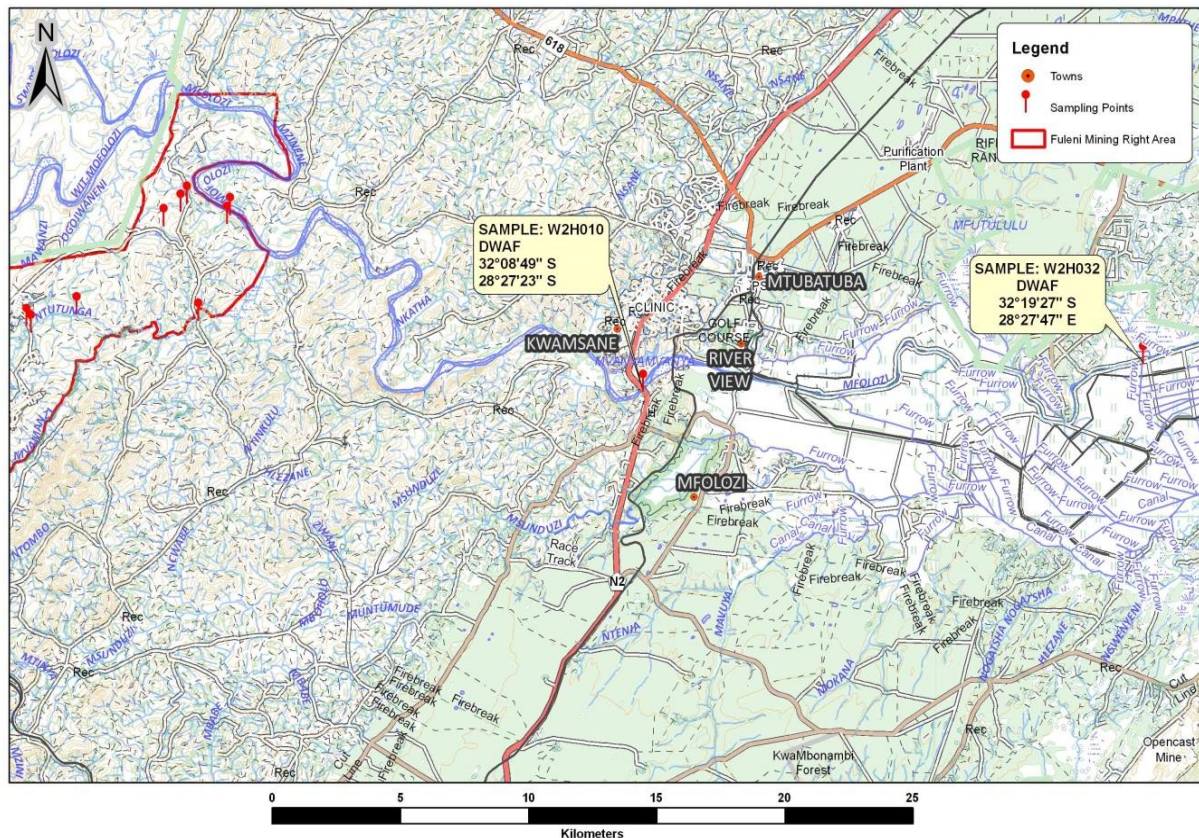


Figure 36: DWA Long-term Water Quality Sampling Points on the Mfolozi River

The test results show that the water is not pristine. The best quality was sampled at the Mfolozi River (T01). The two samples collected downstream of Ntuthunga Village (S01 and T08) exceeded drinking water limits of chloride, magnesium and sodium. Sample T10, collected along the road further away from habitation tested marginally better in terms of drinking water limits.

The results of long term monitoring on the Mfolozi River compared well to those of the single sample T01 with the values almost within drinking water limits.

Figure 37 shows the Total Dissolved Solids (TDS) concentrations within the region of the project. The majority of the project area falls within the Drinking Water and Agricultural (Livestock) water quality thresholds of 1000 mg/l, which is within the drinking water quality limits.

Table 28: Surface Water Quality Results

SURFACE WATER CHEMICAL ANALYSIS

Macro-elements

Element	Unit	Water Sampling Points						Aquatic Ecosystem WQT	Drinking Water WQT	Agriculture WQT (irrigation)	Agriculture WQT (livestock)
		S01	T01	T08	T10	W2H010 ⁽¹⁾	W2H032 ⁽²⁾				
DATE		31-May-13	31-May-13	31-May-13	31-May-13	1977-1987	1995-2009				
pH		8.79	8.49	8.96	8.12	8.4	8.6		6.0 - 9.0	6.5 - 8.4	
E.C	mS/m	875	31.5	406	227	83	114		150	40	
TDS	mg/l					581	852		1000		1000
NO ₃	mg/l	0.746	0.25	0.226	0.708	0.6	0.33	0.5	6	5	100
F	mg/l	1.59	0.351	0.633	0.711	0.6	0.46	0.75	1	2	2
SO ₄	mg/l	189	16.1	69.2	39.2	33.3	24		400		1000
Cl	mg/l	2792	32.1	1268	410	116	193		200	100	1500
Ca	mg/l	25.7	23	36.9	95.1	42	51		150		1000
Mg	mg/l	146	16.6	106	105	35	58		100		500
Na	mg/l	1850	29.2	714	374	79	129		200	70	2000
NH ₄	mg/l	0.406	0.067	0.264	0.116	0.15	0.18				
Total hardness		664	126	529	670						
CO ₃	mg/l										
P	mg/l	0.011	0.017	0.027	0.092						

Trace metals

Element	Unit							Aquatic Ecosystem Water Quality Threshold	Drinking Water Quality Threshold	Agriculture Water Quality Threshold (irrigation)	Agriculture Water Quality Threshold (livestock)
B	mg/l									0.5	5
As	mg/l							0.01	0.05	0.1	1
Sr	mg/l										
Ba	mg/l										
Al	mg/l	-0.003	-0.003	-0.003	-0.003				0.5	5	5
V	mg/l								0.1	0.1	1
Cr	mg/l	-0.001	-0.001	-0.001	-0.001			0.007	0.05	0.1	1
Mo	mg/l									0.01	0.01
Fe	mg/l	-0.003	-0.003	-0.003	-0.003				1	5	10
Mn	mg/l	-0.001	-0.001	-0.001	0.308			0.18	0.4	0.02	10
Ni	mg/l	-0.001	-0.001	-0.001	-0.001					0.2	1
Cu	mg/l	-0.001	-0.001	-0.001	-0.001			0.0008	1.3	0.2	0.5
Zn	mg/l	-0.002	-0.002	-0.002	-0.002			0.002	5	1	20
Cd	mg/l	-0.001	-0.001	-0.001	-0.001			0.00025	0.005	0.01	0.01
Hg	mg/l							0.00004	0.001		0.001
Pb	mg/l	-0.004	-0.004	-0.004	-0.004			0.0005	0.01	0.2	0.1
Ag	mg/l										
Be	mg/l										
Co	mg/l	-0.001	-0.001	-0.001	-0.001					0.05	1
Sb	mg/l										
Se	mg/l							0.002	0.05	0.02	0.05
Sn	mg/l										
Ti	mg/l										

NOTE: VALUES IN GREEN SHOW CONSTITUENTS WHERE RANGE TESTED NOT FINE ENOUGH TO COMPARE TO TARGET WATER QUALITY RANGE

NOTE: VALUES IN RED SHOW CONSTITUENTS WHERE RANGE TESTED HIGHER THAN THE TARGET WATER QUALITY RANGE

⁽¹⁾ & ⁽²⁾ The two columns represent the 90th Percentile obtained from the Resource Quality Services Directorate, Department of Water Affairs

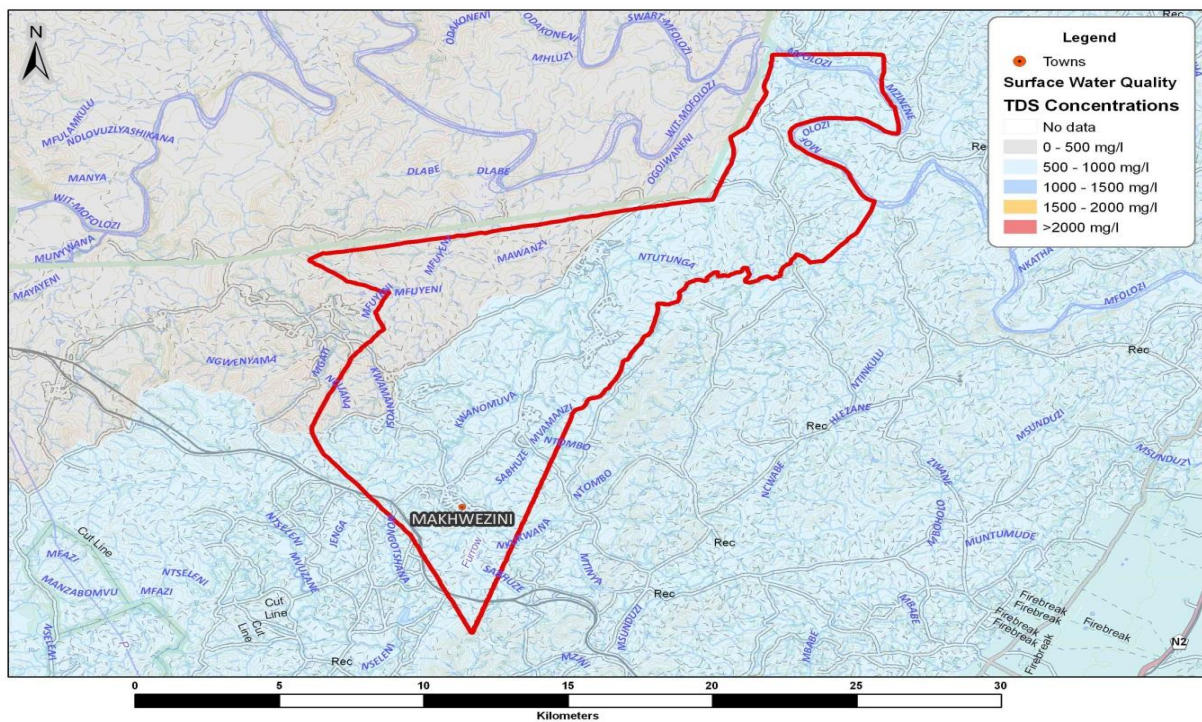


Figure 37: Surface Water Quality – TDS Concentrations as shown in WR90 Study

Erosion and sediment load

The Fuleni Anthracite Coal Project falls within a region that is at risk of very high local erosion as is shown in Figure 38. The data was extracted from WR90 study's base maps.

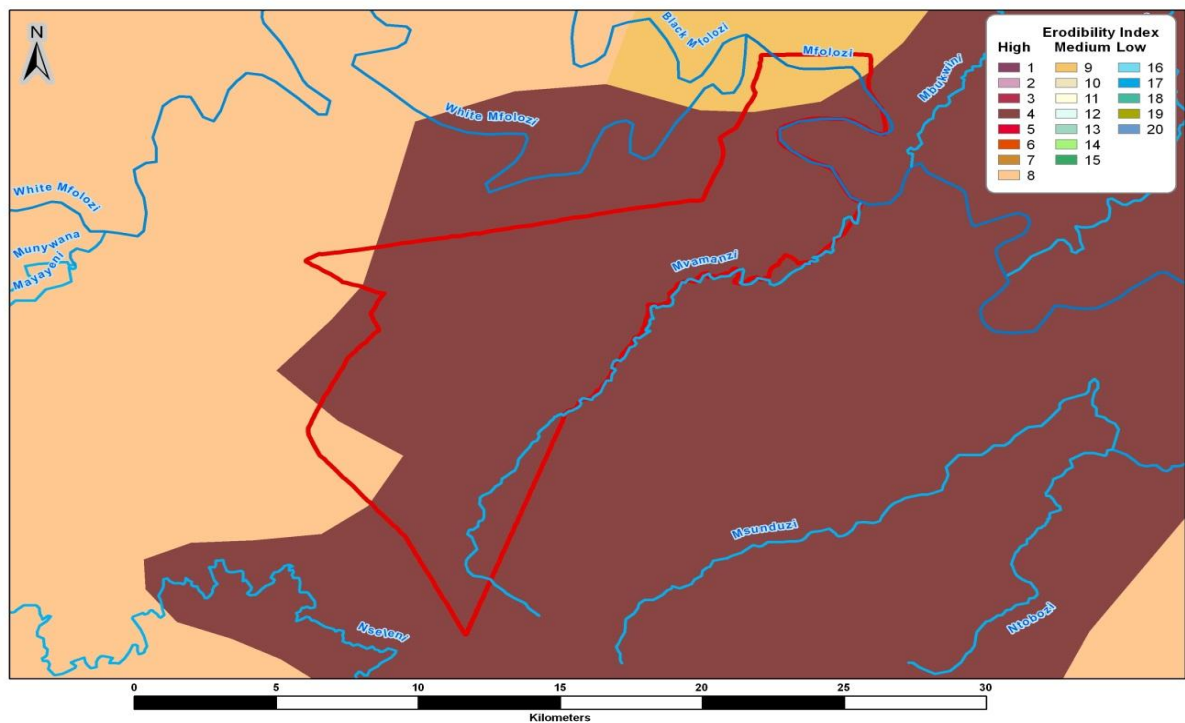


Figure 38: Erodibility of NOMRA area

3.3.6.5 Current Water Use and Sources

3.3.6.5.1 Mfolozi WMA

The Mfolozi River Basin is, after the Tugela River Basin, the second largest river basin in KwaZulu Natal. The total Secondary Catchment W2 catchment has a land area of 10 008 km² to the river's sea outlet. The Mfolozi River (also known as Umfolozi, uMfolozi or iMfolozi) consist of two main tributaries, the Black (Imfoloziemnyama) and White (Imfoloziemhlope) Mfolozi, both of which rise on the eastern escarpment of the Drakensberg Mountain range. The rivers flow eastward across the Zululand coastal plain and then converges to become the lower Mfolozi River that passes through the Mfolozi Flats before it reaches the Indian Ocean. The isiZulu name iMfolozi is generally considered to describe the zigzag course followed by both tributaries.

According to DWA's Internal Strategic Perspective, or ISP Report (DWA, 2004), the Mfolozi River catchment consists mostly of tribal land, with the main activity being cattle farming. There is a limited amount of afforestation in the catchment compared to the total area of the catchment (approximately 435 km²). This is situated mostly in the upper reaches of the catchment near Vryheid, in the vicinity of Nongoma, and near the coast.

There is a significant area under irrigation in the catchment, estimated at about 72 km², with 65 km² dryland sugarcane near the coast.

Table 29 summarizes land use data obtained from WR2005. The afforested area is similar to the ISP data, while the total irrigated area of some 16 km² is only about a quarter of the value given in the ISP document. This may be ascribed to the fact that most irrigation is opportunistic since its cultivation depends on the availability of run-of-river abstraction.

Note that in hydrological terms, alien vegetation is also deemed to be a "water user" and its use is considered in river flow and dam yield modeling.

Table 29: Land Use Data from WR2005

Tertiary Catchment	Forestry (km ²)	Alien Vegetation (km ²)	Irrigated Area (km ²)
W21	117	33.2	0.52
W22	103	19.1	15.28
W23	214	26.6	0
TOTAL	434	78.9	15.8

In terms of water-related infrastructure, the Mfolozi catchment is largely undeveloped and hence the source of water for most users in this catchment is run-of-river abstractions. The only large impoundment is the Klipfontein Dam in the White Mfolozi River downstream of Vryheid, about 200 km upstream of the Project Site. There is an allocation to irrigators downstream of the dam, but very little of this allocation is currently utilized, as is evident from recent satellite images.

A total of 18 million m³/a is transferred from the lower reach of the Mfolozi River to Richards Bay Minerals.

The ISP study found that the catchment as a whole is stressed and the water balance is – 19 million m³/a as shown in Table 30.

Table 30: Water Use and Provisional Water Balance

Water Resources (million m³ /a)								
Natural Resource		Usable Return Flow			Total Local Yield			
Surface Water	Ground Water	Irrigation	Urban	Mining and Bulk				
36	5	5	4	1	51			
Water Requirments/allocations (million m³ /a)								
Irrigation	Urban	Rural	Mining and Bulk	Afforestation	Total Local Need	Transfers Out	Grand Total	
23	12	11	4	2	52	18	70	
Reconciliation of allocation and available water (million m³ /a)								
Local Yield	Tranfers In	Total	Local Needs	Transfers Out	Total	Balance		
51	0	51	52	18	70	-19		

The status quo is however probably acceptable with water users having learned to cope with the situation. However, because the ecological Reserve is not currently being supplied, the stressed situation is reduced. Once the comprehensive Reserve is determined, operating rules will be formulated in order to ensure that it is met with the minimum reduction in allocations to existing lawful users and the minimum socio-economic impacts.

3.3.6.5.2 Local catchment in relation to NOMRA area

A major user of water in the catchment is the operational Somkhele Mine only 5 km across the Mfolozi River. They apparently source water from the Mfolozi River for use in the mine.

The larger settlements in the Fuleni area are served by reticulated water supply. The smaller, widely spread out homesteads may depend on groundwater or water obtained from other sources. Cattle are dependent on surface water. A number of small impoundments have been created which provides water to cattle.

Rudimentary sanitation facilities are provided at homesteads and evidence of faeces in stream beds was found.

3.3.6.6 Flood Peak Assessment

Figure 39 shows the major and minor drainage lines within the vicinity of the proposed project and also shows the general flow direction of the minor drainage system.

Since the NWA identifies a stream as a feature where water flows, albeit intermittently, all identifiable drainage lines are shown.

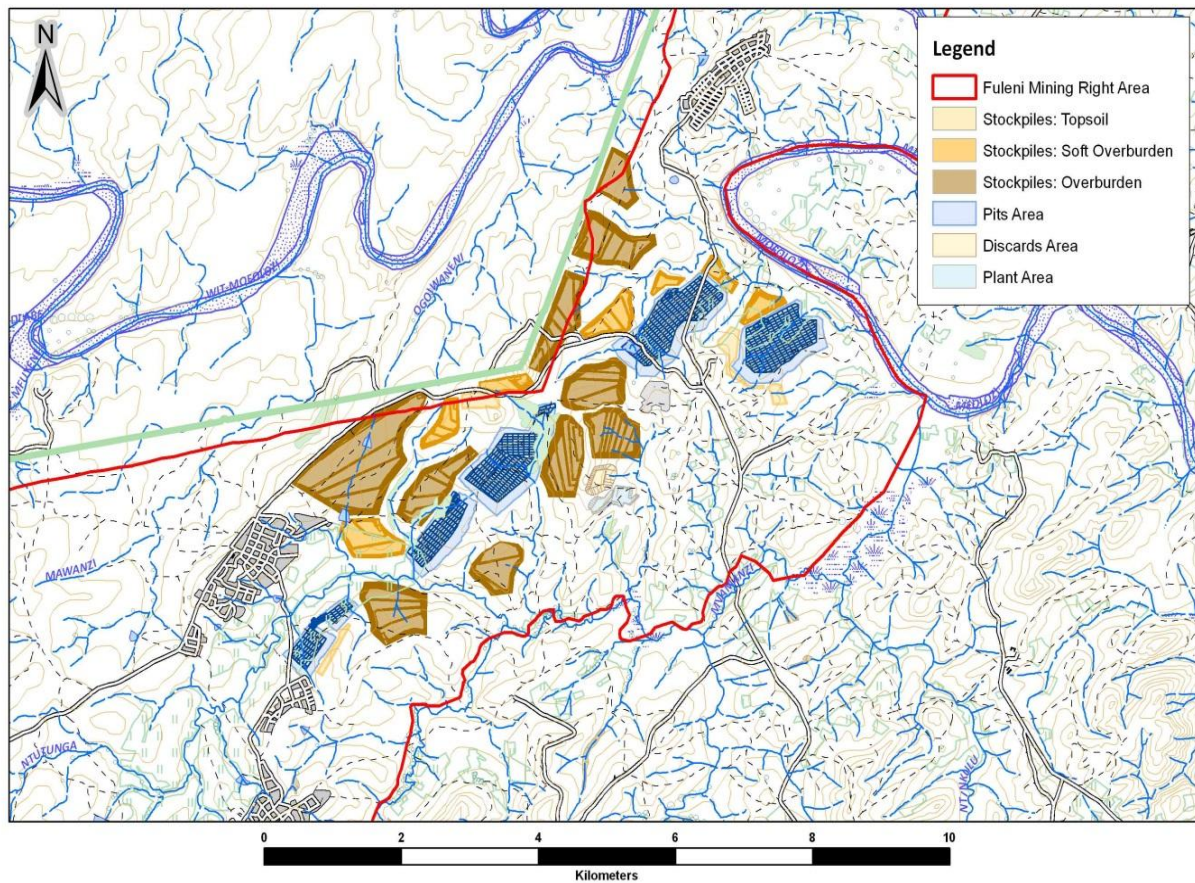


Figure 39: Major and Minor Drainage Lines

Hydraulic modeling of the Mfolozi River and its tributaries was performed by means of the HEC-RAS program. A Manning roughness coefficient of 0,045 was used for the main river channel. The associated 1:100-year flood levels are shown on Figure 40 and Figure 41.

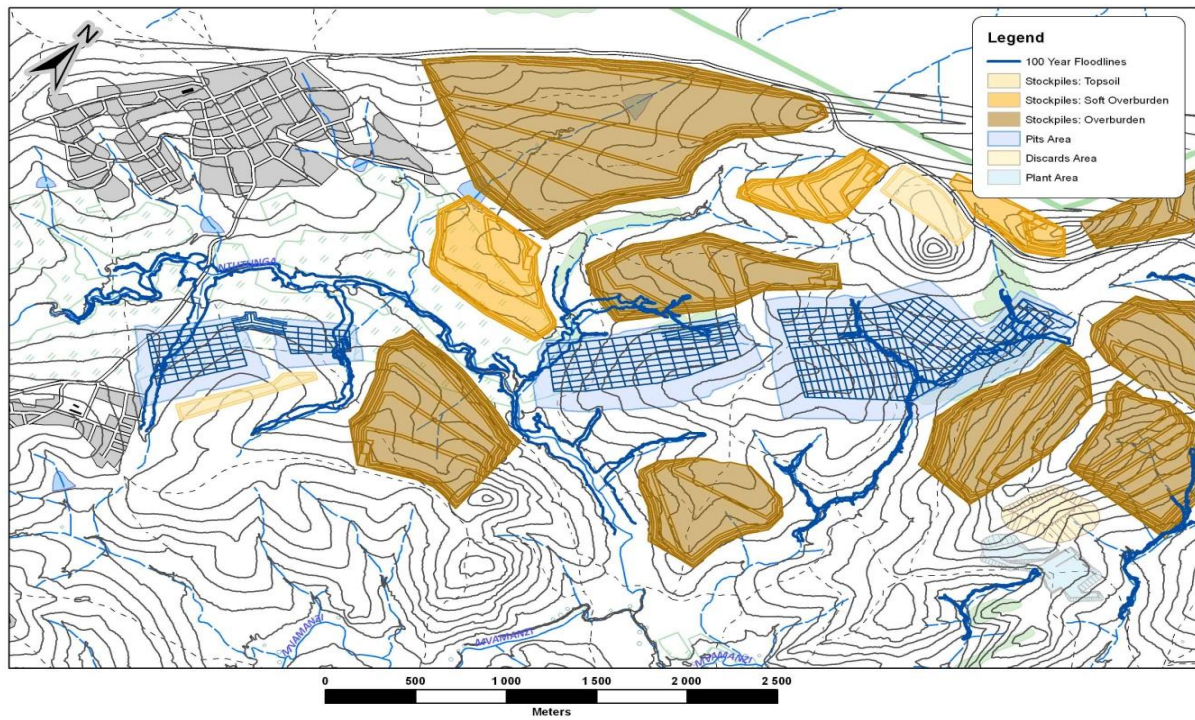


Figure 40: Flood-lines in the western section of the mining area

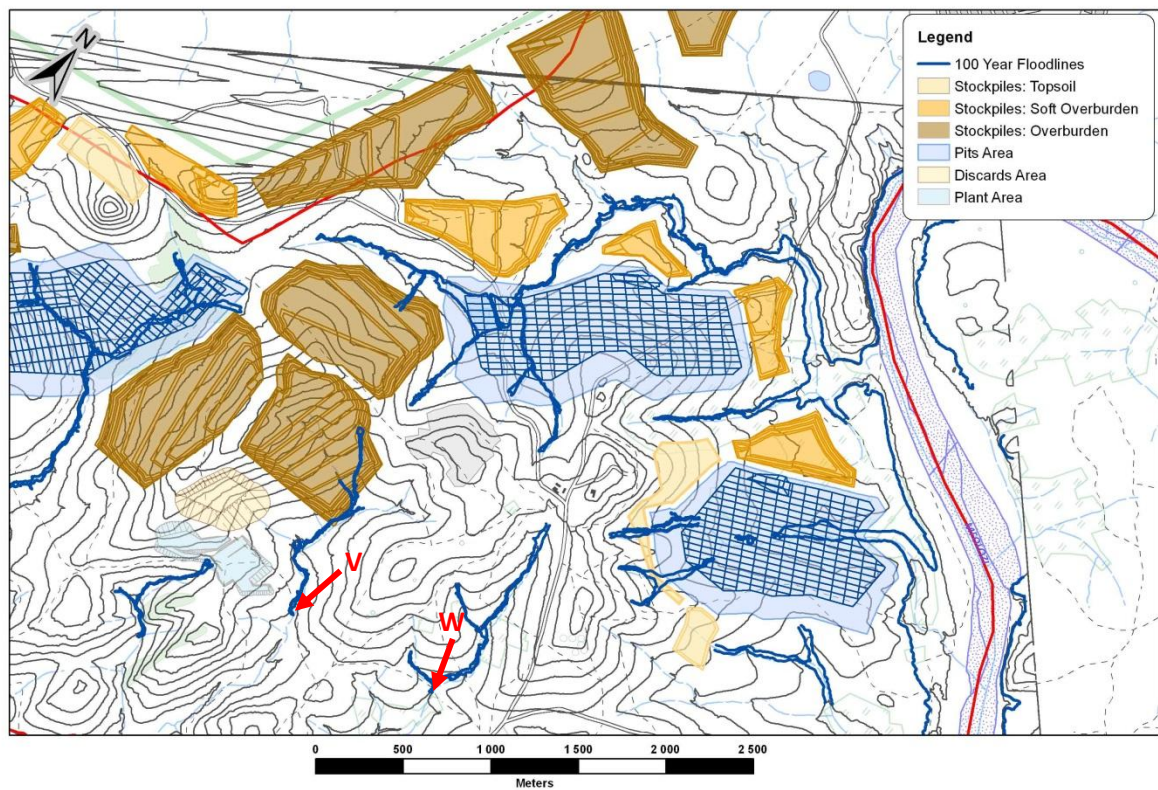


Figure 41: Flood-lines in the eastern section of the mining area

3.3.7 GROUNDWATER

3.3.7.1 Hydrocensus

A hydrocensus survey was conducted by Aquatico in May 2013. A total of 52 localities were recorded of which 3 are taps providing groundwater for drinking water purposes. The remainder of the localities recorded is exploration boreholes drilled by the mine.

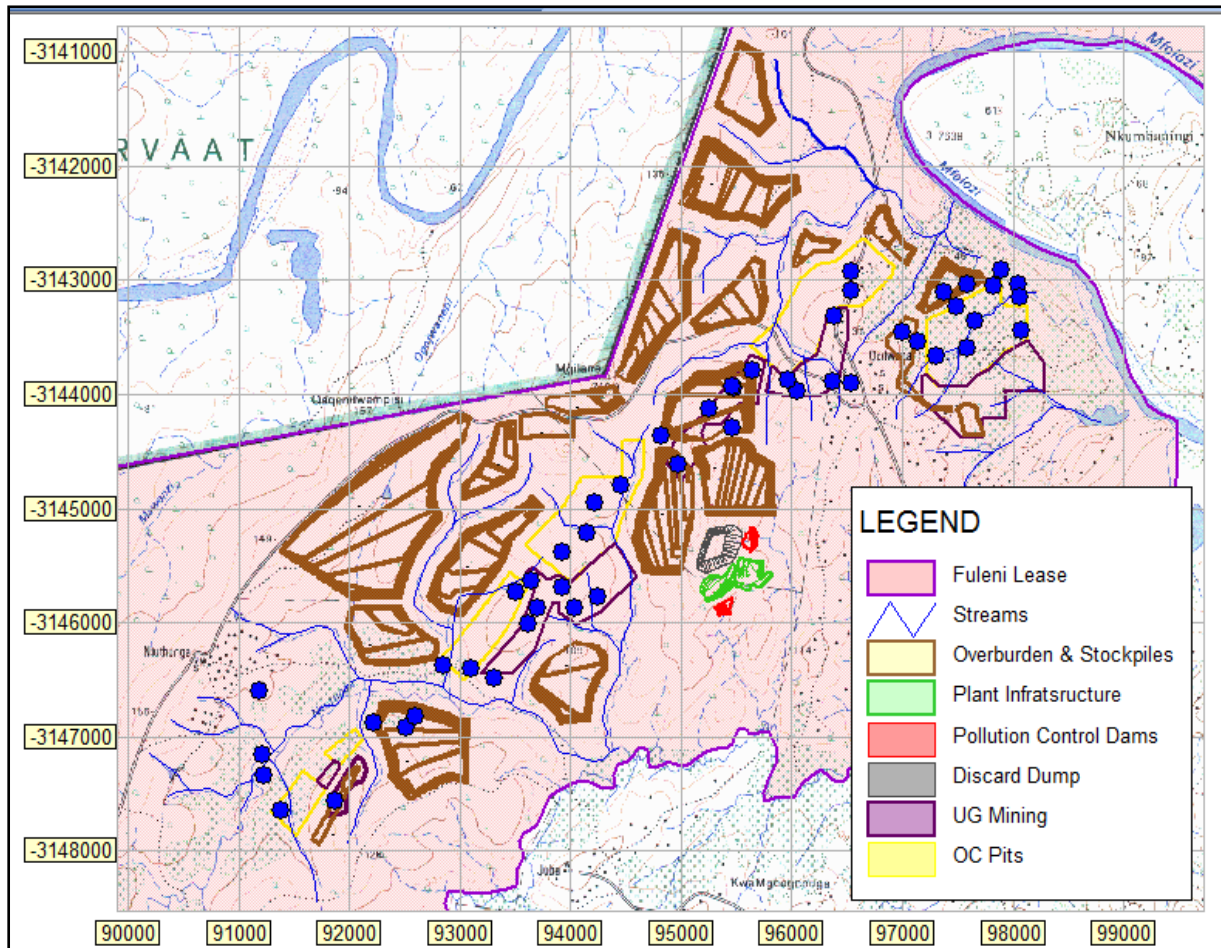


Figure 42: Boreholes localities of the hydrocensus survey conducted in the proposed Fuleni area

The potential radius of influence on the groundwater regime around a coal mine in Karoo sediments is usually accepted as 1 km. This is subjective, because the radius of influence depends strongly on geological structures such as faults and dykes (preferred groundwater flow paths), groundwater gradients, nearby mining operations and the presence of other groundwater production boreholes or dewatering from mining in the area.

Experience from other coal mines in similar Karoo-type aquifer conditions has, however, indicated that the influences of open pit and underground coal mining activities on the regional groundwater level are usually not very extensive and usually limited to as little as 0.5 km.

Different types of groundwater information were obtained for a total of 52 points during a groundwater user survey and hydrocensus (May 2013) conducted in the Fuleni area. No yields of the recorded boreholes were noted. Yields of newly monitoring boreholes will be determined with the aid of pump tests.

No springs were recorded during the hydrocensus in the proposed Fuleni mining project area. Springs in a semi-confined or confined fractured rock aquifer usually occur where structural discontinuities in the aquifer bisect the confining layer/material and a fracture or fracture system reaches the surface. For a spring to occur, the water level or piezometric head at that point in the aquifer must be higher than the land surface.

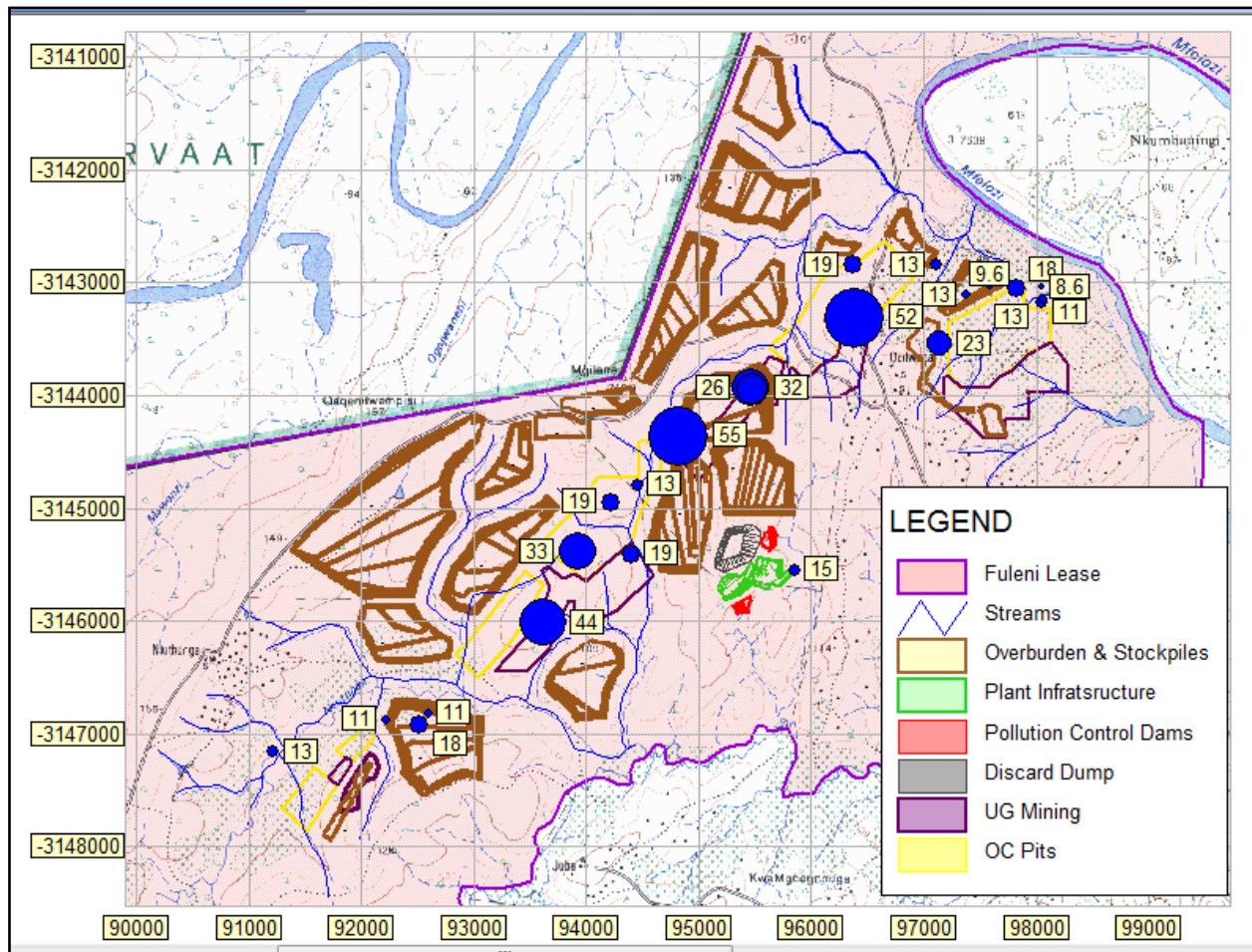
Although the natural trend for the groundwater level or piezometric head is to follow the surface topography, the water level is the closest to surface in the topographically low-lying areas. For this reason, springs will mostly occur in these areas, or at least on the slopes of hills. In perched and confined aquifers however, groundwater or piezometric levels may also be high in topographical higher lying areas with subsequent spring formation.

3.3.7.2 Groundwater Flow Evaluation

3.3.7.2.1 Depth to water level

Groundwater levels in the Fuleni area were measured during the hydrocensus survey and in the new monitoring boreholes. Water level depths for the mining area are shown as a thematic map in Figure 43. Water levels recorded during the hydrocensus and in the new monitoring boreholes vary between 8 and 55 mbs.

The groundwater levels measured during the hydrocensus survey and in new monitoring boreholes will be used as calibration points for the numerical groundwater model to verify the conceptual model and construction thereof.



3.3.7.2.2 Flow gradients

Contours of the static water level or piezometric heads in and around the Fuleni mining area have been shown in Figure 44. Path lines or flow lines of groundwater particles are lines perpendicular to the contours. Flow occurs faster where contours are closer together and gradients are thus steeper.

On the relatively steeper sloping hillocks where groundwater gradients are higher, groundwater seepage rates are correspondingly higher. Seepage rates on the other hand are much lower in the valley bottoms and flat-lying areas.

Average groundwater gradients were calculated from the water level elevation data. The average gradient in the proposed Fuleni mining area varies between 3 and 5%.

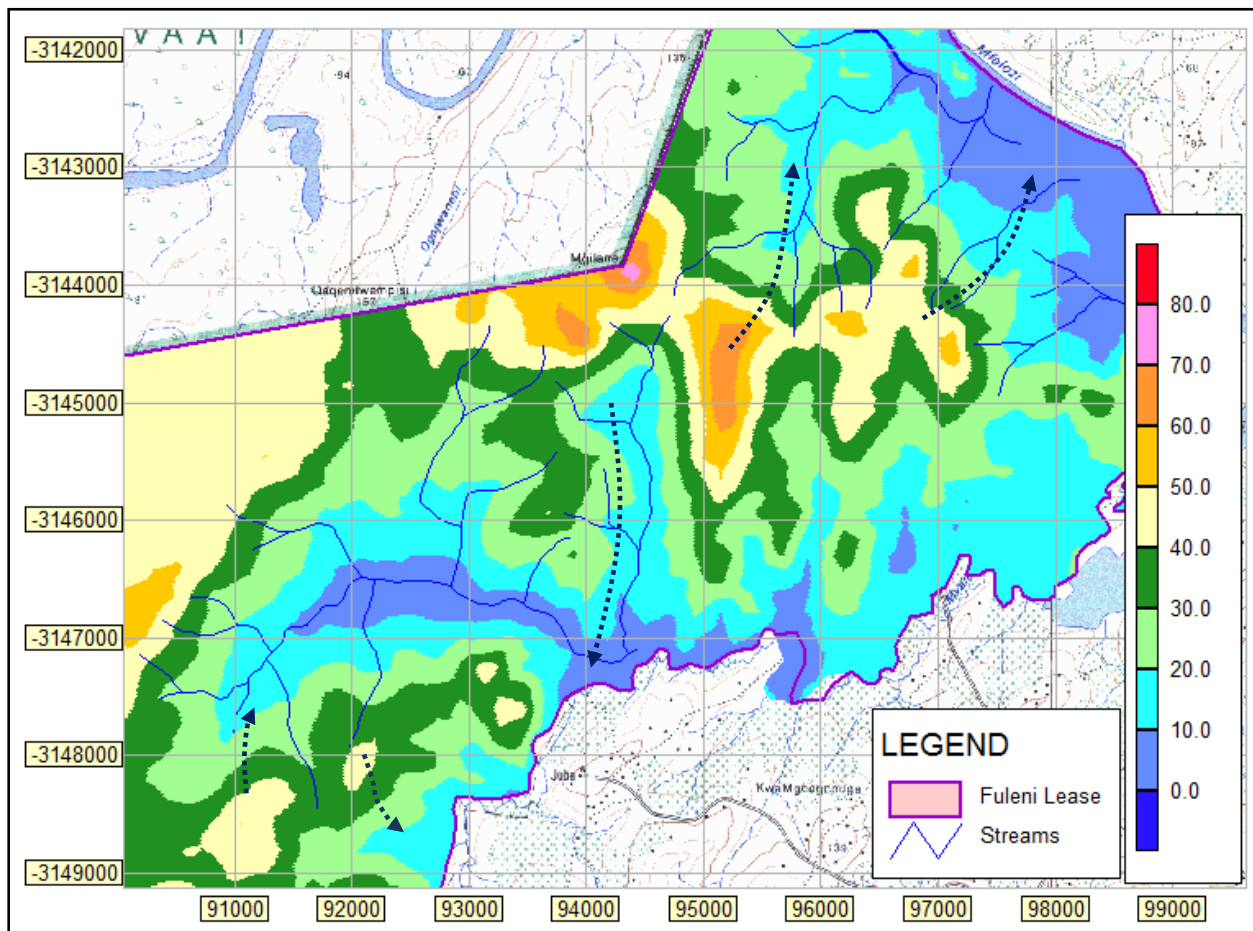


Figure 44: Bayesian water levels in the Fuleni mining area

3.3.7.2.3 Aquifer types and yield

All aquifer characteristics like water strikes and pump test information from the new monitoring boreholes will be used in this investigation.

3.3.7.2.4 Aquifer transmissivity and storativity

Pump tests were performed on the new monitoring boreholes. The pump tests had the main aim of determining the transmissivity and storage characteristics of the solid geological formation – the so-called aquifer matrix. These pump tests are performed instead of the more commonly used slug tests because of the much improved accuracy obtained with the pump tests, resulting in much more reliable aquifer parameters calculated from the tests.

Aquifer transmissivity is defined as a measure of the amount of water that could be transmitted horizontally through a unit width of aquifer by the full-saturated thickness of the aquifer under a hydraulic gradient of 1. Transmissivity is the product of the aquifer thickness and the hydraulic conductivity of the aquifer, usually expressed as m^2/day ($\text{Length}^2/\text{Time}$).

Storativity (or the storage coefficient) is the volume of water that a permeable unit will absorb or expel from storage per unit surface area per unit change in piezometric head. Storativity (a dimensionless quantity) cannot be measured with a high degree of accuracy in slug tests or even in conventional pumping tests. It has been calculated by numerous different methods with the results published widely and a value of 0.002 to 0.01 is taken as representative for the Karoo Supergroup sediments.

Aquifer parameters will be determined from pump tests conducted in monitoring boreholes drilled specifically for the project and the results will be included in the final specialist report to the EIA/EMP.

3.3.7.2.5 Aquifer recharge and discharge rates

Effective recharge in the project area is estimated between 1 and 3% of MAP. Based on this estimate and distribution of rock types, the average recharge (1.5%) to the entire Fuleni mine lease area (MAP = 1200 mm) is approximately 7190 m³/d (2 625 000 m³/y).

3.3.7.2.6 Direction and rate of groundwater movement in potentially impacted areas

The pre-mining groundwater contours have been presented in Figure 44. These contours represent steady state conditions without impacts from sources or actions other than natural conditions like rivers, natural spring discharges, pans or wetland recharge areas.

A large number of manmade actions could impact on the groundwater regime; including the aquifer structure, flow paths and directions, storage, discharges and recharge. Possible impacts relevant to the proposed project will be discussed briefly:

3.3.7.2.7 Aquifer structure, flow paths and directions

During active mining and thereafter, the voids created by mining (opencast and underground) will impact on the natural groundwater movement. Mine voids destroy the in situ aquifer structures and could be compared to areas of very high (even infinitely high) transmissivity and also high storativity. Because groundwater will follow the route of least resistance, groundwater will prefer to move through the mined-out areas. Even after the mine has been closed and the mine voids have been backfilled, the transmissivity and storativity remain higher than the pre-mining natural aquifer(s).

Because the Karoo rocks where mining will take place have relatively low transmissivity values, impacts on the natural flow pattern in the Fuleni region are expected to be only noticeable in the immediate vicinity of the operations. The extent of the impact depends mostly on the transmissivity of the in situ aquifer material. Karoo type formations in the coal mining environment generally do not have very high in situ transmissivities, but this will be confirmed from the pump test results.

3.3.7.2.8 Aquifer discharge

A mining and processing operation may impact significantly on the discharge of an aquifer in different ways. If mining occurs and mine dewatering is required, the natural aquifer discharge will decrease by the volume of groundwater removed by dewatering.

Aquifer discharge may also increase with the use of return water dam, slurry and other dams through leakage of water to the subsurface, especially if water is imported to the project from other sources. Other factors that may decrease the aquifer discharge are compacted surfaces, haul roads and concrete surfaces that prevent infiltration to the aquifer and decrease groundwater discharge, although increasing surface runoff.

After mine closure, however, recharge will be higher to the area and after the mine has filled up, the discharge to surface will also be higher than before the disruption by mining.

3.3.7.2.9 Aquifer recharge

All the aspects mentioned under aquifer discharge apply to aquifer recharge. Opencast and bord-and-pillar mining usually causes an increase in aquifer recharge percentage

3.3.7.3 Groundwater Quality Evaluation

3.3.7.3.1 Hydrocensus boreholes

During the hydrocensus several groundwater samples were taken for quality analysis. Fourteen localities were selected to be analysed. These localities were selected to give a good distribution of points over the proposed mining area. A map showing the distribution of the hydrocensus borehole positions where groundwater quality information is available is presented in Figure 45.

The groundwater quality data of the hydrocensus points was interpreted with the aid of diagnostic chemical diagrams and by comparing the inorganic concentrations with the South African Drinking Water Guidelines for Domestic Use.

The first step in the water quality interpretation was to classify the groundwater quality. The classification was based on the following:

- the spatial distribution of the monitoring points, and
- the proximity of the monitoring points to certain known pollution sources that are expected to impact on the groundwater and / or surface water in the downstream flow direction.

The four main factors usually influencing groundwater quality are:

- annual recharge to the groundwater system;
- type of bedrock where ion exchange may impact on the hydrogeochemistry;
- flow dynamics within the aquifer(s), determining the water age; and
- source(s) of pollution with their associated leachates or contaminant streams.

Where no specific source of groundwater pollution is present upstream of the borehole, only the other three factors play a role.

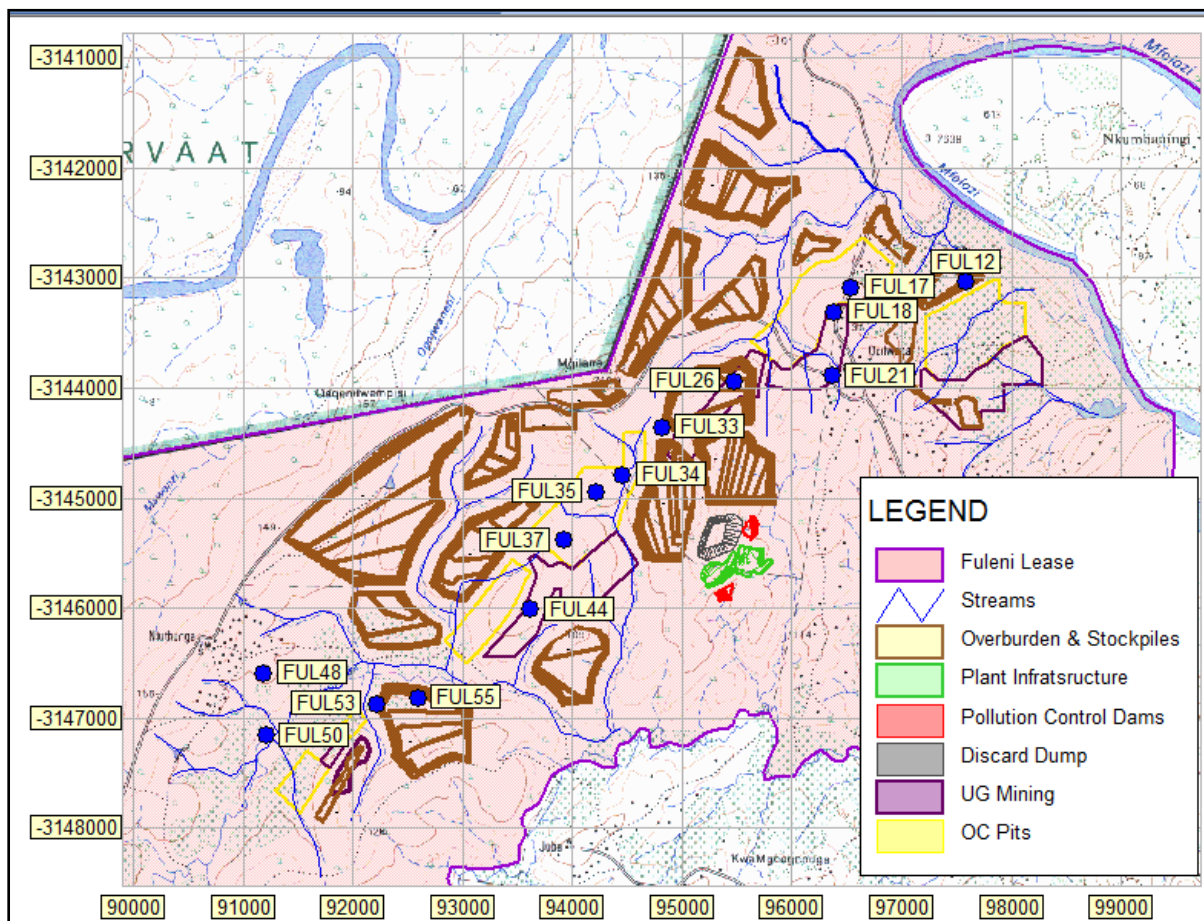


Figure 45: Distribution of hydrocensus localities with water quality information

Water qualities are compared to the SANS241:2011 standards for drinking water.

SANS 241:2011			
Chemical Parameter	Class 0	Class 1	Class 2
	Ideal	Recommended	Maximum
mg/l			
Aluminium	0 - 0.3	0.3 - 0.5	> 0.5
Calcium	No Guide	No Guide	No Guide
Chloride	0 - 300	300 - 600	> 600
Fluoride	0 - 1.5	0 - 1.5	> 1.5
Iron	2	2	> 2
Magnesium	No Guide	No Guide	No Guide
Manganese	0 - 0.5	0.5 - 1	> 1
Nitrate	0 - 11	11 - 20	> 20
pH	5 - 9.7	9.7 - 10	< 5, > 10
Potassium	No Guide	No Guide	No Guide
Sodium	0 - 200	200 - 400	> 400
Sulphate	0 - 500	500 - 600	> 600
TDS	0 - 1200	1200 - 2400	> 2400

Table 31: Groundwater qualities in the hydrocensus boreholes compared to drinking water standards (SANS241:2011)

	FUL03	FUL04	FUL09	FUL12	FUL17	FUL18	FUL21	FUL26	FUL33	FUL34	FUL35	FUL37	FUL44	FUL48	FUL50	FUL53	FUL55
Aluminium	0.017	<0.003	<0.003	0.028	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.81	0.012	<0.003	<0.003	<0.003	0.825	<0.003
Calcium	24	112	80.1	3.93	24.7	8	25.9	20.4	46.6	12.8	2.19	152	43.4	25.5	23.2	21.3	34.7
Chloride	158	222	504	204	84.1	340	83.9	207	170	38.6	50.2	2846	434	84.6	2855	186	1387
Fluoride	1.81	0.546	0.728	0.952	0.455	1.89	0.486	0.952	0.444	0.489	0.998	1.55	0.389	0.474	1.06	2.53	4.06
Iron	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	2.08	0.139	<0.003	<0.003	<0.003	<0.003	9.81	<0.003
Magnesium	12.9	120	171	1.06	24.6	0.247	26.2	16.5	28.6	11.8	2.11	129	10.8	25.7	119	23.5	14.7
Manganese	0.007	0.012	0.363	<0.001	<0.001	<0.001	<0.001	<0.001	0.103	0.153	<0.001	0.429	<0.001	<0.001	<0.001	0.437	<0.001
Nitrate	0.418	9.22	1.35	0.188	0.185	0.134	0.182	0.477	0.154	0.117	8	0.269	0.613	0.183	0.444	0.091	0.144
pH	7.6	7.42	7.39	9.3	8.23	8.8	8.18	8.32	7.62	8.05	10	8.18	7.56	8.19	8.91	6.87	8.06
Potassium	3	2.29	3.51	9.31	5.25	2.18	5.66	3.52	4.62	4.92	13.2	17.7	2.62	4.87	12.1	8.43	8.08
Sodium	136	114	309	131	73.5	307	74	277	238	70.3	110	1620	326	82.7	1894	257	920
Sulphate	6.54	72.5	73.5	0.358	25.4	237	24.7	46.8	10.1	<0.04	7.55	48.8	121	24.4	202	<0.04	<0.04
TDS	476	959	1696	380	345	916	343	817	798	290	338	5305	1021	356	5466	809	2547

Groundwater qualities measured in the hydrocensus boreholes are not of good quality and the chemical elements often exceed ideal and maximum permissible limits for drinking water.

The TDS is a measure of inorganic salts dissolved in the water. At high concentrations the overall salinity can have adverse health effects on the groundwater users if used for drinking water. Elevated TDS concentrations are observed especially in the boreholes to the south of the proposed mining area. The ideal limits for drinking water were exceeded in one borehole and the maximum permissible exceeded in 3 boreholes. The measured TDS concentrations varied from 290 to 5470 mg/l.

Groundwater pH under natural conditions is affected by the geology and geochemistry of the host rocks. At very low pH levels dissolved toxic metal ions are present which can lead to severe health problems if consumed. At low pH levels (less than ± 4.5) the water will have a sourly taste. At high pH levels there is a health hazard due to the de-protonated species. Water which has a high pH will have a soapy taste. The pH in the hydrocensus boreholes varies from 6.87 to 10. Overall basic pH conditions exist in the Fuleni area. The pH value in FUL35 is on the boundary between ideal and maximum permissible limits.

Calcium and magnesium are usually coexisting cations in natural groundwater. These two elements are the main cations responsible for the hardness in water when bound with the bicarbonate anion. The major effect of high concentrations is scaling problems in especially heating appliances. These two elements will have no or little effect in terms of health on the consumer. Magnesium can lead to diarrhea in some users. For the SANS241:2011 standards no guides are provided for the magnesium and calcium concentrations, but these two elements will however be discussed in this report. The magnesium and calcium concentrations in all of the boreholes are low. No guide for magnesium exists in the SANS241:2011 drinking water guidelines.

Sodium is an alkali metal and when reacting with water it forms highly soluble, positively charged sodium ions. At high concentrations the water will have a salty taste and can lead to the disturbance of the electrolyte balance in the human body. Sodium concentrations in the hydrocensus boreholes are high, exceeding ideal limits for drinking water in 6 boreholes and the maximum permissible limits in 3 boreholes. The sodium concentration in the hydrocensus boreholes varies from 70 to 1895 mg/l.

The main effects of aluminium are aesthetic and currently no adverse impacts on health have been confirmed. The maximum permissible limits for aluminium in drinking water have been exceeded in 2 boreholes.

Chloride concentration at high concentration will give a very salty taste to the water. Nausea and disturbance of the electrolyte balance can occur which can eventually lead to dehydration. The chloride concentration exceeds ideal limits for drinking water in 3 boreholes and maximum permissible limits also in 3 boreholes. Chloride concentrations vary from 50 to 2855 mg/l.

Fluoride at high concentrations can cause severe tooth damage and even skeletal fluorosis. Fluoride concentrations exceed maximum permissible limits for drinking water in 5 of the hydrocensus boreholes. The fluoride concentrations vary from 0.38 to 4.1 mg/l.

Elevated iron concentration mostly has aesthetic impacts but can also at very high concentrations have an effect on the health of users. The maximum permissible limits for iron concentrations in terms of drinking water have been exceeded in 2 of the hydrocensus boreholes.

It should be noted that the water quality of the drinking water (FUL17, FUL21 and FUL48) is good with all chemical parameters within ideal limits for drinking water.

One of the most appropriate ways to interpret the type of water at a sampling point is to assess the plot position of the water quality on different analytical diagrams like a Piper, expanded Durov and Stiff diagrams. Of these three types, the expanded Durov Diagram probably gives the most holistic water quality signature.

The characteristics of the different fields will be discussed briefly:

- Field 1: Fresh, very clean recently recharged groundwater with HCO_3^- and CO_3^{2-} dominated ions.
- Field 2: Field 2 represents fresh, clean, relatively young groundwater that has started to undergo Mg ion exchange, often found in dolomitic terrain.
- Field 3: This field indicates fresh, clean, relatively young groundwater that has undergone Na ion exchange (sometimes in Na-enriched granites or other felsic rocks) or because of contamination effects from a source rich in Na.
- Field 4: Fresh, recently recharged groundwater with HCO_3^- and CO_3^{2-} dominated ions that has been in contact with a source of SO_4 contamination or that has moved through SO_4 enriched bedrock.
- Field 5: Groundwater that is usually a mix of different types – either clean water from fields 1 and 2 that has undergone SO_4 and NaCl mixing/contamination or old stagnant NaCl dominated water that has mixed with clean water.
- Field 6: Groundwater from field 5 that has been contact with a source rich in Na or old stagnant NaCl dominated water that resides in Na rich host rock/material.
- Field 7: Water rarely plots in this field that indicates NO_3 or Cl enrichment or dissolution.
- Field 8: Groundwater that is usually a mix of different types – either clean water from fields 1 and 2 that has undergone SO_4 , but especially Cl mixing/contamination or old stagnant NaCl dominated water that has mixed with water richer in Mg.
- Field 9: Old or stagnant water that has reached the end of the geohydrological cycle (deserts, salty pans etc) or water that has moved a long time and/or distance through the aquifer or on surface and has undergone significant ion exchange because of the long distance or residence time in the aquifer.

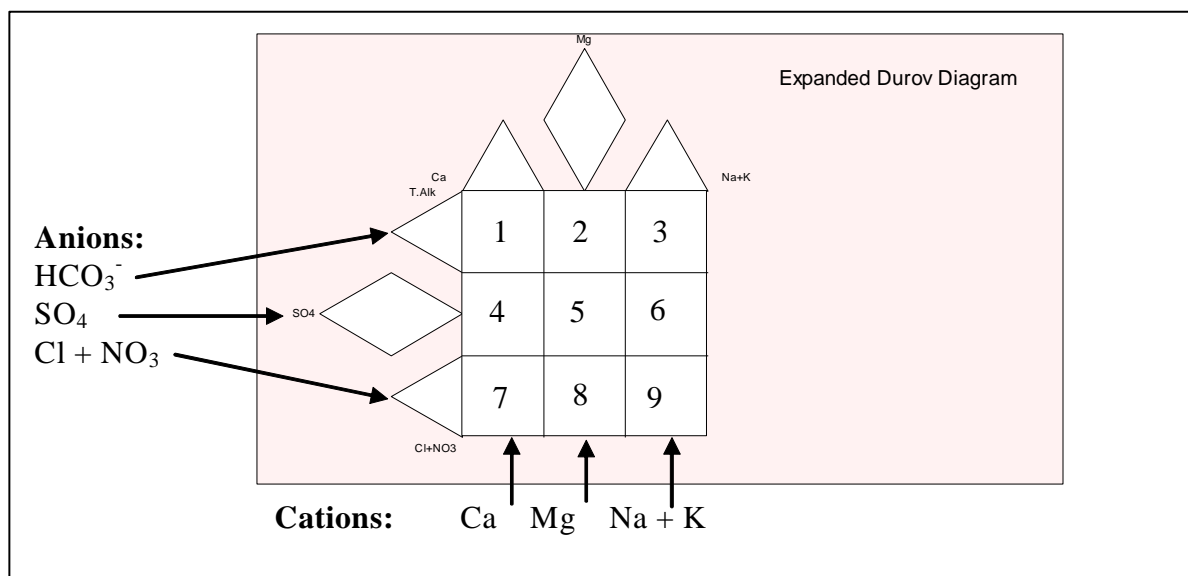


Figure 46: Layout of the fields in the expanded Durov

Another way of presenting the signature or water type distribution in an area is by means of Stiff diagrams. These diagrams plot the equivalent concentrations of the major cations and anions on a horizontal scale on opposite sides of a vertical axis. The plot point on each parameter is linked to the adjacent one resulting in a polygon around the cation and anion axes. The result is a small figure/diagram of which the geometry typifies the groundwater composition at the point. Groundwater with similar major ion ratios will show the same geometry. Ambient groundwater qualities in the same aquifer type and water polluted by the same source will for example display similar geometries.

The expanded Durov diagram and stiff diagrams indicates a very prominent domination of sodium on the cation side. The anion side is dominated by bi-carbonate alkalinity or chloride (Figure 47 and Figure 48).

In summary:

- Groundwater in the hydrocensus boreholes does not display good qualities;
- Several chemical parameters exceed the ideal and maximum permissible limits for drinking water;
- The groundwater used for drinking water purposes does however display good qualities and is suitable for human consumption; and
- The stiff and expanded Durov diagrams indicate clear domination of sodium cations and either bi-carbonate alkalinity or chloride anion domination.

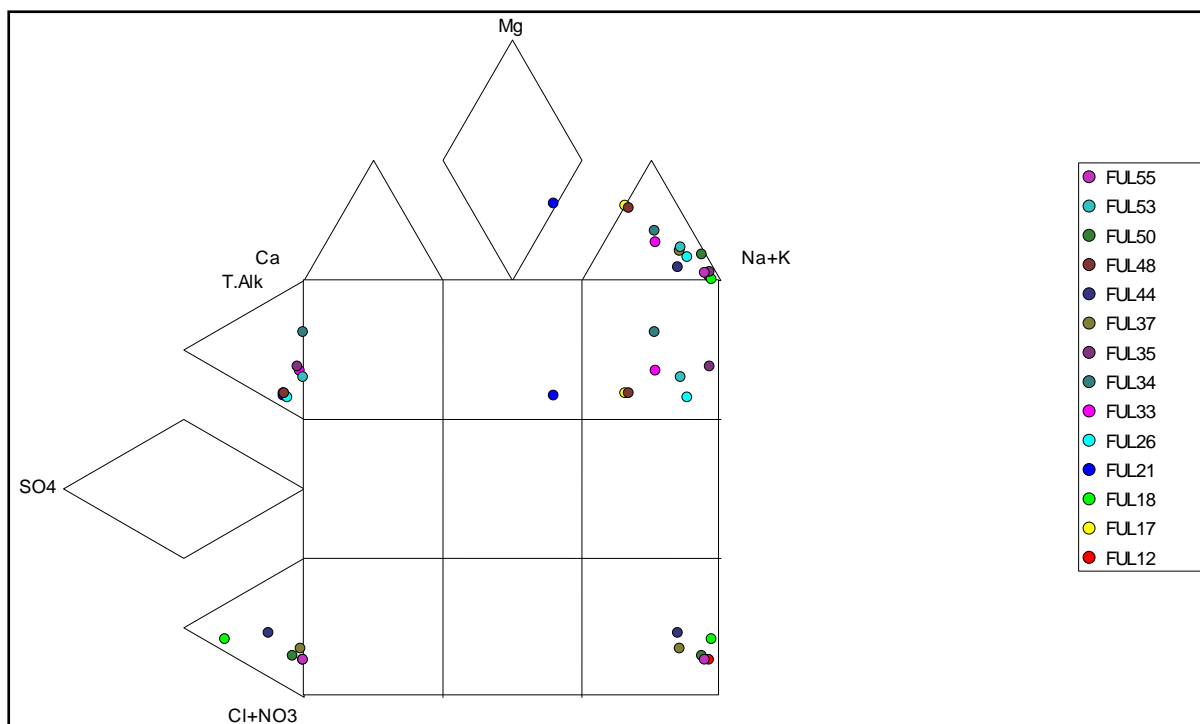


Figure 47: Expanded Durov diagram of hydrocensus groundwater qualities

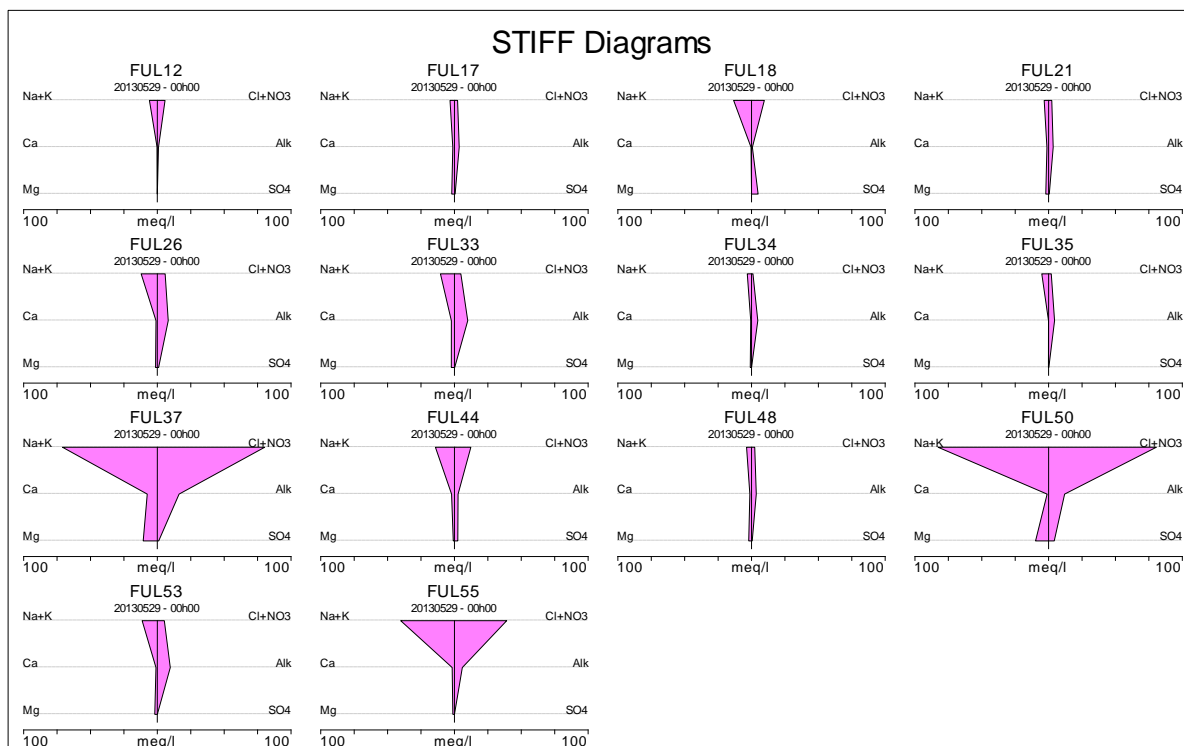


Figure 48: Stiff diagrams of hydrocensus groundwater qualities

3.3.7.3.2 New monitoring boreholes

Eight new monitoring boreholes were drilled within the proposed Fuleni project area. All eight of these boreholes have been sampled and analysed. A map indicating the distribution of the new monitoring boreholes, where groundwater quality information is available, is presented in Figure 49.

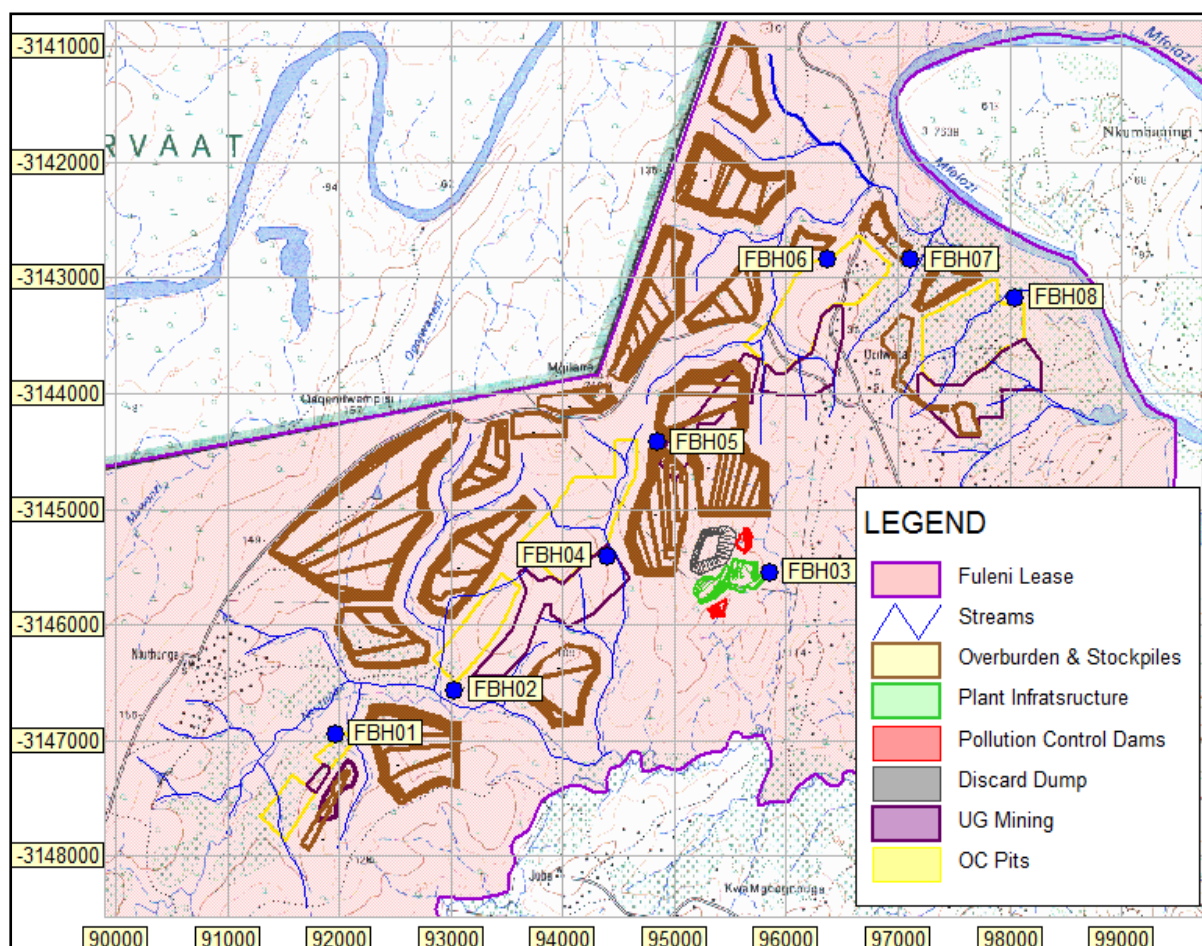


Figure 49: Position of new monitoring boreholes

Once again the groundwater quality data of the monitoring points was interpreted with the aid of diagnostic chemical diagrams and by comparing the inorganic concentrations with the South African Drinking Water Guidelines for Domestic Use.

Table 32: Groundwater qualities in the new monitoring boreholes compared to drinking water standards

	FBH03	FBH06	FBH08	FBH04	FBH05	FBH02	FBH01	FBH07
Aluminium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Calcium	56.4	125	106	121	134	86.7	267	39.3
Chloride	360	683	692	739	700	1682	5713	201
Fluoride	3.5	0.524	0.694	0.555	0.433	3.06	0.773	0.836
Iron	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Magnesium	47.8	91.2	242	107	104	59.5	495	53
Manganese	<0.001	0.246	0.051	0.617	0.781	0.016	<0.001	0.006
Nitrate	0.359	0.302	4.26	0.468	0.406	0.252	0.188	14.3
pH	7.6	7.29	7.42	7.29	7.37	7.61	7.24	7.4
Potassium	2.18	8.65	2.83	10.7	16.7	6.91	21	1.48
Sodium	387	607	438	612	558	1173	2498	283
Sulphate	37.8	8.84	118	140	155	2.2	312	80.5
TDS	1345	2051	2168	2172	2083	3261	9661	1089

Groundwater qualities measured in the new monitoring boreholes are of poor quality and the chemical elements often exceed ideal and maximum permissible limits for drinking water.

Elevated TDS concentrations are observed in all the boreholes. The ideal limits for drinking water were exceeded in five boreholes and the maximum permissible exceeded in 2 boreholes. The measured TDS concentrations varied from 1089 to a very high 9661 mg/l.

The pH in the monitoring boreholes varies from 7.24 to 7.6. Overall near neutral pH conditions exist in the Fuleni area. All pH levels are within ideal limits for drinking water.

The magnesium and calcium concentrations in all of the boreholes are low. No guide for magnesium exists in the SANS241:2011 drinking water guidelines.

Sodium concentrations in the monitoring boreholes are high, exceeding ideal limits for drinking water in 2 boreholes and the maximum permissible limits in the other 6 boreholes. The sodium concentration in the monitoring boreholes varies from 280 to 2500 mg/l.

The chloride concentration in the monitoring boreholes is once again elevated. The chloride concentration exceeds ideal limits for drinking water in FBH03 and maximum permissible limits also in 6 of the other monitoring boreholes. Chloride concentrations vary from 200 to 5713 mg/l.

Fluoride concentrations exceed maximum permissible limits for drinking water in FBH03 and FBH02. The fluoride concentrations vary from 0.43 to 3.5 mg/l.

The expanded Durov diagram and stiff diagrams indicates a very prominent domination of sodium on the cation side. The anion side is dominated by bi-carbonate alkalinity or chloride (Figure 50 and Figure 51).

In summary:

- Groundwater in the monitoring boreholes does not display good qualities;
- Several chemical parameters exceed the ideal and maximum permissible limits for drinking water and;
- The stiff and expanded Durov diagrams indicate clear domination of sodium cations and either bi-carbonate alkalinity or chloride anion domination.

Although the groundwater qualities are very poor, they represent natural qualities and not qualities affected by contamination sources.

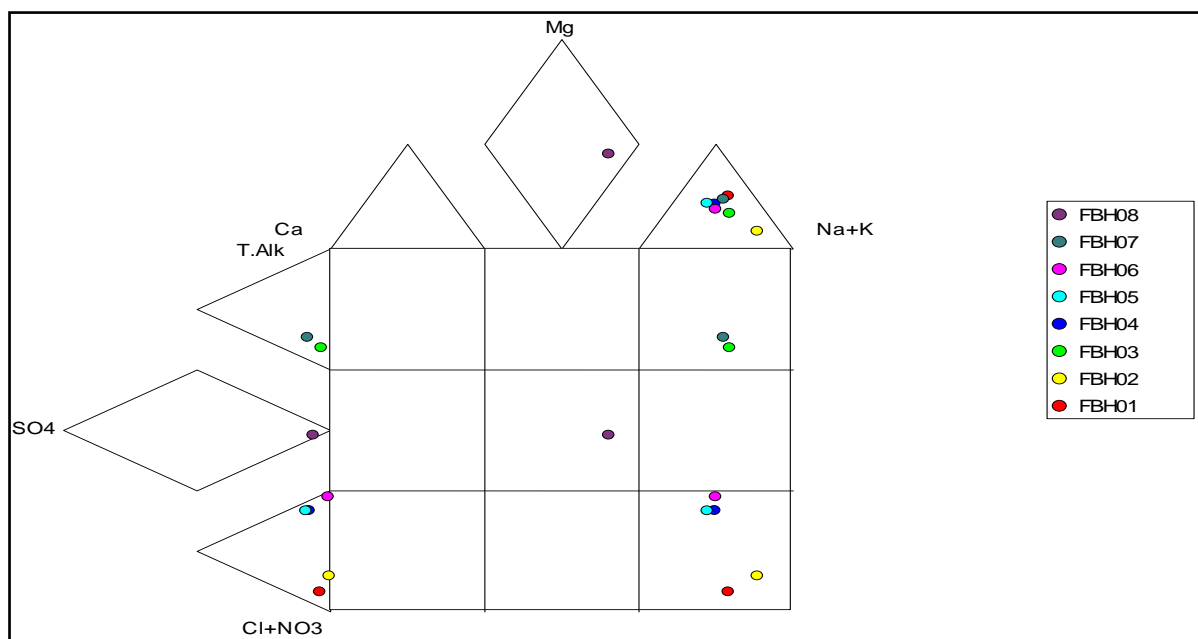


Figure 50: Expanded Durov diagram of monitoring boreholes groundwater qualities

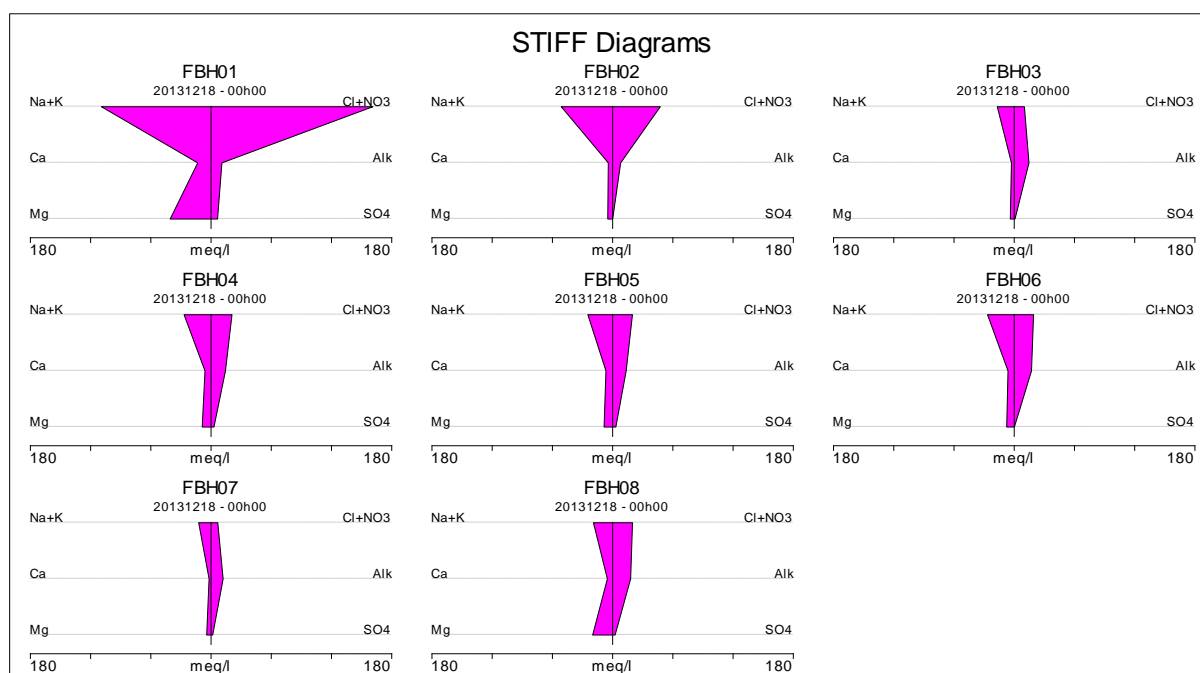


Figure 51: Stiff diagrams of monitoring boreholes groundwater qualities

3.3.8 AIR QUALITY

3.3.8.1 Baseline Air Quality

The Fuleni Project is located in rural areas where the population density is very low. There are no large industries or activities in the surrounding region, except for the Somkhele Mine located 10km to the north-east of the beneficiation plant area. The vegetation in the mining rights area of CoAL is located within the coast-hinterland bushveld, consisting out of grasslands and bushveld. The site is also closely related to the Natal Lowveld.

Based on the site visit and 1:50 000 topographical map the following sources of air pollution have been identified:

- Agricultural activities;
- Vehicle entrainment and exhaust gas emissions;
- Domestic fuel burning;
- Fugitive emissions from mining operations; and
- Veld Fires.

A qualitative discussion on each of these source types is provided in the subsections which follow.

3.3.8.1.1 Agriculture

Agricultural activity can be considered a significant contributor to particulate emissions, although harvesting and other activities associated with field preparation are seasonally based. The majority however of the agricultural activities are on small scale and will only have a localised effect.

The main focus internationally with respect to emissions generated due to agricultural activity is related to animal husbandry, with special reference to malodours generated as a result of the feeding and cleaning of animals. The types of livestock assessed included pigs, sheep, goats and chickens and these are significant source of fugitive dust especially when the animals trample on confined areas. Emissions assessed include ammonia and hydrogen sulphide which is associated with dairy production. Organic dust is also emissions associated with farming of animals, it includes dried manure, urine, bacteria and fungi. Organic dust levels are higher in winter or whenever the animals are fed, handled or moved.

Little information is available with respect to the emissions generated due to the growing of crops.

3.3.8.1.2 Vehicles

The force of the wheels of vehicles travelling on unpaved roadways causes the pulverisation of surface material. Particles are lifted and dropped from the rotating wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The quantity of dust emissions from unpaved roads varies linearly with the volume of traffic (USEPA, 1996).

Due to the nature of both industrial and agricultural activity, road networks can often be of a temporary nature, and are thus unpaved. An extensive unpaved road network exists in the area and

the proposed route options are in the majority unpaved and only some sections will be paved on the commencement of the project.

Exhaust tailpipe emissions from vehicles is a significant source of particulate emissions and can be grouped into primary and secondary pollutants. Primary pollutants which are CO₂, CO, hydrocarbons, SO₂, NO_x, particulates and lead are those emitted directly into the atmosphere and secondary pollutants which are nitrogen dioxide, ozone which is a photochemical oxidant, hydrocarbons, sulphuric acid, sulphates, nitric acid and nitrate aerosol are those formed in the atmosphere as a result of chemical reactions. Toxic hydrocarbons include acetaldehyde, benzene and formaldehyde, carbon particles, sulphates, aldehydes, alkanes, and alkenes.

3.3.8.1.3 Domestic fuel burning

It is anticipated that certain low income households in the area are likely to use coal and wood for space heating and/ or cooking purpose. The problems facing South Africa around the impact of air pollution generated indoors as a result of the use of coal and wood are not unique. Similar problems are reported around the world in poor communities which either lack access to electricity or lack the means to fully utilize the available supply of electricity (Van Horen et al. 1992).

Globally, almost 3 billion people rely on biomass (wood, charcoal, crop residues, and dung) and coal as their primary source of domestic energy. Exposure to indoor air pollution (IAP) from the combustion of solid fuels is an important cause of morbidity and mortality in developing countries. Biomass and coal smoke contain a large number of pollutants and known health hazards, including particulate matter, carbon monoxide, nitrogen dioxide, sulphur oxides (mainly from coal), formaldehyde, and polycyclic organic matter, including carcinogens such as benzo[a]pyrene (Ezzati and Kammen, 2002).

Coal burning is an incomplete combustion process with carbon monoxide, methane and nitrogen dioxide being emitted during the process. Exposure to indoor air pollution (IAP) from the combustion of solid fuels has been implicated, with varying degrees of evidence, as a causal agent of several diseases in developing countries, including acute respiratory infections (ARI) and otitis media (middle ear infection), chronic obstructive pulmonary disease (COPD), lung cancer (from coal smoke), asthma, cancer of the nasopharynx and larynx, tuberculosis, perinatal conditions and low birth weight, and diseases of the eye such as cataract and blindness (Ezzati and Kammen, 2002).

Monitoring of pollution and personal exposures in biomass-burning households has shown concentrations are many times higher than those in industrialized countries. The latest South African National Ambient Air Quality Standards, for instance, required the daily average concentration of PM₁₀ (particulate matter < 10µm in diameter) to be < 180 µg/m³ (annual average < 60 µg/m³). In contrast, a typical 24-hr average concentration of PM₁₀ in homes using biofuels may range from 200 to 5000 µg/m³ or more throughout the year, depending on the type of fuel, stove, and housing. Concentration levels, of course, depend on where and when monitoring takes place, because significant temporal and spatial variations may occur within a house. Field measurements, for example, recorded peak concentrations of 50 000 µg/m³ in the immediate vicinity of the fire, with concentrations falling significantly with increasing distance from the fire. Overall, it has been estimated that approximately 80% of total global exposure to airborne particulate matter occurs

indoors in developing nations. Levels of CO and other pollutants also often exceed international guidelines (Ezzati and Kammen, 2002).

3.3.8.1.4 Fugitive emissions from mining operations

Potential sources of fugitive dust emissions (PM₁₀ and DUST) are released from these sources; material handling operations, vehicle entrainment by haul vehicles, windblown dust from tailings dams and oxides of nitrogen (NOX) and carbon monoxide (CO) which are produced during mining operations. Fugitive dust emissions released during mining operations are generally only of concern within 3 - 5 km of the mine boundary.

The only mine in the region is the Somkhele Mine on the opposite side of the river, the emissions from this site can blow over into the study area of the Fuleni Project.

3.3.8.1.5 Veld fires

A veld fire is a large-scale natural combustion process that consumes various ages, sizes, and types of flora growing outdoors in a geographical area. Consequently, veld fires are potential sources of large amounts of air pollutants that should be considered when attempting to relate emissions to air quality. The size and intensity, even the occurrence, of veld fires depend directly on such variables as meteorological conditions, the species of vegetation involved and their moisture content, and the weight of consumable fuel per hectare (available fuel loading).

Once a fire begins, the dry combustible material is consumed first. If the energy released is large and of sufficient duration, the drying of green, live material occurs, with subsequent burning of this material as well.

Under suitable environmental and fuel conditions, this process may initiate a chain reaction that results in a widespread conflagration. It has been hypothesized, but not proven, that the nature and amounts of air pollutant emissions are directly related to the intensity and direction (relative to the wind) of the veld fire, and are indirectly related to the rate at which the fire spreads. The factors that affect the rate of spread are (1) weather (wind velocity, ambient temperature, relative humidity); (2) fuels (fuel type, fuel bed array, moisture content, fuel size); and (3) topography (slope and profile). However, logistical problems (such as size of the burning area) and difficulties in safely situating personnel and equipment close to the fire have prevented the collection of any reliable emissions data on actual veld fires, so that it is not possible to verify or disprove the hypothesis.

The major pollutants from veld burning are particulate matter, carbon monoxide, and volatile organics. Nitrogen oxides are emitted at rates of from 1 to 4 g/kg burned, depending on combustion temperatures. Emissions of sulphur oxides are negligible (USEPA, 1996).

A study of biomass burning in the African savannah estimated that the annual flux of particulate carbon into the atmosphere is estimated to be of the order of 8 Tg C, which rivals particulate carbon emissions from anthropogenic activities in temperate regions (Cachier et al, 1995).

3.3.9 AMBIENT NOISE

3.3.9.1 Ambient Noise Conditions

Noise measurements to establish current ambient noise conditions were taken at five (5) sites on Thursday 27 June 2013 from 09h00 to 12h00. The sound pressure level (SPL) (noise) measurements were taken in accordance with the requirements of the South African National Standard SANS 10103:2008, *The Measurement and Rating of Environmental Noise with Respect to Annoyance and Speech Communication*.

For all measurements taken to establish the ambient noise levels, the equivalent noise level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) during that measurement period were recorded. The frequency weighting setting was set on “A” and the time weighting setting of the meters were set on Impulse (I). Measurement periods of a minimum of 10 minutes were used. In addition, the variation in instantaneous sound pressure level (SPL) over a short period was also measured at some of the Sites. For these latter measurements the time weighting setting of the meter was also set on Impulse (I).

3.3.9.1.1 Summary of the residual sound pressure level measurements

The results of the residual noise condition measurement survey are summarised in Table 33. The equivalent sound pressure (noise) level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) are indicated. Note that the equivalent sound pressure (noise) level may, in layman’s terms, be taken to be the average noise level over the given period. This “average” is also referred to as the residual noise level (excluding the impacting noise under investigation) or the ambient noise level (if the impacting noise under investigation is included).

3.3.9.1.2 Determination of night-time noise levels

No 10 minute to 15 minute measurements were taken during the night-time period. The typical night-time noise conditions were established from the minimums recorded during the daytime measurements, from measurements immediately north of the planned mine in the vicinity of the Somkhele Mine, in other similar areas, from the traffic noise calculations and from auditory observations in the respective areas.

3.3.9.2 Noise Climate related to Road Traffic

In order to complement the short-term noise measurements, the existing 24-hour residual noise levels related to the average daily traffic (ADT) flows on a number of main and secondary roads through the area and the roads directly affected by the Fuleni Project were calculated.

There are two main roads servicing the Fuleni Mine development area:

- National Road N2; and
- Provincial Road P425.

Table 33: Measures residual noise levels (2013)

Site No	Location Description	GPS Co-ordinates	Measured Sound Pressure (Noise) Level (dBA)					
			Daytime Period			Night-time Period ⁽ⁱ⁾		
			L _{Aeq}	L _{max}	L _{min}	L _{Aeq}	L _{max}	L _{min}
1	Off the main gravel road in Velongezinyo, just north of the radio mast.	-28.4109S 31.9897E	35.7	56.6	25.7	<30	-	
2	In the river valley, approximately 550m south-east of the nearest village.	-28.4378S 31.9324E	42.2	59.9	22.7	<30	-	
3	Next to the gravel road, immediately south-east of Mgilane Hill, which forms the south-eastern corner of the Hluhluwe-iMfolozi Park	-28.4097S 31.96253E	36.0	61.9	18.7	<30	-	
4	At a borrow site next to the main gravel road, at the northern side of Ocilwana.	-28.4066S 31.98222E	47.8	70.6	29.8	<30	-	
5	Just south of a small group of homesteads, approximately 870m west of the main gravel road.	-28.4231S 31.9809E	37.3	57.0	20.7	<30	-	

Notes:

The typical night-time noise conditions were established from the minimums recorded during the daytime measurements, from measurements in similar areas, from the road traffic noise calculations and from auditory observations in the respective areas.

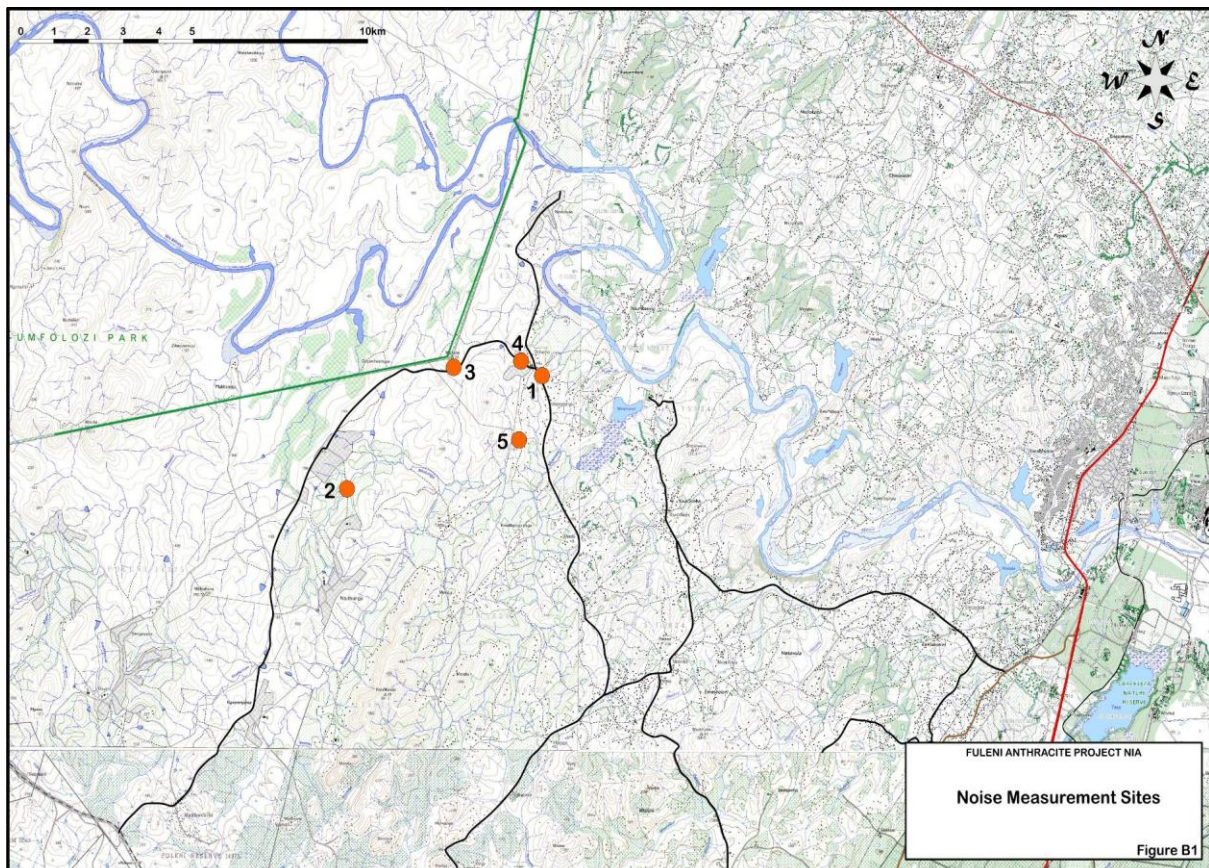


Figure 52: Ambient noise monitoring sites

There are several secondary Provincial Roads that link the N2 and Road P425 to the new mine site. A feasibility study has identified 6 alternatives, but the exact route has not yet been decided. Three sections of the secondary roads whose traffic affects the baseline noise climate in the area of the planned mine were analysed to give some indication of the existing impact:

- Road P499;
- Road D873 (near Richards Bay railway line); and
- Road D873 (near planned Fuleni Mine).

The roads that will be used as the access route to the mine will need to be upgraded.

The traffic data were obtained from the KwaZulu Natal Department of Transport and Mikros Traffic Monitoring (Pty) Ltd.

These calculated noise values provide an accurate base for the SANS 10103 descriptors. The noise levels generated from the traffic on these roads were calculated using the South African National Standard SANS 10210, Calculating and Predicting Road Traffic Noise. Typical situations were used for the calculation site. The Year 2013 traffic data were used as the baseline for the calculations.

The noise levels at various offsets from the relevant road centre-lines were established and are summarised in Table 35. The noise levels given are for generalised and the unmitigated conditions. There will be greater attenuation than shown with distance where there are houses, other buildings and terrain restraints in the intervening ground between the source and the receiver point.

3.3.9.3 Noise Climate related to Railway Traffic

There are two railway lines in the study area:

- The Ermelo to Richard's Bay line (Richards's Bay Coal Line): This railway line is aligned in a north-west to south-east direction through the southern sector of the study area. There are at present, on average, 38 trains (freight) per day on this line.
- Richards Bay to Swaziland line: There are at present, on average, 13 trains (freight) per day on this line.

There is no commuter service on these lines. These data were obtained from Transnet.

With the pass-by of each train there will be a fluctuation in sound pressure level ranging from the normal background noise for the area (residual noise level) to a maximum as the train passes and then reducing again to the residual level as the train moves away from the receiver point. The approximate maximum noise levels that will be experienced with the pass-by of a typical freight train at various offsets from the railway line and for various typical cross-section types are given in Table 34. These values were measured by Jongens Keet Associates, as well as from Nelson (1987) and UK Department of Transport (1995). Note that the noise levels for the sections at-grade and the sections on fill are the same. The values given are the unmitigated noise levels.

Table 34: Typical maximum noise levels for operational conditions along the railway line

Offset (m)	Maximum Pass-by Noise Level (LA _{max}) (dBA)		
	At-grade/Fill Section	Cutting Section	
		3m Depth	7m Depth
25	93,3	81,5	77,9
50	88,3	75,7	71,1
100	82,2	69,3	64,3
200	75,6	62,6	57,4
300	71,9	58,9	53,4
500	66,5	53,5	48,0

The operations of the trains have the potential to adversely influence the noise climate of the areas along the railway corridor to a larger or lesser extent for significant distances from the tracks. The propagated noise will be attenuated with distance from the source, the nature of the ground cover on the intervening ground, and from screening by the natural topography and buildings. The wheel-rail generated noise is enhanced where the train is travelling on elevated structure.

The character (qualitative aspect) of the railway operational noise will have many facets. The component of noise that will predominate at maximum operating speed will be the wheel-rail interaction noise. The noise from diesel locomotives will be much higher than that from electric

locomotives. The noise from the locomotives will be slightly louder than that from the wagons. With the pass-by of each train, the perceived noise at any one receiver point within the area of influence of the train will fluctuate relatively rapidly from the normal background (ambient) noise level of the area to peak at the maximum, will then fall slightly once the locomotives have passed the closest point to the receiver to remain fairly constant at this level until the whole train has passed by the near-ground and then will fall back to the area's ambient level as the train moves into the far distance. This whole cycle can take place over a period of several minutes.

The noise of the braking systems may sometimes be audible. There will possibly be some "flange squeal" (rail-wheel interaction) heard in areas where there are tight-radius track curves. There will also be mechanical banging sounds from the wagon couplings when the trains slow down or accelerate.

It is normally mandatory that a train sounds a warning horn at at-grade crossings with roads. Noise from these horn soundings can be as loud as 105 dBA at 30 metres and 84dBA at 350 metres from the train.

3.3.9.4 Prevailing Noise Climate

In overview, the existing situation with respect to the existing noise climate in the study area was found to be as follows:

- The main sources of noise in the area are from:
 - Traffic on the main roads.
 - The Ermelo to Richard's Bay railway line (Richards's Bay Coal Line), and the Richards Bay to Swaziland railway line.
 - The Somkhele Mine to the north of the proposed Fuleni Project.
- General farming activities (not major source of noise).
- The main noise sensitive receptors in the study area are:
 - Numerous farmhouses and farm labourer residences to the east of Road P425 (east of the proposed mining area).
 - Residential urban area of KwaMbonambi.
 - Rural residential dwellings either in a scattered pattern or clustered into small villages, in the area from Road P425 westwards to the proposed mine and in the area north of the proposed mine.
 - Various schools in the study area.
 - Hluhluwe-iMfolozi Park.
- The areas relatively far from the main roads and the other mentioned major noise sources are generally very quiet.
- Most of the core study area, namely where the mine will be developed comprises scattered rural residential dwellings and agricultural land. It has a typical rural noise climate. Ideally the ambient noise levels for a rural area should not exceed 45 dBA during the daytime period (06h00 to 22h00) and 35dBA during the night-time period (22h00 to 06h00).
- The noise climate of the villages can generally be said to have a suburban residential character. Ideally the ambient noise levels for a suburban residential area should not exceed

50 dBA during the daytime period (06h00 to 22h00) and 40 dBA during the night-time period (22h00 to 06h00).

- The minor provincial roads that penetrate the study area carry small volumes of traffic and the impact of traffic noise from these facilities is minimal.
- The noise climate close to National Road N2 is severely degraded and adjacent to the following roads for the distances shown from the road the noise levels exceed acceptable residential living conditions as specified in SANS 10103 (using the night-time standards of 35 dBA_{LReq,n} as the indicator for rural residential areas and 40 dBA_{LReq,n} as the indicator for suburban residential areas):

Road	Rural residential	Suburban residential
National Road N2	1850m	1000m
Provincial Road P425	900m	400m
Road P499	45m	15m
Road D873 (R)	-	20
Road D873 (M)	250m	100m

- The Ermelo to Richard's Bay line (Richards's Bay Coal Line) carries at present, on average, 38 trains (freight) per day. The Richards Bay to Swaziland line carries at present, on average, 13 trains (freight) per day. These have only a minor influence on the general noise climate of the area, except at noise sensitive sites very close to the railway line with the pass-by of a train.

Table 35: Existing noise climate adjacent to main roads (2013)

Road	Noise Climate Alongside the Main Roads at Given Offset from Centreline (SANS 10103 Indicator) (dBA)																																
	25m Offset			50m Offset			100m Offset			250m Offset			500m Offset			1000m Offset			1500m Offset			2000m Offset			2500m Offset			3000m Offset			4000m Offset		
	L _d	L _n	L _{dn}	L _d	L _n	L _{dn}	L _d	L _n	L _{dn}	L _d	L _n	L _{dn}	L _d	L _n	L _{dn}	L _d	L _n	L _{dn}	L _d	L _n	L _{dn}	L _d	L _n	L _{dn}	L _d	L _n	L _{dn}	L _d	L _n	L _{dn}			
N2	65.1	58.5	66.6	62.1	55.5	63.6	58.9	52.3	60.4	54.5	47.9	56.0	50.7	44.1	52.2	46.2	39.6	47.7	43.1	36.5	44.6	40.9	34.3	42.4	39.0	32.4	40.5	37.6	31.0	39.1	35.1	28.5	36.6
P425	59.9	53.4	61.4	56.9	50.4	58.4	53.7	47.2	55.2	49.3	42.8	50.8	45.5	39.0	47.0	41.0	34.5	42.5	37.9	31.4	39.4	35.7	29.2	37.2	33.8	27.3	35.3	32.4	25.9	33.9	29.9	23.4	31.4
P499	44.0	37.5	45.5	41.0	34.5	42.5	37.8	31.3	39.3	33.4	26.9	34.9	29.6	23.1	31.1	25.1	18.6	26.6	22.0	15.5	23.5	19.8	13.3	21.3	17.9	11.4	19.4	16.5	10.0	18.0	14.0	7.5	15.5
D873R	39.9	33.3	41.4	36.9	30.3	38.4	33.7	27.1	35.2	29.3	22.7	30.8	25.5	18.9	27.0	21.0	14.4	22.5	17.9	11.3	19.4	15.7	9.1	17.2	13.8	7.2	15.3	12.4	5.8	13.9	9.9	3.3	11.4
D873M	52.4	45.8	53.8	49.4	42.8	50.8	46.2	39.6	47.6	41.8	35.2	43.2	38.0	31.4	39.4	33.5	26.9	34.9	30.4	23.8	31.8	28.2	21.6	29.6	26.3	19.7	27.7	24.9	18.3	26.3	22.4	15.8	23.8

- N2 - National Road N2
- P425 - Provincial Road P425.
- P499 - Road P499.
- D873R - Road D873 (south-west of planned Fuleni Project near Richards Bay railway line).
- D873M - Road D873 (near planned Fuleni Project).

The noise descriptors used are those prescribed in SANS 10103:2008, namely:

- Daytime equivalent continuous rating (noise) level ($L_{Req,d}$) (L_d used in Table), namely for the period from 06h00 to 22h00).
- Night-time equivalent continuous rating (noise) level ($L_{Req,n}$) (L_n used in Table), namely for the period from 22h00 to 06h00).
- Day-night equivalent continuous rating (noise) level ($L_{R,dn}$) (L_{dn} used in Table), namely for the 24 hour period from 06h00 to 06h00).

3.3.10 SENSITIVE LANDSCAPES

3.3.10.1 National List of Threatened Terrestrial Ecosystems for South Africa (2011)

The Biodiversity Act (Act 10 of 2004) provides for listing of threatened or protected ecosystems, in one of four categories: critically endangered, endangered, vulnerable or protected. Threatened ecosystems are listed in order to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function and composition of threatened ecosystems. The purpose of listing protected ecosystems is primarily to conserve sites of exceptionally high conservation value (SANBI, BGIS).

According to the National List of Threatened Terrestrial Ecosystems (2011) the mining rights area covers a small area of the remaining extent of the vulnerable Eastern Scarp Forest vegetation at its western edge. This vegetation type has undergone ecosystem degradation and a loss of integrity.

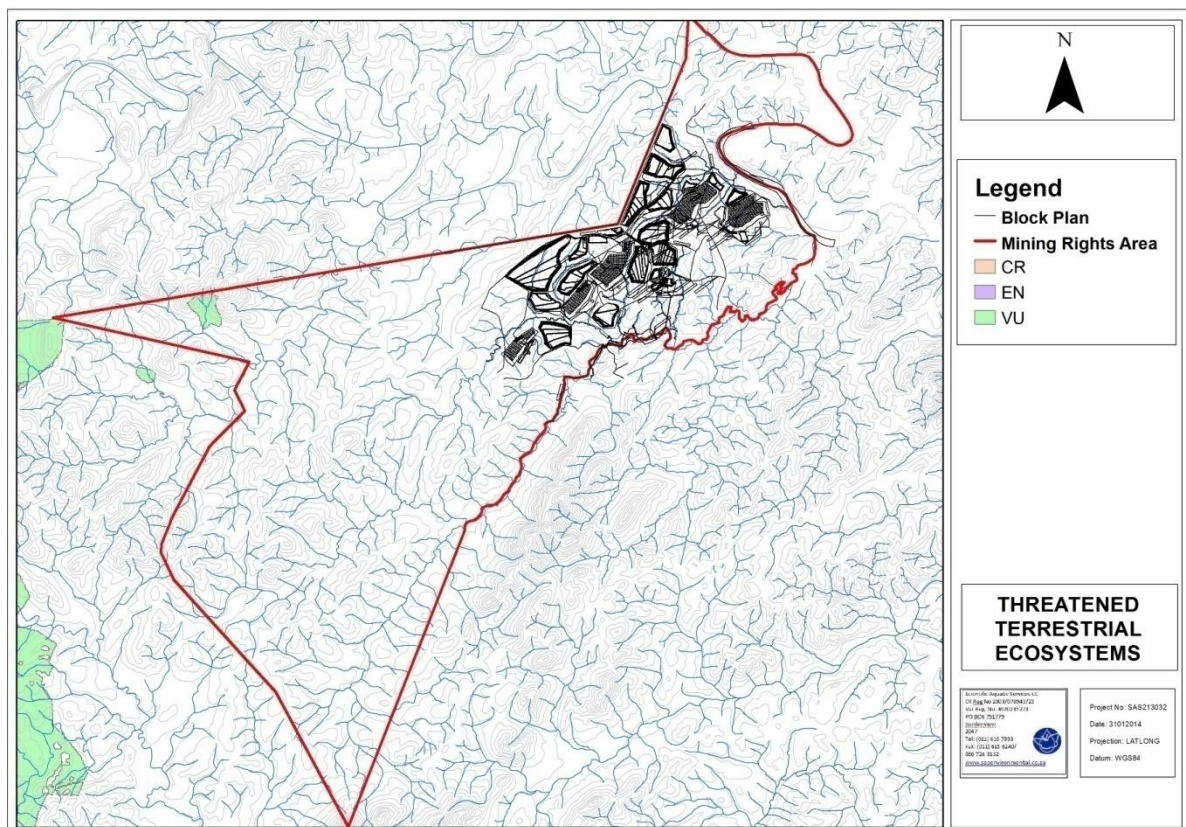


Figure 53: Threatened terrestrial ecosystems

3.3.10.2 The National Protected Areas Expansion Strategy, 2010 (NPAES)

The goal of the National Protected Area Expansion Strategy (NPAES) is to achieve cost effective protected area expansion for ecological sustainability and adaptation to climate change. The NPAES sets targets for protected area expansion, provides maps of the most important areas for protected area expansion, and makes recommendations on mechanisms for protected area expansion. It deals with land-based and marine protected areas across all of South Africa's territory (SANBI BGIS).

According to the NPAES, the mining rights area and study area are not located within a NPAES protected area (formal or informal). However, a NPAES focus area is located within the western portion of the NOMRA area. NPAES Focus Areas are focus areas for land-based protected area expansion. Focus areas are large, intact and unfragmented areas of high importance for biodiversity representation and ecological persistence, suitable for the creation or expansion of large protected areas.

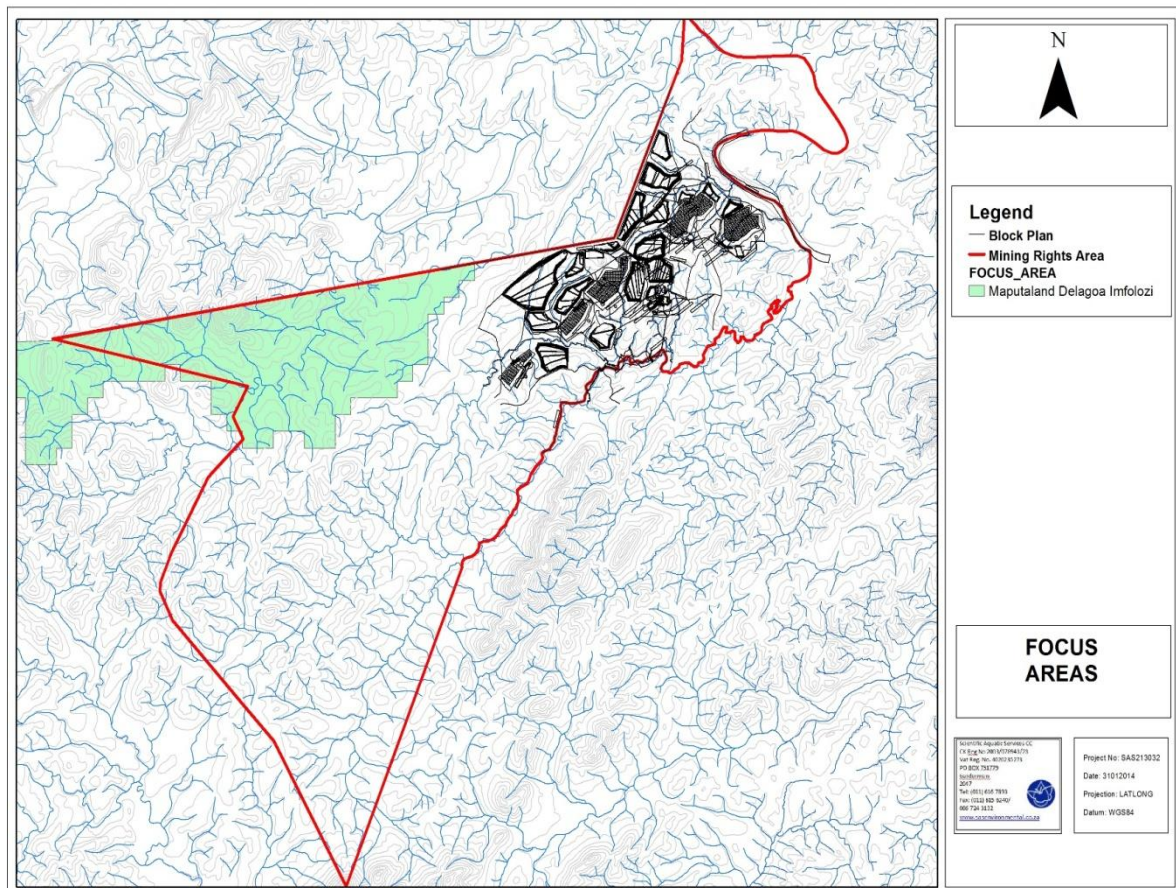


Figure 54: NPAES Focus Areas

3.3.10.3 National Biodiversity Assessment, 2011 (NBA)

The recently completed NBA 2011 provides an assessment of South Africa's biodiversity and ecosystems, including headline indicators and national maps for the terrestrial, freshwater, estuarine and marine environments. The NBA 2011 was led by the South African National Biodiversity Institute (SANBI) in partnership with a range of organisations, including the DEA, CSIR and SanParks. It follows on from the National Spatial Biodiversity Assessment 2004, broadening the scope of the assessment to include key thematic issues as well as a spatial assessment. The NBA 2011 includes a summary of spatial biodiversity priority areas that have been identified through systematic biodiversity plans at national, provincial and local levels (SANBI BGIS).

According to the NBA (2011), the NOMRA area is not located within either a formal or informal protected area or within a national park. However, the NOMRA area borders on the formally protected Hluhluwe-iMfolozi Game Reserve.

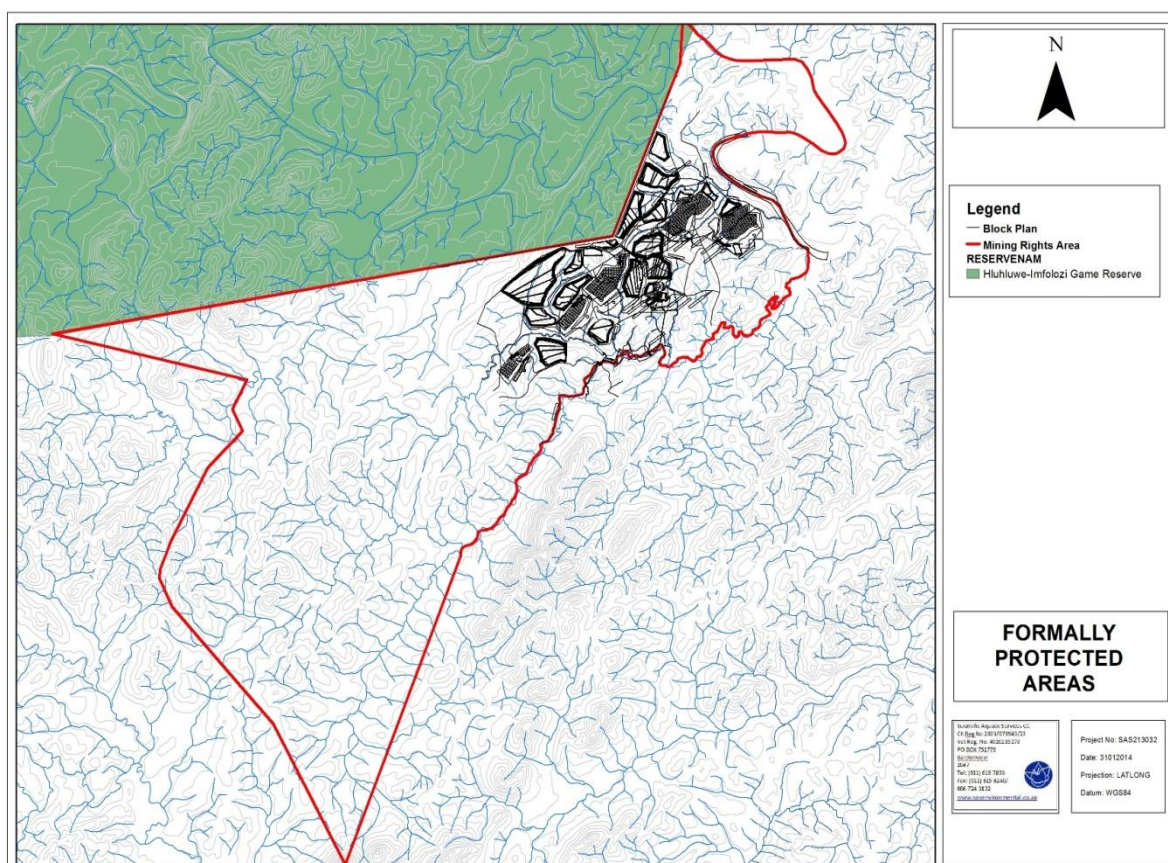


Figure 55: Formally protected areas

3.3.10.4 KwaZulu-Natal Systematic Conservation Plan, 2005

In order to appropriately monitor development and derive useful conservation plans, we need appropriate measures of the state of the landscape and extent of transformation. The KwaZulu-Natal (KZN) Land Cover Dataset is a single, contiguous land-cover dataset covering the entire KZN Province that has been generated from multi-date SPOT2/4 imagery acquired primarily in 2005, and represents the final 2005 KZN Province Land-Cover product.

According to the KZN Land Cover Dataset the land cover of the mining rights area and study area is a combination of urban areas, rural dwellings, woodland, grassland, dense bush, bushland, grassland/bushclump mix, degraded grassland, wetlands, dams and freshwater systems (SANBI BGIS).

3.3.10.5 KwaZulu Natal Terrestrial Biodiversity Priority Areas

According to the KwaZulu-Natal Terrestrial Conservation plan the NOMRA area contains areas specified as Biodiversity Priority Areas 1 (Critical Biodiversity Areas (CBAs) 1 Mandatory) and Biodiversity Priority Areas 3 (CBA 3 Optimal).

The CBA 1 Mandatory areas are based on the C-Plan Irreplaceability analyses. Identified as having an Irreplaceability value of 1, these planning units represent the only localities for which the conservation targets for one or more of the biodiversity features contained within can be achieved i.e. there are no alternative sites available.

CBA3 Optimal areas reflect the negotiable sites with an Irreplaceability score of less than 0.8. Even though these areas may display a lower Irreplaceability value it must be noted that these areas, together with CBA 1s and CBA 2s, collectively reflect the minimal reserve design required to meet the Systematic Conservation Plans targets and as such, they are also regarded as CBA areas.

4 DETAIL PROJECT DESCRIPTION

The Fuleni Project layout plan is shown in Figure 56. The proposed Fuleni Project is essentially an opencast mine, with some underground potential towards the south of the open pit areas. The intention is to maintain a constant product stream and first develop the opencast Pits 1, 2 and 3 simultaneously, followed by underground mining via portals to be developed at the headwalls of these pits. Pits 4, 5 and 6 will follow.

Associated infrastructure including roads, stockpiles and plant is mainly situated towards the south of the open pit workings.

4.1 MINING OPERATIONS

The potential for both opencast and underground mining has been identified and the estimated Life of Mine (LOM) for Fuleni is 32 years with a mineable resource of 35.7 Mt Run-of-Mine (ROM) for the opencast production and 1.8 Mt for underground production. The process design allows for the production of a primary anthracite product suitable for the export and inland market and a lower grade middling product for the thermal market. The two types of coal products targeted by the open pit and underground mining are shown in the table below. The products are essentially determined based on size and ash content.

Product	Product Tonnes	Opencast	Underground
Anthracite coal	14.2	13.4	0.9
Thermal coal	5.2	4.9	0.3

4.1.1 METHODOLOGY

4.1.1.1 Open Pit Mining

The envisaged mining method for this operation is a conventional drill and blast operation with truck and shovel load and haul. Figure 57 is a graphical representation of the typical high wall design in a bench based mining operation as planned at Fuleni.

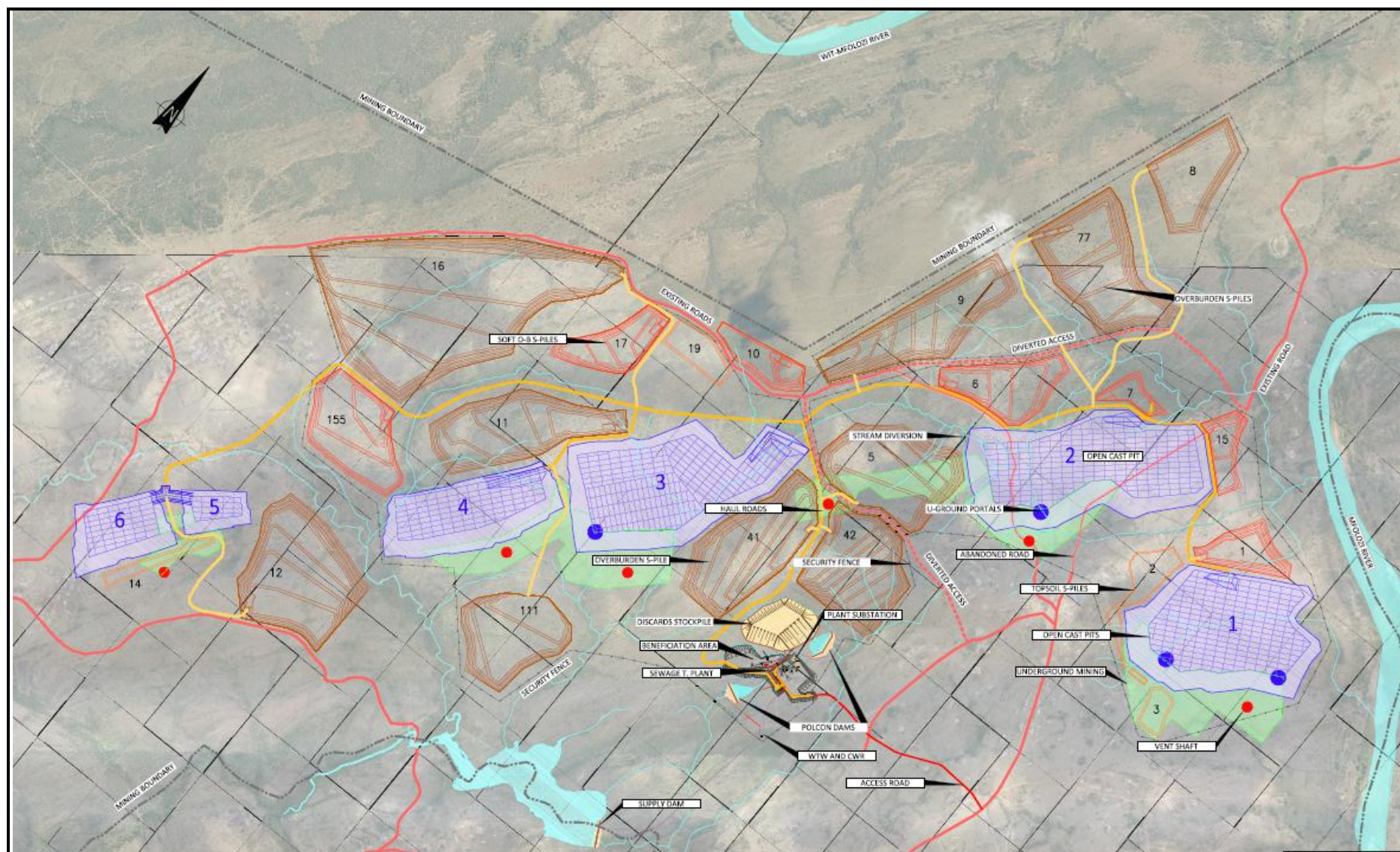


Figure 56: Layout Plan for Fuleni Project

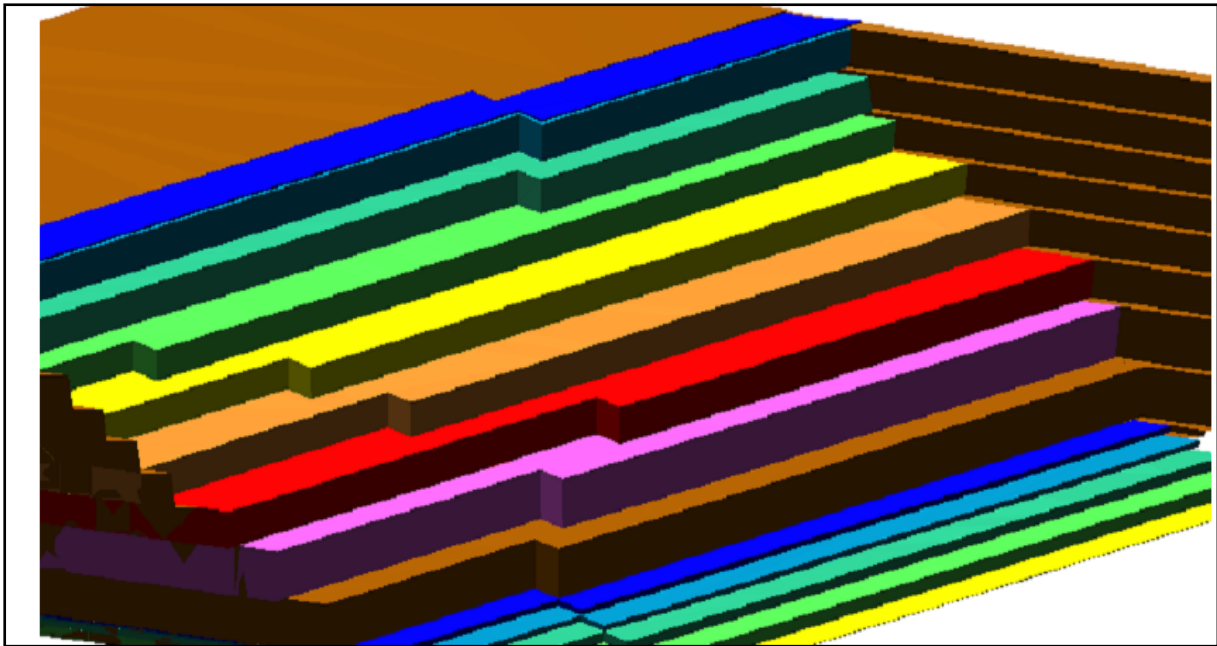


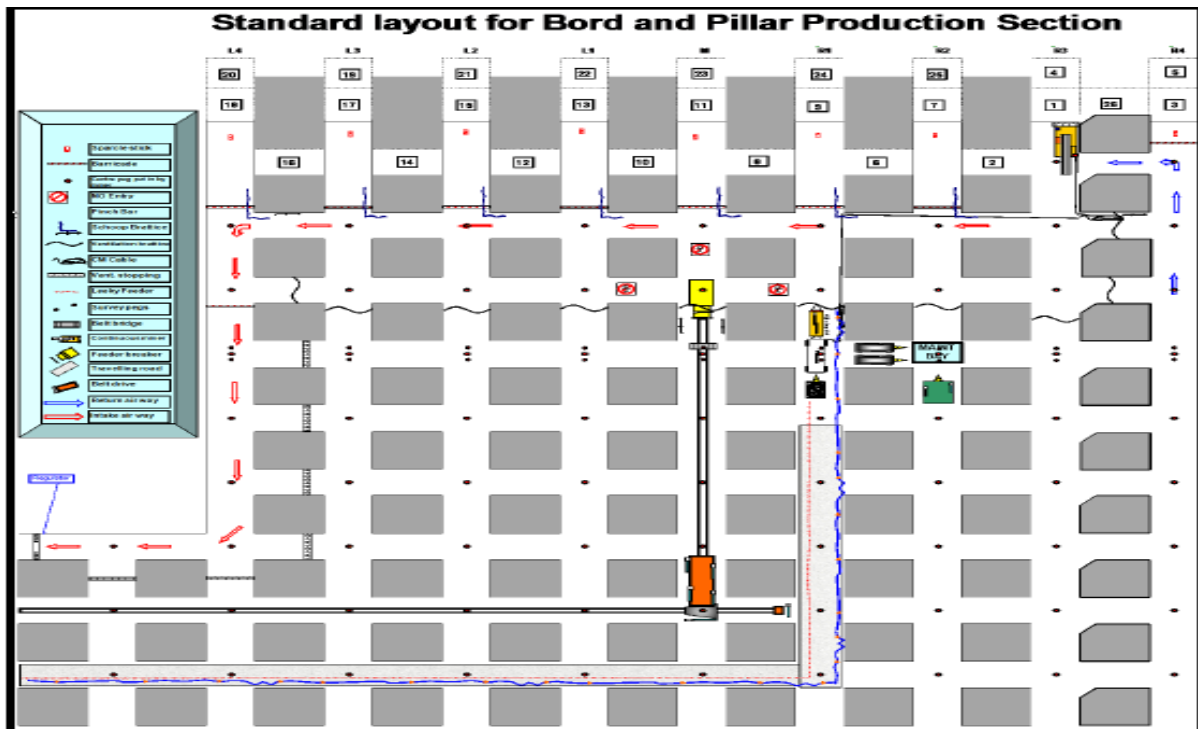
Figure 57: Typical benches in open pit mining



Figure 58: Typical view of an open pit coal mine

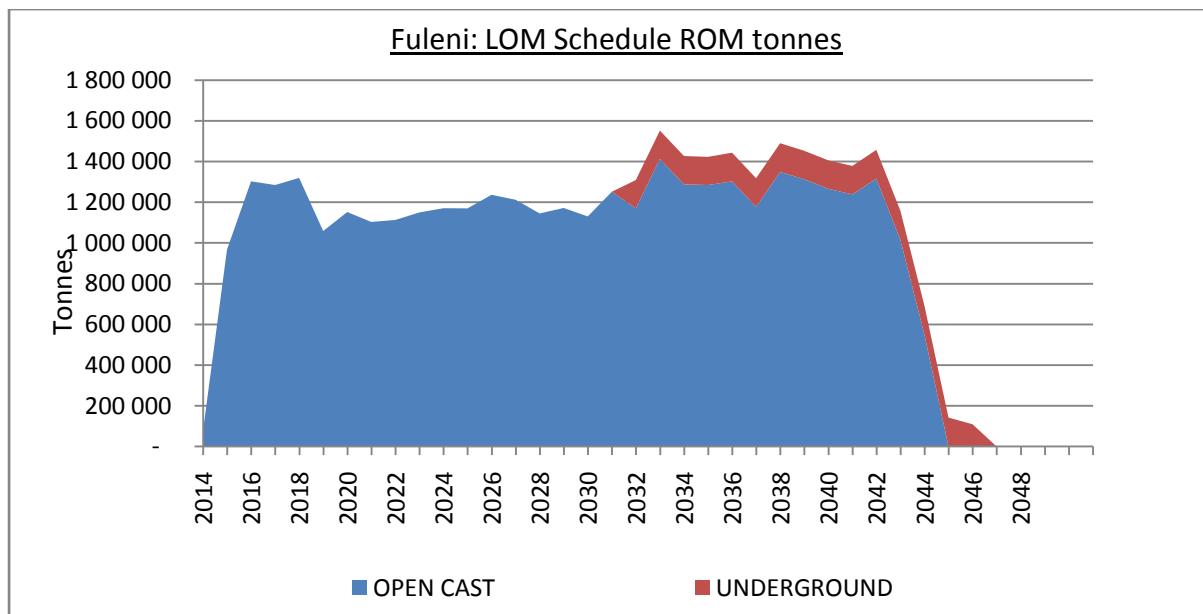
4.1.1.2 Underground Mining

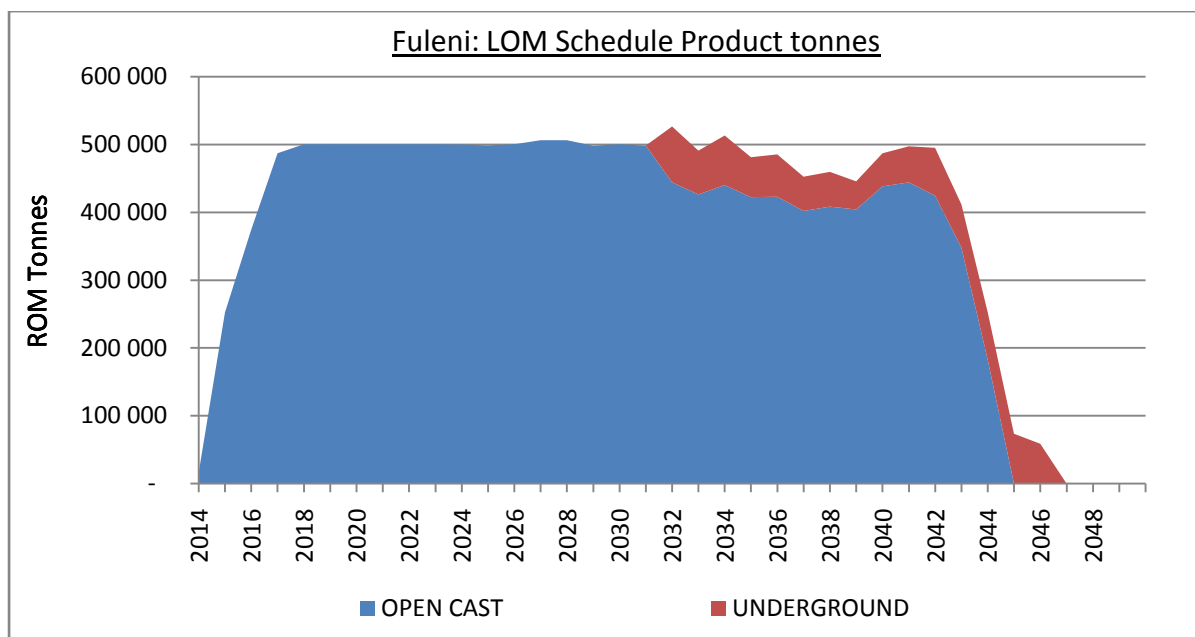
Underground mining will be done from year 15 to the end of the mining schedule. Access will be from selected positions in the open pits. After underground activities have been completed, the access will be closed with the final rehabilitation of the open pit. A single production section is planned for all underground mining. The following figure illustrates a typical bord-and-pillar layout for an underground coal mining operation.



4.1.2 MINING SCHEDULE

The anthracite product tonnes will be delivered at a rate of 0.5Mt per year. The secondary thermal coal product will be delivered at a rate of 0.15Mt per year. Illustrated in the figures below are the ROM and anthracite product production profiles over the life of mine.





4.2 PROCESSING PLANT

The Fuleni Coal Handling Process Plant (CHPP) will treat an average of 1.5Mt per annum of ROM coal. In order to achieve this, the Fuleni CHPP is designed to treat ROM coal at a rate of 250 tonnes per hour for a minimum of 500 hours on coal per month. This is achieved with a key compliment of approximately 60 people, from the managerial, operational and engineering functions. The CHPP will be manned for operations on a 24 hour per day, 7 days per week basis, with the exclusion of statutory public holidays. The process design allows for the production of a primary anthracite product suitable for the export and inland market and a lower grade middling product for the thermal market. Refer to Figure 60 for the process flow diagram for the Fuleni CHPP.

In order to achieve the required product specifications, the ROM coal is subjected to double stage crushing, which will reduce the ROM top size from approximately 600mm to below 50mm. This material is sized into coarse (+15mm) and fine (-15mm) fractions and fed to a double stage dense medium separation (wash) process. The high gravity separation will take place first to remove the large discard content, followed by the low gravity separation into anthracite and middlings products. A spiral plant will upgrade the fine material to produce two products in the size fraction from 150µm to 1mm for inclusion into the primary and secondary products respectively.

The final discard material from the plant will be disposed of in mined-out open pits. In the event that these pits are unavailable due to existing mining activities, the discard material will be placed on a temporary discards stockpile, in horizontal compacted layers. From here it will be reclaimed and dumped into the mined-out open pits towards the end of the mine life.

The ultrafine discard material (slimes) is thickened in the thickener from where the clear water thickener overflow is re-circulated for reuse in the process plant and the thickened slurry or underflow is pumped to a filter press. The filtrate water from the filter press is re-circulated to the clarified water tank and the filter cake is discarded with the final coarse discard. The plant will thus have a closed water circuit in order to minimise the environmental impact as far as possible.

Figure 2: CHPP BLOCK FLOW DIAGRAMME

OVERALL MASS BALANCE			
In	Primary ROM Feed	Avg t/hr	%
In	CHPP Feed	250	100

Out	Coarse Primary Product	44	17%
	Fine Primary Product	40	16%
	Spiral Primary Product	10	4%
	Middlings	37	15%
	Discard	105	42%
	Slimes	15	6%
Total		250	100%

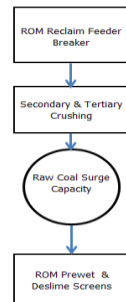
CHPP Size Fractions			% Mass	
			Avg	Max
Coarse	50 x 15		44%	59%
Fine DMS	15 x 1		40%	46%
Fines	1 x 0.15		16%	18%
Slimes	-0.15mm		6%	9%

Avg % ROM	100%
Max % ROM	100%
Avg t/hr	350
Design t/hr	400

Avg % ROM	100%
Max % ROM	100%
Avg t/hr	350
Design t/hr	400

Capacity (min. tons)	200
Surge (Hrs)	0.8

Avg % ROM	100%
Max % ROM	100%
Avg t/hr	250
Design t/hr	300



FULENI ANTHRACITE COAL HANDLING & PROCESSING PLANT BLOCK FLOW

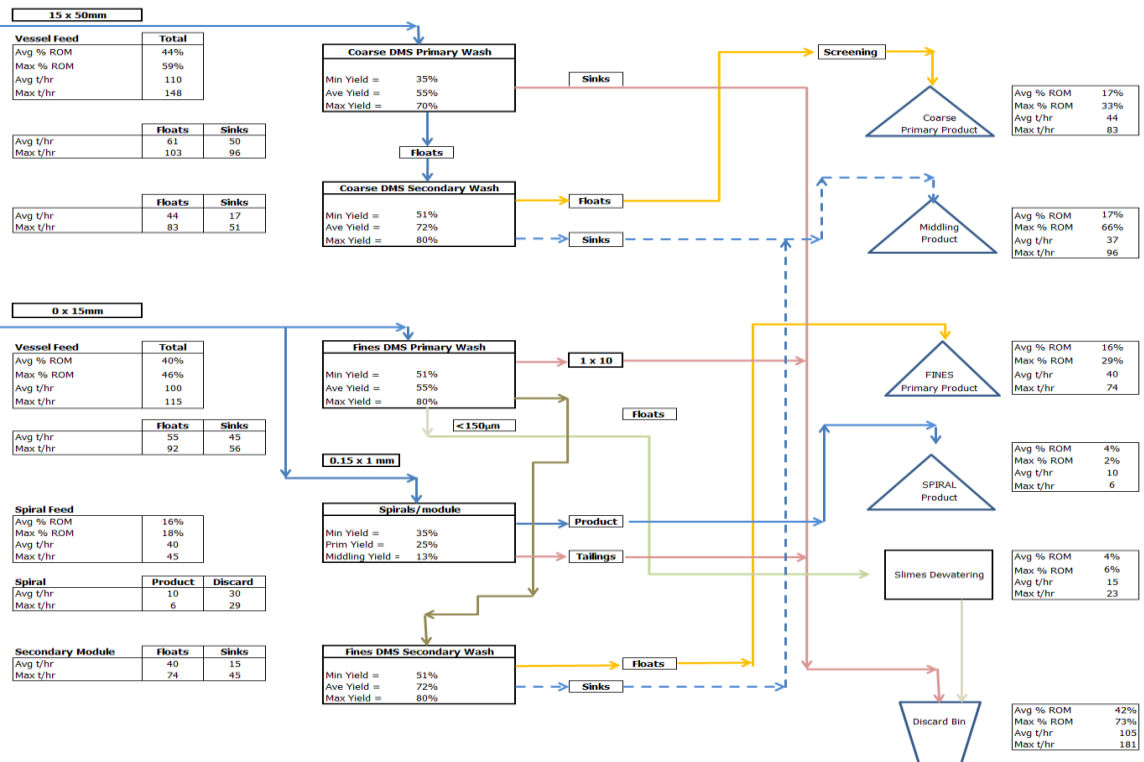


Figure 60: Fuleni CHPP Process Flow Diagram

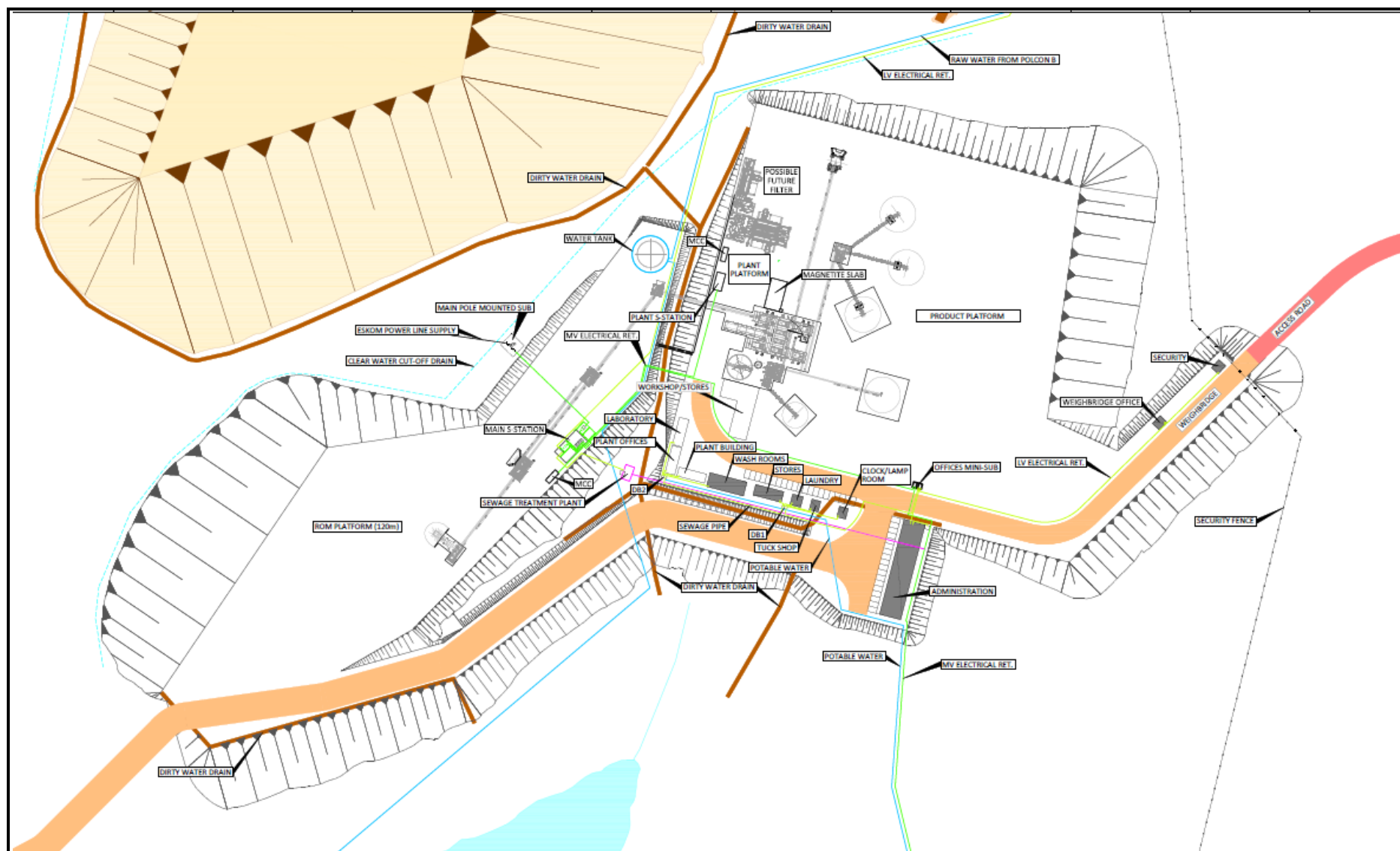


Figure 61: Fuleni plant layout

The proposed CHPP will consist of the following main areas:

- Run of Mine (ROM) reception area;
- Crushing and Screening;
- Coarse Coal High- and Low Gravity Dense Medium Cyclone Plants;
- Fine Coal High- and Low Gravity Dense Medium Cyclone Plants;
- Fine Coal Spiral Plant;
- Thickening of Ultrafine Material;
- Plate and Frame Filter Press;
- Magnetite Storage and Feeding;
- Discard Bin Area;
- Product Screening and Stockpiling;
- Make-up Water Handling System; and
- Electrical Power and Control System.

4.3 MATERIALS HANDLING REQUIREMENTS

4.3.1 RUN OF MINE (ROM) AREA

The ROM enters the beneficiation plant from the West and provision is made for the temporary storage of such ROM from up to 3 pits, allowing for some blending before being loaded into the primary crusher. The maximum floor slope on this platform is 5%, with a minimum of 1%. The platform area space available for such stockpiles is some 9,000 m² in extent, which implies a maximum stockpile volume of some 24,000 m³.

4.3.2 DISCARDS STOCKPILE

No permanent discards stockpile is envisaged and only sufficient temporary stockpile area is proposed to the north of the beneficiation area. Once sufficient capacity is available in the pits, this discards stockpile will be transferred back into the pits.

The discards stockpile is situated to the north of the beneficiation area. The area to be prepared to accommodate this stockpile is large enough to accommodate some 900,000 tonnes of discards (+/- 18 months of peak production).

The floor of the discards stockpile will be prepared to ensure that all moisture released from the discards as well as rain falling on the discards area is captured without polluting any sub-strata and channelled to Pollution Control Dams (Polcon Dams).

This preparation comprises of an impervious clay layer over which are placed filter drains covered by a graded gravel layer to protect the clay layer and filters from mechanical damage.

Toe drains at the edges of the defined area are provided to collect dirty water from the filter drains as well as from surface water run-off directly from the discards. All run-off created by rainfall falling on the discards stockpile is to be collected in toe drains situated on the periphery of the stockpile. Some of the peripheral drains feed by gravity to Polcon Dam B, and the rest feed via the dirty water drainage channels through the plant site to Polcon Dam A.

4.3.3 PRODUCT STOCKPILES AND HANDLING

The Product handling area accommodates four product stockpiles and sufficient traffic turning circle and working space for the loading equipment and product haulage vehicles, with a centrally located parking area. The maximum floor slope on this platform is 2%, with a minimum of 1%.

4.4 INFRASTRUCTURE

4.4.1 BUILDINGS

The anticipated building requirements are indicated in the table below. These requirements are based on staff required over the production period for permanent employees and sub-contractors.

Office Facilities	m ²
Administration and Staff Offices	215
Reception area	10
1 x filing Room	10
1 x Storage room for Training and Administration	10
1 x meeting room	60
2 x Environmental Control Offices	20
1 x Training Room	60
1 x Control Room	10
2 x Ablution Facilities for Male and female	30
1 x kitchen	12
Ablution Facilities for Production Staff	
Ablution Facility for 45 users	120
Locker Rooms for 160 lockers	120
Ancillary buildings	
Clock Room	9
Lamp Room for 50 units	16
Tuck Shop	20
Laundry	18
Security Building	20
Weigh-bridge Control room	10
Workshops and Stores	120
Explosive Magazine Room	100
Field Offices	
3 x Site Office Buildings	30
Summary	
Total area for Administration and Staff offices	437
Total Area for Ablution Facilities	240
Total Area for Ancillary Buildings	313
Total Area for Field Offices	30
Total Infrastructure excluding Plant	1020

4.4.2 ROADS

4.4.2.1 Access Roads

There are two main roads servicing the Fuleni Project area:

- National Road N2; and
- Provincial Road P425.

There are several secondary Provincial Roads that link the N2 and Road P425 to the Fuleni Project site.

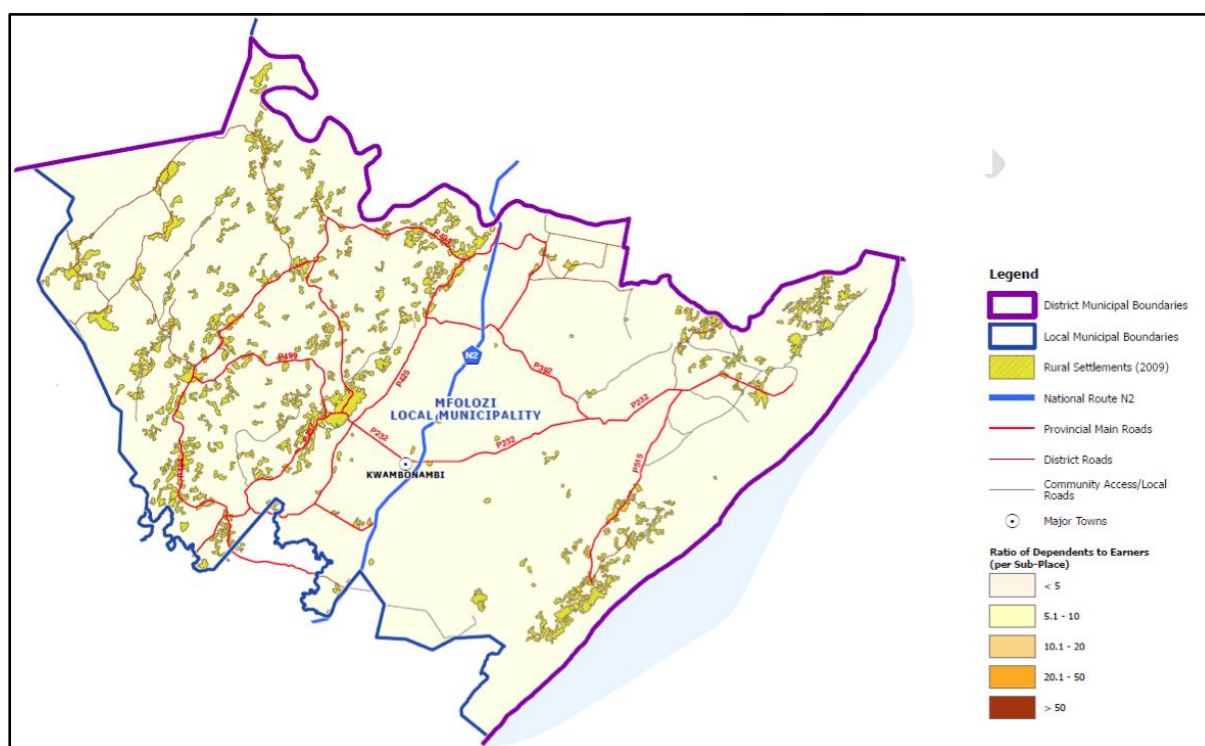


Figure 62: Mfolozi Local Municipality Transport Network

The washed coal will be transported via road to the Richards Bay Coal Terminal (RBCT) for export. The thermal coal will be sold locally, however investigation to optimise revenue for this is still being pursued.

A feasibility study has identified 5 alternatives for access to and from site and for product hauling, but the final route has not yet been decided. The roads that will be used as the access route to and from the mine will need to be upgraded.

The construction of roads will involve:

- Upgrading of existing gravel access roads: All roads will have a gravel wearing course.
- Appurtenant storm water handling measures: It is proposed that culverts at stream crossings and other storm water infrastructure along the haul road routes be designed for a recurrence interval of 1 in 50 years

4.4.2.2 Road Diversions

Existing provincial gravel roads will be affected by two opencast pits (O/C2 and O/C6). These roads will have to be diverted and/or replaced to ensure continual access to the communities.

4.4.3 *STORM WATER MANAGEMENT*

4.4.3.1 Separation of Clean and Dirty Water

It is proposed to separate the clean and dirty water by constructing a system of clean and dirty water channels within the plant layout area. The plant and discards stockpile area will be delineated into dirty clean water areas as defined by the catchments of each type of run-off.

The clean water channels will discharge into natural tributaries after necessary energy dissipating measures in order to mitigate soil erosion. The dirty water channels will discharge into the Pollution Control Dams (Polcon dams), from which the water will be reused.

4.4.3.2 River Diversions

Several diverging streams exist within the defined opencast pit limits. Appropriate water management in line with the environmental requirements for regulatory approval will have to be implemented and managed throughout the life of the operation. Clean runoff will need to be diverted around the opencast pits for discharge into natural tributaries.

4.4.3.3 Pollution Control Dams (Polcon)

Dirty storm water runoff and seepage from the plant and discards stockpile area will be directed along dirty water drains towards two Polcon Dams situated to the east and the south-west of the plant footprint. The dams will be designed for the 1:100 year flood event, with preliminary capacity requirements estimated at some 49,173 m³ for Polcon Dam A and 15,620 m³ for Polcon Dam B.

The dirty water in these dams will be recycled as primary sources for all process water and dust suppression requirements.

4.4.3.4 Silt Traps

Silt traps will be constructed where the dirty water drains enter the Polcon dams. These silt traps will be sized to ensure that they can be cleaned out using mechanical equipment such as a small front end loader and labour without damaging their structural integrity.

4.5 BULK POWER SUPPLY

The power demand for Fuleni is anticipated at 3.6 MW of power on average, and 5.5 MW at peak periods as summarised below.

Open Pit		
Energy	Mega Watt Hour/Month	9.6
Average Power	Mega Watt	0.013
Peak Power	Mega Watt	0.020
Underground		
Energy	Mega Watt Hour/Month	760
Average Power	Mega Watt	1.583
Peak Power	Mega Watt	2.400
Plant		
Energy	Mega Watt Hour/Month	1296
Average Power	Mega Watt	1.8
Peak Power	Mega Watt	2.8
Lighting, Workshops and Offices		
Energy	Mega Watt Hour/Month	48
Average Power	Mega Watt	0.067
Peak Power	Mega Watt	0.10
Pumps		
Energy	Mega Watt Hour/Month	48
Average Power	Mega Watt	0.067
Peak Power	Mega Watt	0.10
Water Treatment Works and Sewage Treatment Plant		
Energy	Mega Watt Hour/Month	28.8
Average Power	Mega Watt	0.04
Peak Power	Mega Watt	0.06
Total Power		
Energy	Mega Watt Hour/Month	2190
Average Power	Mega Watt	3.6
Peak Power	Mega Watt	5.5

The long term power supply has been applied for with Eskom. Should the mine become operational before this supply has been secured and/or power infrastructure is in place, power will be supplied via the use of diesel-fired generators.

4.6 BULK WATER SUPPLY

4.6.1 WATER REQUIREMENTS

4.6.1.1 Potable Water

The potable requirement at the plant area has been determined for use at the washrooms and kitchen/ablution facilities at the various buildings only.

The total average potable demand for the mine has been determined at about 113 kl/d with a peak day demand of some 121 kl/d.

The proposed source of supply is a supply dam to be constructed on the stream due south of the plant area. The water is to be pumped via a raw water pipeline to a package type Water Treatment Works (WTW) situated south east of the plant area. A package type water treatment works, housed in a container is proposed.

The water losses at this WTW are expected to approximate 10% on average, hence implying an average raw water requirement to the plant of about 131 kl/d. This WTW and chlorination facility will maintain a full supply level in a 200 kl covered reservoir, adjacent to the WTW.

4.6.1.2 Non-Potable Water

Non-Potable comprises of make-up water for the process plant and dust suppression water.

4.6.1.2.1 Process water

The daily demand at the process plant for dust suppression, wash-down water and make- up water has been determined to vary between 500 kl/d up to a maximum of 2,333 kl/d, with an average demand over the LOM of some 1,889 kl/d.

4.6.1.2.2 Dust suppression

Water carts are to be utilised to minimise dust pollution on the haul roads and the gravelled section of the access road to Richards Bay. In addition, dust suppression will be required at the discards stockpile and at the opencast pits.

It is assumed that the water requirements for the pits will be obtained from rainwater falling in the Pits.

The total dust suppression water requirements have been determined to vary from a minimum of 0 to a maximum of 2,232 kl/d with an average requirement of some 2,010 kl/d over the LOM.

4.6.1.2.3 Underground mining

Once this activity commences, the total water requirements for the underground mining operations have been determined to vary from a minimum of 33 kl/d to a maximum of 337 kl/d with an average requirement of some 335 kl/d over the period that underground operations take place.

Non-Potable Water		
Open Cast		
Min Demand	kl/month	1 000
Max Demand	kl/month	10 109
Average Demand	kl/month	10 050
Underground		
Min Demand	kl/month	442
Max Demand	kl/month	994
Average Demand	kl/month	662
Dust Suppression (Water Carts)		
Min Demand	kl/month	1 000
Max Demand	kl/month	21 600
Average Demand	kl/month	11 300
Plant		
Min Demand	kl/month	15 000
Max Demand	kl/month	70 000
Average Demand	kl/month	56 667
Total Process quality		
Average	kl/month	78 679
	MI/d	2.62
Max	kl/month	102 702
	MI/d	3.42
Potable water - Washrooms and consumption		
Average Demand	Total Users/day	140
Water demand	kl/cap/d	0.518
Av Daily Demand	kl/d	72.5
Peak demand	l/s	22.8
Offices	kl/d	23
Total Potable	kl/d	95.5
Contingency	%	15%
Allow for	kl/d	110
Total Water		
Average	kl/month	81 974
	MI/d	2.7
Max	kl/month	105 998
	MI/d	3.5

4.6.2 WATER SOURCES

The following water sources have been investigated:

- Direct abstraction from the Mfolozi River: The Mfolozi River is a water-stressed river and it is unlikely that the DWA will grant a permit to abstract water directly from the river.
- Boreholes: From the various geotechnical investigations it was shown that there is little likelihood of finding sufficient underground water for the mine.
- Off-channel storage from the Mfolozi River: Off-channel storage utilising flood water from the Mfolozi River. A desktop study revealed that the topography of the area did not lend itself to any viable or economical solution using this idea.
- Supply dam on the Utuntunga Stream: The Utuntunga Stream, which passes about 1 km south of the plant area and flows into the Mfolozi River, appears to be a viable source if some storage is provided. The position of the Supply Dam is shown in Figure 56.

In addition to the above, an additional source of water is the rainfall falling on the site, together with the re-use of water draining from the site. Treated sewage effluent will also be recycled via the Polcon Dams.

Such rainfall and recycled water has been adopted for purposes of this report to be a source of water.

4.7 MINE RESIDUE MANAGEMENT

4.7.1 MINING WASTE

The final discard material from the plant will be disposed of in mined-out open pits. No permanent discards stockpile is envisaged and only sufficient temporary stockpile area is proposed to the north of the beneficiation area. Once sufficient capacity is available in the pits, this discards stockpile will be transferred back into the pits. The discards stockpile is situated to the north of the beneficiation area. The area to be prepared to accommodate this stockpile is large enough to accommodate some 900,000 tonnes of discards (+/- 18 months of peak production).

The ultrafine discard material (slimes) is thickened in the thickener from where the clear water thickener overflow is re-circulated for reuse into the process plant and the thickened slurry or underflow is pumped to a filter press. The filtrate water is re-circulated to the thickener feed well and the filter cake is discarded via the final discard conveyor belt. The plant will thus have a closed water circuit in order to minimise the environmental impact as far as possible.

4.7.2 NON-MINING WASTE

4.7.2.1 Sewage

The only sewage expected to be generated on the mine is from the ablution facilities and wash-rooms at the plant area. It is envisaged that this sewage will be treated in a package plant, fed by gravity from the various facilities.

The peak sewage outflow from the site has been determined at some 96 kl/d. The treated sewage is to be discharged into the dirty water drains that feed into Polcon Dam A from where the effluent will be recycled for use in the process.

The proposed sewage treatment works is to be of a semi-package plant design and will require a control building of some 10 square metres in area to house nominal water testing equipment, control equipment and an office for the operator.

The Sewage Treatment plant will include for a balancing storage at the inlet to allow balancing of the peak inflows expected from the wash-rooms.

A grease and oil trap is to be provided at the inlet to the balancing tank to allow removal of oils and grease from the incoming sewage, which could negatively impact on the treatment process.

The processes included in the proposed plant are:

- Primary settling
- Anaerobic digestion
- Aerobic digestion
- Final settling
- Disinfection

The proposed plant has already been utilised on many mines and carries the approval of the DWA.

4.7.2.2 General and Hazardous Waste

Upon approval of the project, a dedicated, approved (registered) waste contractor will be appointed by the mine to manage the non-mining waste generation and safe disposal thereof. The following waste types will be generated during the course of the project:

- Domestic waste
- Hazardous waste
- Fluorescent tubes
- Glass and plastics
- Chemicals
- Medical waste
- Scrap metal
- Used oil/diesel/greases
- Building rubble (construction & demolition activities)
- Used tyres

- Old explosives

The different waste streams will be segregated and disposed of in appropriate designated receptacles. All waste will be disposed off-site at approved landfill sites. No landfill site will be established on the Fuleni Project site.

The closest waste facility suitably registered to accept all types of waste that may be generated at the mine is situated in Richards Bay. It is therefore proposed that refuse is collected in Waste Tech type containers on site and delivered to this dump site on a fortnightly basis, using a crane truck.

It is estimated that the total volume of refuse accumulating at the mine should not exceed 3 m³/week. It is proposed that an area of some 10m² be allocated at the Plant area for the collection of refuse and temporary storage of hydrocarbon contaminated waste.

4.8 CLOSURE PLANNING AND REHABILITATION

The successful rehabilitation of impacted areas (soil, land capability and potential land use perspective) is determined by a number of critically important factors, as follows:

- Soil compaction, organic carbon, fertility, suitable 'topsoiling' materials and 'topsoiling' depth;
- Sequence of horizons;
- Slope – must not exceed critical erosion slopes;
- Pollution – soluble pollutants, acid mine drainage and dust;
- Re-vegetation; and
- Climate.

These factors interact and have a large bearing on the ease with which roots colonise the soil. In areas where plants thrive, there will consequently be a higher level of vegetative basal cover, and lower levels of run-off and soil erosion. Any one of the aforementioned factors (either singly or in combination) may jeopardize the successful rehabilitation of mine related facilities/features and will be taken into consideration during the final rehabilitation planning.

4.8.1 REHABILITATION OBJECTIVES

The following preliminary objectives have been set for the successful rehabilitation of the disturbed areas associated with the proposed Fuleni Project:

- Reclamation: To reclaim all mining related infrastructure from underground and seal the underground operations when production ceases.
- Demolition: To demolish the surface structures where alternative use is not possible (agreed with community) and rehabilitate the areas where required
- Rehabilitation: To rehabilitate the opencast pits, remaining surface stockpiles and other disturbed areas to a post-mining grazing capability class

4.8.2 REHABILITATION PLAN

To achieve the objectives, the following actions will be implemented when mining cease:

- Reclamation
 - Reclaim all usable infrastructure from underground for recycling with the surface infrastructure.
 - Shafts and adits will be filled with non-combustible inert building rubble and terrace material.
 - Shafts will be capped and permanently sealed in accordance with DMR specifications.
- Demolition
 - All buildings and steel structures will be demolished in a safe and environmentally responsible manner.
 - Material will be recycled as far as possible and use will be made of contractors specialising in this field to dismantle the surface infrastructure and recycle the building material as far as possible.
 - Inert building rubble that cannot be recycled will be used to seal the incline and ventilation shafts.
 - Other non-recyclable building material will be disposed of at a registered landfill site.
 - All contaminated and carbonaceous material within the Infrastructure Area will be removed and disposed off at an appropriate registered landfill site
- Rehabilitation
 - As far as practically possible, all areas will be designed to be free-draining as far as practically possible and all clean surface runoff to be discharged into the natural environment.
 - Final destination scheduling will be developed during the Feasibility Phase. This schedule will indicate the removal of materials from all pits (mainly box-cut excavations), and utilize this material to ensure an overall compliance of the rehabilitation objectives.
 - All disturbed areas will be ripped to a minimum depth of 1m.
 - Levelling, sloping and landscaping of the disturbed area.
 - Topsoiling and re-vegetation according to the rehabilitation plan.
- Rehabilitation of remaining surface infrastructure
 - Final sloping and landscaping of remaining surface dumps.
 - Engineered capping of the remaining surface dumps to minimize water ingress and spontaneous combustion.
 - Stabilisation of any erosion in and around the remaining surface dumps.
 - Construction of energy dissipating structures along steep slopes.
 - Final topsoiling and re-vegetation of the remaining surface dumps according to the rehabilitation plan.

A detail rehabilitation plan will be developed for the Fuleni Project during the EIA Phase.

5 DESCRIPTION OF POTENTIAL IMPACTS ASSOCIATED WITH ACTIVITY

5.1 SOCIO- ECONOMIC AND CULTURAL ASPECTS

The preliminary socio-economic and cultural impacts are listed below:

- Demographic and Population Impacts
 - Population growth pressures
 - Influx of job seekers
 - Changes in Settlement & Housing Patterns
- Health and Social Well-being
 - Nuisance Impact caused by noise, dust and vibrations on neighbouring communities
 - Safety and Risk Exposure: Increase in crime
 - Community health
- Quality of the living environment
 - Quality and Aesthetic Value of physical environment
 - Increased strain on infrastructure due to potential influx
 - Quality and availability of housing
 - Change processes and impacts related to daily movement patterns
- Socio-economic and Material Well-Being
 - Participation of Local Communities in Employment Opportunities and Skills Development
 - Equity Participation of the Local Communities
 - Participation of local business in procurement opportunities
 - Participation of Local Communities in Bursary Programme
 - Participation of Local Communities in Local Economic Development (LED) Initiatives
 - Conversion of land use
 - Decrease in food security and availability of grazing and rain fed crop farming areas
- Family and Community Impacts
 - Disruption of Social Networks
 - Community relationships/networks
- Physical Impacts
 - Displacement of households residing close to opencast operations
 - Impacts on graves and graveyards
 - Impacts on arable plots and grazing land
- Vulnerable Groups
 - Displacement of poor households
 - Gendered division of labour
 - Impact on Disabled population

5.1.1 HERITAGE RESOURCES

At present it is believed that the most significant heritage resources potentially affected by the proposed project are likely to be the following:

- Places associated with oral traditions and living heritage;
- Landscapes and natural features;
- Traditional burial places; and
- Archaeological sites.

It is unlikely that structures or buildings older than 60 years (other than those older than 100 years, which then constitute archaeological sites) are present in the proposed development area. Other than places associated with oral traditions and living heritage, as described above, it is possible and indeed likely that individual trees/medicinal plants are present. These are not strictly considered heritage resources in terms of heritage legislation, but in projects such as these are usually identified in the Social and/or Botanical/Biodiversity Impact Assessments, which provide recommendations for mitigation.

It is unlikely that a palaeontological study of any nature will be necessary for this project, since coal-bearing strata are typically devoid of fossiliferous material. However, the requirements of Amafa in this regard will be ascertained during the HIA.

5.1.2 ECONOMIC IMPACT

Key issues likely to arise during the EIA process relating to the Economic Impact of the proposed Fuleni Project include:

Ezemvelo KZN Wildlife: Given the location of the site alongside the Wilderness Area of Hluhluwe-iMfolozi Park it is likely that Ezemvelo KZN Wildlife will object to the mine based on the environmental impact and based on the economic impact of having a large development alongside a wilderness area which could undermine its appeal. These arguments will need to be addressed and mitigation provided.

Grazing and agricultural land: Local farmers will lose some land to the mining and these farmers need to be correctly identified in the public participation process and mitigation provided for them.

Businesses: Small shop owners who are located near or within the site will be impacted by the mine. This impact should mostly be positive as higher income and higher footfall within the area will increase sales. However those shops and businesses located within the area need to be compensated.

Brick makers: There are brick makers located between the proposed mine and the Mfolozi River who might be negatively impacted by the proposed mine. These brick makers could be used to supply construction materials to the mine. This would provide them with sustained income and assist the mine with local procurement and micro enterprise support policies.

Flood lines: Several diverging streams exist within the defined open cast pit limits. Appropriate water management in line with the environmental requirements for regulatory approval will have to be implemented and managed throughout the life of the operation.

Public access roads: The figure below indicates the existing provincial gravel access roads within the Fuleni Project area. Existing roads will be affected by two pits (O/C2 and O/C6) as indicated in the figure below.

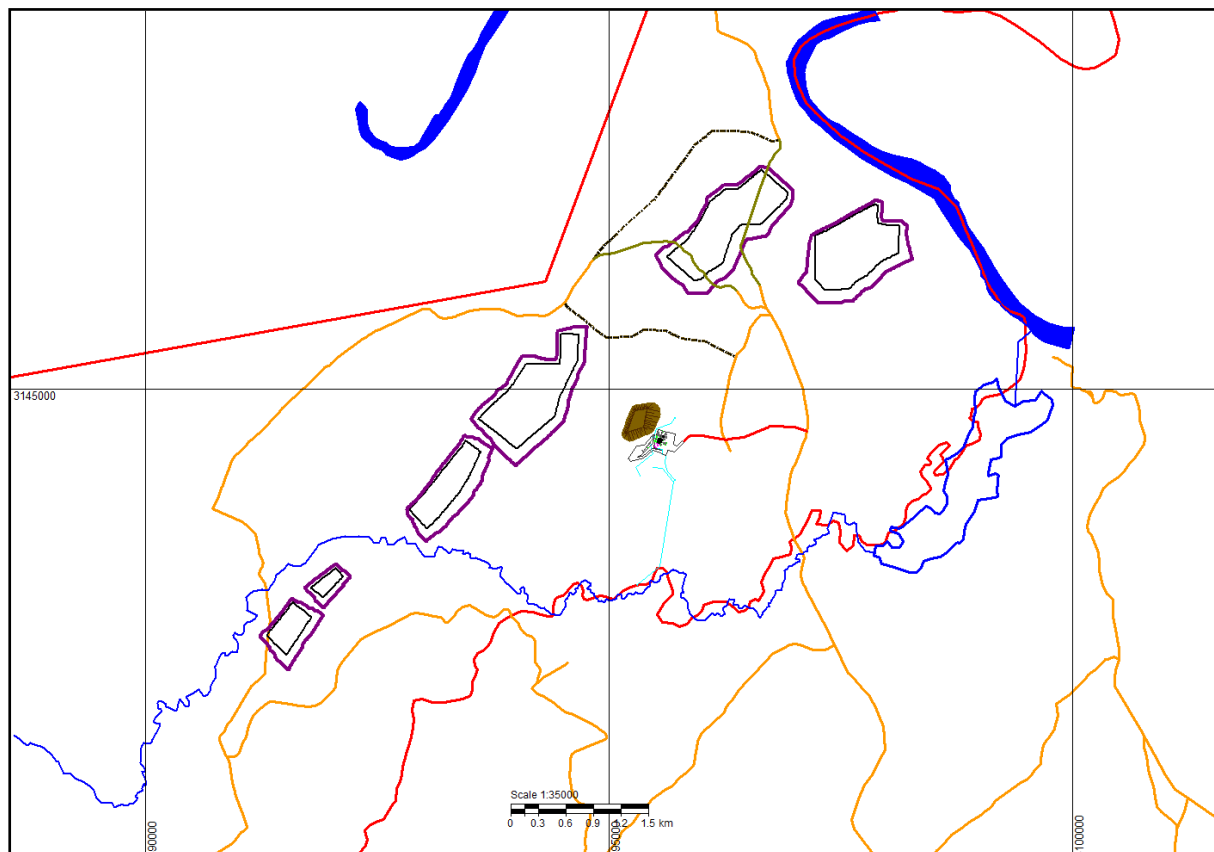


Figure 63: Opencast boundaries relative to existing provincial roads in orange

Relocation of settlements: Various settlements are located within and around the mining area. Blasting, noise, dust and other factors should be considered. All relocations should be properly addressed and mitigated for in the EMP. The figure below displays a 500m radius for the opencast workings. The appropriate blasting radius still needs to be determined for each specific area of concern by a qualified person prior to making a final commitment in this regard.

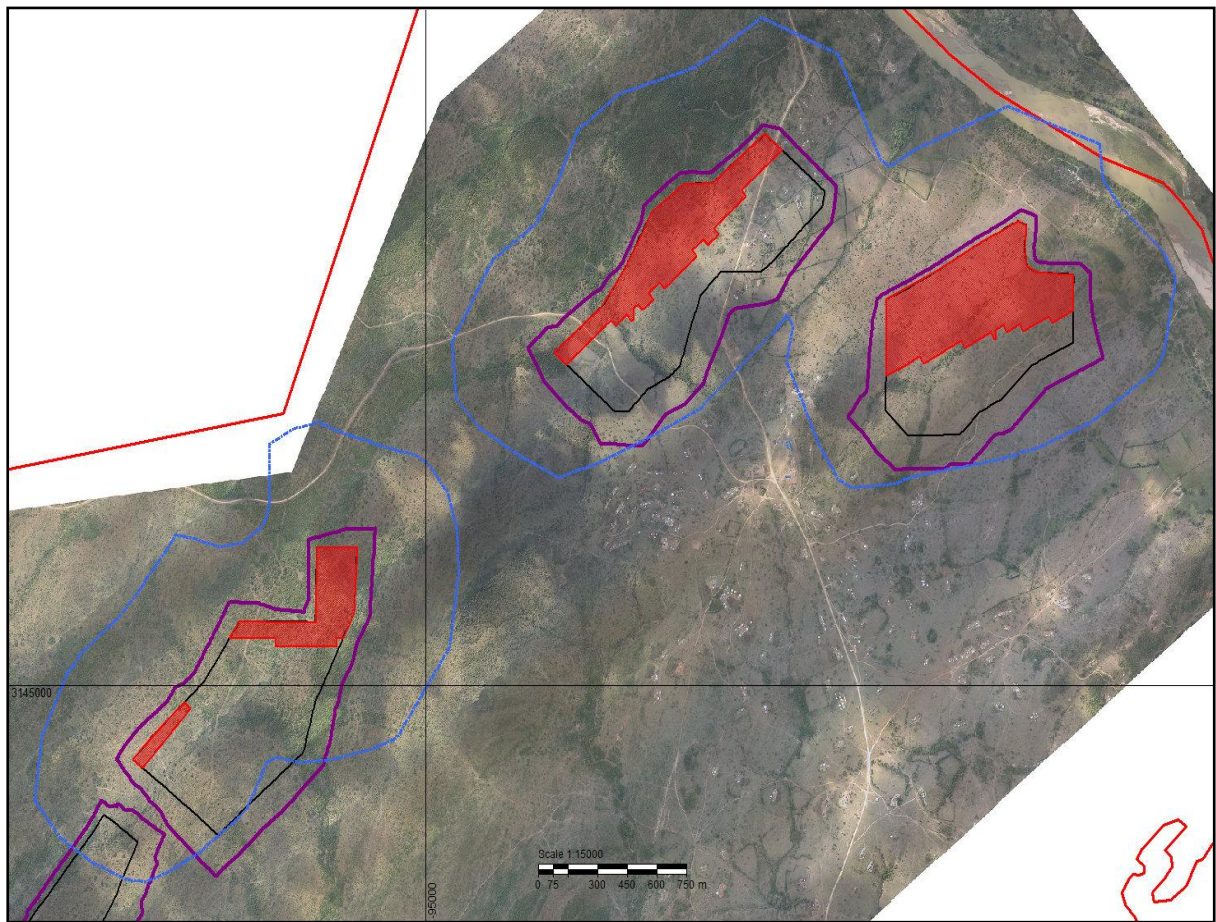


Figure 64: Opencast pits indicating the 500m radii and rural settlements for Y1 to Y7

5.2 BIOPHYSICAL ENVIRONMENT

5.2.1 SOILS, LAND USE AND LAND CAPABILITY

Figure 65 illustrates the position of the proposed opencast and underground mining areas, as well as the area earmarked for mining related infrastructure in relation to the soil forms encountered on the surveyed area. The information is transposed onto a digital elevation model of the area.

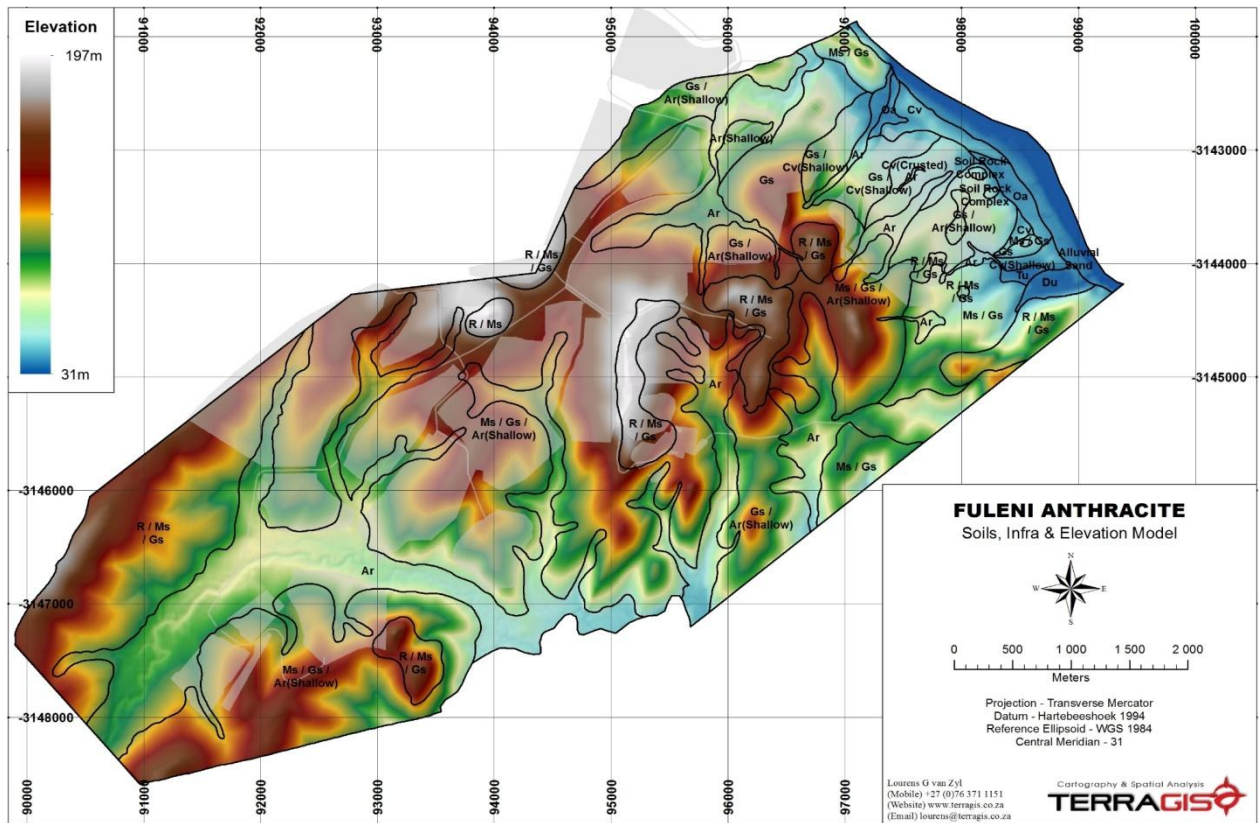


Figure 65: Position of the mining areas and related infrastructure transposed on a soil map and digital elevation model

All of the soil groups that are to be impacted fall into the grazing land capability. The impact of the mining activities, from an agricultural perspective, is therefore not as pronounced as it is from a hydrogeological perspective.

The most significant impact in the area is on the soils of the deep Arcadia soil form. These soils are not wetland soils but are found in and around stream channels and preferential water flow channels. The hydrogeological functioning of the soils will be severely impacted.

The nature of the impact of opencast mining on the soil include the stripping and stockpiling of topsoil (consisting of A and B soil horizons) and the construction of facilities such as discard dumps, overburden stockpiles, pollution and run-off control dams and any other possible footprint structures. Heavy machinery traffic on the soil surface and possible chemical pollution of soil through polluted water or certain geological materials could constitute further impacts on soil.

Stripping and stockpiling of topsoil will result in:

- Loss of the original spatial distribution of natural soil forms and horizon sequences which cannot be reconstructed similarly during rehabilitation, especially in an area dominated by swelling and shrinking soils.
- Loss of natural topography and drainage pattern.
- Loss of original soil depth and soil volume.
- Loss of original fertility and organic carbon content.
- Soil compaction from heavy machinery traffic during earthworks and rehabilitation will adversely affect effective soil depth, structure and density, thus influencing the pedohydrology of the area.
- Exposure of soils to weathering, compaction, erosion, and chemical alteration of nutrients, particularly nitrogen.
- Exposure of the soils to acidic, neutral or alkaline mine drainage that may be high in sulphates and heavy metals.

Underground mining could result in subsidence. This is the process through which the earth's surface lowers owing to the collapse of bedrock and unconsolidated materials (sand, gravel, salt, and clay) into underground mined areas. Subsistence could also occur where material settling occurs in the case of filled opencast pits. Two types of subsidence are identified: i) sinkhole or pit and ii) sag or through.

Pit subsidence results in an abrupt sinking of the earth's surface to form circular and steep sided craters. These areas usually do not fill with water as the water drains to deeper lying strata. Sag subsidence is a more gradual settling of the soil service and may also happen in open-cast areas that have been rehabilitated. Usually sag subsidence is associated with pillar crushing or deeper mines. These areas can hold water if the post mining or post subsidence topography lends itself thereto, as in the case of deeper soils of the Arcadia soil form. Water will seep into these areas if the subsidence intersects the water table or if surface runoff is high. Acid, neutral or alkaline mine drainage becomes an issue as pyrite, contained in coaliferous spoil, oxidises. The mine drainage can be a source of salinity, but is more often rich in heavy metals and sulphate. Very little can be done to combat subsidence in the mining environment. It is therefore evident that both underground and opencast mining could severely impact the hydro-pedological functioning of the area and therefore the quality and volume of water that flows towards the catchments situated towards the east of the site.

Heavy machinery traffic on the soil surface during and after mining can lead to compaction and this could adversely affect the land capability of the area. Fine sand and silt are more prone to compaction. The lower lying soils of the area exhibit a sandy texture while the higher lying soils, especially of the Arcadia soil form, are high in clay content. Compaction and hard-setting of the Arcadia soil form are definite concerns. These soils are difficult to stockpile and tend to cement if the stockpile is not kept moist. Compaction and hard setting hampers root growth and root development. Surface runoff increases, but the area already exhibits high surface runoff rates.

Erosion of the Arcadia soil forms during and after mining is a major concern. These soils tend, as mentioned, to cement when stockpiled and these stockpiles could easily erode. The areas where

soils of Arcadia soil form are present are already eroding as is evident by the many proximal and lateral head cuts found throughout the site. Heavy machinery traffic could exacerbate this process. If not kept moist while stockpiled and placed correctly during rehabilitation these will be the first soils to erode. Erosion of rehabilitated areas will lead to soil loss and impact the land capability of the area adversely. If hard setting occurs, sheet erosion could be a significant concern on the site. In areas such as this where steep slopes dominate, erosion may occur even if hard-setting does not.

5.2.1.1 Post Mining Land Capability

It is doubtful that the areas will ever function in the same manner as is presently the case from a hydropedological perspective. One can assume that the rehabilitated land will exhibit a much higher infiltration and percolation rate than is presently the case. Rehabilitated land tend to be rather permeable and large volumes of water that currently manifests as surface runoff will end up in the open cast pits – even after infilling. It is doubtful that any mitigation and/or rehabilitation procedures will lead to a situation where the area can be re-created to its current hydropedological functioning. Nonetheless, it is imperative that an effort be made in this regard. It should be possible to restore the areas to grazing land capability if erosion and hard-setting do not occur, although the grazing capacity may be lower than is currently the case.

The lowered potential / land capability could be attributed to the following:

Compaction, Consistency and Hard-Setting

Soil compaction and hard setting can be attributed to the total destruction of soil structure in the stripping and redressing operations.

Consistency is the degree of cohesion or adhesion within the soil mass, or its resistance to deformation or rupture. given the above, soil consistence (in the area) appears to be directly related to soil texture and soil structure, whereby heavier textures and increasing grades of structure lead to increasing levels of hardness in the dry state.

Hard-setting of a cultivated soil involves slumping, a process of compaction that occurs without the application of an external load. Hard-setting involves the collapse of the aggregate structure during and after wetting, and a hardening without re-structuring during drying. This can be attributed to a decline in microbial activity, loss of organic carbon and subsoil material lying on the surface.

Mitigation measures such as suitable crops, the leaching of the soil to reduce the exchangeable sodium percentage, fertilizer applications to correct nutritional imbalances, mulching and organic matter, increasing irrigation water salinity, soil stabilizers, soil moisture, and suitable ‘topsoiling’ materials will be discussed.

These recommendations will be made in order that only high to moderate quality ‘topsoiling’ material will be replaced on the immediate surface during rehabilitation operations, thereby providing an acceptable medium for the growth of vegetative cover.

Subsidence

In the opencast and infrastructure areas, the pre-mining/pre-disturbance grade (slope), slope shape, contours and drainage density (not necessarily pattern) should be implemented where possible, at all times bearing in mind the critical erosion slopes (which will be calculated from the soil erodibility nomograph of Wischmeier, Johnson and Cross – 1971) for the various broad soil groups/phases which occur. This will be done by surface re-grading. Concave (rather than convex) slopes should be maximized wherever possible, while the creation of undulating ‘basin and ridge’ topography with frequent blind hollows should be avoided.

Limited surface subsidence of rehabilitated ‘topsoiled’ areas within the various pit footprints is likely to occur, this being caused by the settling of the spoil over time. Should a differential settling of the spoil occur, then this settling may lead to an interruption to the free-drainage of water, and thus the localized ponding of water. Furthermore localized soil erosion may begin to occur upslope of the same area due to the slope change and slower infiltration rates as previously discussed. Such areas must similarly be re-graded (re-sloped), ‘topsoiled’ and re-vegetated in order to re-establish a free-draining final topography. Thus limited ‘topsoil’ (stockpiles) must be held in reserve for use in repair work during the operational, closure and post-closure phases of the mine.

5.2.1.2 Other Potential Impacts

Other impacts include the following:

- Alteration of the topography (changed slope shape, slope grade, drainage distribution, drainage density, and increased soil erosion);
- Alteration of soil horizons (decreased permeability, decreased moisture holding capacity, increased susceptibility to erosion, reduced fertility, and decreased levels of plant growth);
- Alteration of sub-surface layers; and
- Soil pollution.

5.2.1.3 Conclusions

The following can be concluded:

- The 3048 ha that was surveyed comprise of mostly shallow soils that exhibit a poor infiltration capacity and therefore act as discharge soils, meaning that surface runoff after a rainfall event is pronounced. The higher lying areas comprise soils of the Mispah, Glenrosa and shallow Arcadia soil forms, while stream flow channels and preferential water flow channels are bordered by soils of the deeper Arcadia soil form. Close to the Mfolozi River and therefore comprising the lower lying areas, soils of the Tukulu, Oakleaf, Clovelly, Alluvial Sand and Dundee are encountered. The soils of the Tukulu soil form comprise the only arable land (3.8 ha) while the alluvial sands and soils of the Dundee soil form comprise wetland areas (76 ha). The remainder of the site falls in the grazing land capability class.
- The most significant impact of mining in the area will be on the hydro-pedological functioning of the area. Mining and rehabilitation will lead to a decrease in surface runoff from higher lying areas and therefore smaller volumes of water will reach the Mfolozi River. Pollution

emanating from the mining areas could severely influence catchment areas that feed into the St Lucia wetland system. Mining will only impact soils of the grazing land capability. The area is already overgrazed and exhibits a low grazing capacity. Soil erosion is a problem.

- The remainder of the 14568 ha should predominantly comprise soils of the grazing land capability with some wetland and arable areas in lower lying areas.

5.2.2 BIODIVERSITY

An impact assessment will be undertaken where the anticipated impacts on the ecological environment arising from the project will be assessed. The significance of each impact will be determined for each phase of the project life cycle. Following the assessment of impacts, mitigatory measures will be developed which will aim to lessen or negate the significance of the identified impacts. Possible impacts which have been conceptually identified are listed below:

- Mining activities are likely to have a significant impact on sensitive habitat present on the study area, along with communities of RDL and protected faunal species which have been identified during the initial site visit.
- Encroachment of infrastructure or construction or operational waste materials into wetland areas could occur and would affect the habitat integrity of these areas.
- Seepage from facilities such as mine residue facilities, PCDs, general dirty water areas as well as spillages of hydrocarbons, has the potential to contaminate the groundwater environment which in turn can affect water quality in surface water sources in the area.
- Ineffective rehabilitation of wetland and riparian areas could cause siltation and changes in the hydrological functioning of these areas.
- Indiscriminate fires by construction personnel may lead to uncontrolled fires, impacting on floral communities of the property.
- Ineffective monitoring of the burning regime could lead to either destruction of existing plant communities or in the case of decreased burning frequency, dead organic matter build-up, preventing establishment of healthy plant communities. This will lead to a decrease in the availability of fodder for herbivores and may also pose a physical threat to the safety of fauna on the property.
- Vehicles may impact upon sensitive areas during construction, operation and rehabilitation, resulting in a loss of habitat.
- Mining related activities may lead to destruction of habitat and overall loss of biodiversity through expansion activities, road construction, waste facilities etc.
- Dust generated by ineffective rehabilitation of exposed areas may impact on the floral characteristics of the property.
- Construction and introduction of foreign material e.g. soils may lead to the further introduction of alien invader species, impacting on the floral characteristics of the study area.
- Ineffective removal of alien invader species and exposed areas could lead to re-establishment of invasive species, impacting on floral community rehabilitation efforts.
- Poaching and trapping due to increased human activity in the area may lead to increased impacts on the faunal resources of the area.

- Large scale mining activities in certain areas such as open pit areas may lead to the loss of RDL floral and faunal taxa which rely on specific areas in the landscape for survival.
- Ineffective rehabilitation and monitoring of disturbed areas could lead to loss of species diversity.
- Vehicles may impact upon sensitive riparian areas during rehabilitation, resulting in a loss of habitat.

Please note that the above list is not exhaustive, and during the detailed impact assessment phase additional impacts may be identified.

5.2.3 SURFACE WATER

The surface water impacts of the Project can be divided into three aspects, namely:

- Impacts on surface water quantity
- Impacts on surface water quality
- Impacts on the aquatic environment

It must be kept in mind that water quality is naturally linked to water quantity due to the fact that changes in water quantity are likely to affect the dilution of pollutants.

5.2.3.1 Impacts on Quantity

5.2.3.1.1 Impact on mean annual runoff (MAR) to the Mfolozi River

Mean annual runoff (MAR) from the Project site into the Mfolozi River via its affected tributaries is anticipated to be primarily affected by the following:

- Direct rainfall in the opencast pits. Rain falling directly into the pits will collect in a sump at the bottom of the pit/s and thus be polluted. This water may be recycled for use, or be evaporated in dirty water dams, thereby decreasing the MAR.
- Run-off from stockpiles. Rain falling directly onto the 'dirty' stockpiles will either seep into the stockpile or run-off the sides of the stockpile. Any runoff or horizontal seepage from the stockpile will be captured in control dams or a leaching system for water quality control reasons, and thus subsequently be prevented from discharging to tributaries and into the Mfolozi River.
- Concentration of flow when runoff is intercepted by canals. The canal system will intercept run-off that would otherwise have flowed naturally over the ground surface until reaching a defined watercourse. Vegetation and surface topography, particularly in flatter areas, would in the natural state have encouraged interception and infiltration. Once water has been intercepted by a canal however, no further interception or infiltration is likely until the canal discharges the flow into a watercourse. Even once discharged back into a watercourse (if canals are not extended to the Mfolozi River), the concentration of flow would still discourage interception and infiltration. There is thus likely to be a marginal increase in MAR resulting from the construction of the canal system.

5.2.3.1.2 Change to peak flow rates in the Mfolozi River and its affected tributaries during flood conditions

A substantial increase to the peak flow of flood events in the Mfolozi River and its major tributaries could cause erosion and change in channel character and dimensions, destroy riverine vegetation, alter bed roughness and cause eroded sediment to be deposited downstream.

It is expected that Project activities will cause a change to peak flows in the Mfolozi River and its major affected tributaries downstream of the Project site, due to the following factors:

- Change in surface coverage. Development of the Project area will change the surface coverage in some areas from vegetated soil to buildings, hardened gravel roads, paved areas (parking), and compacted earth. These new surface types will allow considerably less infiltration into the ground (typically 0-20%) than the natural surface (typically 60-70%), resulting in more surface runoff following storms and consequently higher peak flow rates.
- Capture of Run-off. Capture of rainfall in the 'dirty' area would lower peak flow rates.
- Canalisation of runoff. Intercepting runoff from the hill-slopes above the opencast pits and canalising the flow could reduce the amount of time that water would take to reach the Mfolozi River. This is due to the decreased friction on the water associated with concentrated flow in a concrete-lined canal as opposed to sheet flow on the hill slopes, and the consequently higher flow velocities.

In technical terms, the time of concentration would be reduced and reducing the time of concentration results in higher peak flow rates. This effect is dependent on the design of the canal system, as increasing the length of flow paths, and implementing other detention measures, could negate this effect.

5.2.3.1.3 Drying up of tributaries and establishment of new watercourse due to canalization

A cut-off canal system is required to separate unpolluted ('clean') and polluted ('dirty') water, which is a positive intervention. However, intercepting the tributaries that flow from the water divide across the mining areas, and redirecting them via canals around the pits, will starve those same watercourses of water along their reach between the point of interception and the discharge of the canals into the same river course. It is probable that in many instances the canals may discharge into a different watercourse which will have a more serious effect on the impacted streams

Furthermore, if the canals only extend as far as to route water around the outer edge of the opencast pits, then concentrated volumes of water will be discharged at point locations on the hill slopes. Also, the soils most susceptible for erosion are those where sandy topsoil overlies structured subsoils.

When considered together, this information suggests that the soils on the hill slopes are particularly prone to erosion. Hence rather than dispersing out over the surface, the concentrated flow at the canal discharge points would erode gulleys into the soil and carry silt into the Mfolozi River and its affected tributaries, impacting on water quality.

5.2.3.2 Impacts on Quality

The philosophy supporting the following section of the report is that if all constituents in the cumulative discharge from the Project site are within the applicable target water quality ranges, then the Project activities will not contribute significantly to an unacceptable cumulative impact.

The converse of this statement is not necessarily true, as different activities within the catchment may discharge different pollutants at different concentrations, and the dilution effect may mean that a constituent that is out of the target water quality range in the cumulative discharge from the Project site is within the target water quality range when the discharge is combined with the Mfolozi River flow itself.

However the Precautionary Principle requires that a conservative approach be taken, in this case to account for possible discharge of pollutants by future activities in the river catchment, and therefore the dilution effect of the Mfolozi River cannot be relied upon.

5.2.3.2.1 Increased sediment load in the Mfolozi River and its affected tributaries

In the natural state of the project site, vegetation cover causes friction to rainfall runoff, that reduces flow velocities and consequently shear forces between the water and the ground surface, resulting in the ground surface remaining intact and not being eroded away. If for any reason flow velocities are increased, there is potential for increased erosion to occur.

Increased erosion means that the runoff contains a higher silt or sediment load, which is discharged to the Mfolozi River. A component of this sediment load is particles fine enough to remain in suspension, 'clouding' or 'muddying' the water.

The extent of this effect can be quantified by measuring a water quality parameter, suspended solids. If there are too many suspended solids in the water this can negatively affect biological life.

In addition, a changed sediment load could have similar morphological effects to the river as changing peak flow rates, such as changes in channel character or dimensions and changes to bed roughness. All of these changes could potentially affect biological life.

The following activities are likely to cause an increase in flow velocities, or directly increase erosion:

- Stripping (vegetation clearance) of mining areas prior to excavation of pits;
- Construction of hard-standing areas that increase runoff volumes, including roads, buildings and paved areas;
- Canalisation of run-off, particularly if canals do not discharge directly into the Mfolozi River; and
- Construction activities that loosen the ground surface.

Furthermore, if runoff from the stockpiles is uncontrolled, such runoff would likely contain a high sediment load due to the fine particles in the waste product resulting from the ore crushing process.

It can thus be stated that without any mitigation measures, the sediment load in the Mfolozi River and its affected major tributaries will increase as a result of mining activities associated with this Project.

5.2.3.2.2 Impaired water quality due to pollutants discharged from processing plant

Wastewater from the coal ore beneficiation process would contain pollutants in excess of the target water quality ranges for the water uses of the receiving water body and discharge of this would impact negatively on the surface water quality. A further consideration is the runoff of pollutants from the process plant area following rainfall, due to the activities within that area.

5.2.3.2.3 Impaired water quality due to pollutants in runoff from stockpiles

It is likely that runoff from the stockpiles will have a different chemical composition to natural runoff. In this event it is best practice to keep 'dirty' water from stockpile runoff separate from 'clean' water from natural runoff.

5.2.3.2.4 Impaired water quality due to pollutants in water discharged from opencast pits

Overflow of water (decant), whether surface or ground, from the pits could release pollutants to the surface water environment if geochemical testing indicates a possible acid mine drainage or other water quality issue.

5.2.3.2.5 Impaired water quality due to petrochemical spills

Fuel or oil spills from vehicles could contaminate surface water resources. Leakages, spills or runoff from vehicle wash bays, workshop facilities, fuel depots or storage facilities of potentially polluting substances could contaminate surface water resources.

5.2.3.3 Aquatic Environment

Potential impacts on the aquatic environment include:

- Impacts caused by a cone of dewatering associated with the open pit mining areas on nearby aquatic resources.
- Encroachment of infrastructure or construction or operational waste materials into aquatic ecosystems could occur and would affect the habitat integrity of these areas.
- Site clearing and the removal of vegetation may lead to increased run-off and erosion of the aquatic environment.
- Inadequate separation of clean and dirty water areas may lead to the contamination of the aquatic habitat and the loss of aquatic biodiversity and sensitive taxa.
- In channel pollution control dams may lead to inundation and altered stream-flow patterns thereby impacting the aquatic habitat, aquatic biodiversity and sensitive taxa.
- Topsoil stockpiling adjacent to aquatic systems and run-off from stockpiles may contaminate the aquatic environment.
- Construction of stream crossings may alter stream and base-flow patterns and water velocities thereby impacting on the aquatic habitat.
- Seepage from mining facilities, general dirty water areas as well as spillages of hydrocarbons, has the potential to contaminate the groundwater environment which in turn can affect water quality in surface water sources in the area.
- Vehicles may impact upon sensitive riparian areas during construction, operation and rehabilitation, resulting in a loss of aquatic habitat.

5.2.4 GROUNDWATER

Mining operations can impact on groundwater by the cone of dewatering that forms from removal of inflows into the pit as it is deepened and by contamination of groundwater due to mining activities.

5.2.4.1 Groundwater Inflows

During the operational phase of mining and for a time after closure both the opencast pits and underground workings act as groundwater sinks. Groundwater will thus flow radially inwards towards the mine voids and the natural groundwater flow direction will be increased, decreased, altered or reversed, depending on the position in the depression cone.

After filling up of the mine voids the groundwater flow directions will tend to return to the normal flow directions that existed before mining commenced. Because of the higher conductivity of the backfilled opencast pit areas and underground mine workings, flow on a regional scale will be through the voids as preferred flow regions due to high transmissivity.

During decommissioning, and for a certain time after closure, the geohydrological environment will dynamically attain a new equilibrium after the dewatering effects of the open pits and underground workings of the operational phase. Decant predictions are affected by the following:

- The mean annual precipitation (MAP);
- Recharge to the mine void, expressed as a percentage of the MAP. Recharge on the other hand is affected by:
 - The size of the surface area disturbed by mining activities;
 - The transmissivity of the overlying strata;
 - The presence of preferred flow paths, which may link the surface to the mine void (i.e. boreholes, shafts, both natural and manmade fractures formed as a result of subsidence, etc.); and
- The groundwater contribution to water inflow is determined by the hydraulic properties of the surrounding undisturbed aquifer/s.

An accurate prediction of the exact decant position of an underground mine void is never as clear-cut as it may seem. Decanting will begin to occur wherever the void is hydraulically connected to the lowest surface elevation by means of geological structures, boreholes, shafts, etc.

5.2.4.2 Groundwater Contamination

Groundwater contamination due to mining occurs when the rock is broken up either by blasting or excavation to expose a greater surface area of mineralized rock to water. The soluble elements in the rock enter into the groundwater system. Coal deposits are usually accompanied by the presence of sulphide minerals, most commonly pyrite (FeS_2). Sulphides decompose when exposed to oxygen and water to form sulfuric acid. The acidified water has an enhanced capacity to dissolve other elements in the rock. Acidified water is undesirable in nature because aquatic life is sensitive to pH as well as possible toxic elements in solution. This process is commonly known as acid mine drainage (AMD) or acid rock drainage (ARD). Sources of pollution from coal mining include the following:

- Overburden and waste stockpiles;
- Mine residue facilities;
- Return water dams, effluent and evaporation ponds; and
- Opencast pits.

The hydraulic conductivities of spoils used to backfill the open pit voids are significantly higher than the in situ material and can be as high as 10 to 100 m/d with boreholes in spoils yielding up to 15 l/s (Hodgson et al., 1985). Weathering and fracturing of geological formations will enhance their water bearing capacity. Blasting operations and excavation of subsoil will increase the fracturing of the rock material within only few meters (< 20 m) from the pits and underground workings.

Rehabilitation of the opencast pit areas should aim at duplicating the pre-existing in situ soil profile. This will be followed by the placement of clayey overburden in a dry state, compacted by frequent traversing of the surface after flattening by graders, and a final cover of topsoil.

The effective recharge percentage to the aquifer is a function of the amount of rainfall, the permeability of the strata and evapotranspiration from surface. Depending on the shaping and compaction of the capping layers (especially the clay), the effective recharge to the groundwater system at the opencast pits will vary between 3 and 20% of the mean annual precipitation (MAP). Given that the aquifer overlying the underground mine workings remain undisturbed, recharge to the underground workings will remain unaffected at around 1% of the mean annual rainfall.

Over the long-term, the groundwater quality will improve because of dilution effects with high quality recharging water and also settling of the suspended solid matter in the recovering mine voids. Such recharge will in the end result in a stratified water quality distribution in the backfilled opencast pits with the best quality water on top and the more saline (and with slightly higher specific gravity) water in the bottom of the pit.

5.2.5 AIR QUALITY

5.2.5.1 Construction Phase

Heavy construction is a source of dust emissions that may have substantial temporary impact on local air quality. Buildings and roads construction are two examples of construction activities with high emissions potential. Emissions during the construction of a building or road can be associated with land clearing, drilling and blasting, ground excavation, cut and fill operations and construction of a particular facility itself. Dust emissions often vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions. A large portion of the emissions results from equipment traffic over temporary roads at the construction site.

The temporary nature of construction differentiates it from other fugitive dust sources as to estimation and control of emissions. Construction consists of a series of different operations, each with its own duration and potential for dust generation. In other words, emissions from any single construction site can be expected (1) to have a definable beginning and an end and (2) to vary substantially over different phases of the construction process. This is in contrast to most other fugitive dust sources, where emissions are either relatively steady or follow a discernable annual

cycle. Furthermore, there is often a need to estimate area-wide construction emissions, without regard to the actual plans of any individual construction project.

The quantity of dust emissions from construction operations is proportional to the area of land being worked and to the level of construction activity. By analogy to the parameter dependence observed for other similar fugitive dust sources, one can expect emissions from heavy construction operations to be positively correlated with the silt content of the soil (that is, particles smaller than 75 micrometers [μm] in diameter), as well as with the speed and weight of the average vehicle, and to be negatively correlated with the soil moisture content.

The identified sources of airborne pollution from this phase of development are:

- General construction of roads and beneficiation plant (including all infrastructure); and
- The preparations of each opencast pit mine.

The preparation of each coal mining pit is a combination of different factors and will occur on different scheduled timeframes. It is likely that the preparation of a pit will be conducted while other pits are active and some being rehabilitated or the activity in the pit has changed to underground mining. The emission inventory will calculate the emission factors so to include the time variation of the activities.

The sources listed below will be included in the emission rate calculation for the preparation of each pit:

- Earth Clearing;
- Grading and Scraping;
- Un/loading of material;
- Wind Erosion; and
- Vehicle Generated Dust.

The emission calculations for each emission factor will be based on either the US EPA AP-42 or Australian Government National Pollution Inventory Manual for Mining (NPI).

5.2.5.2 Operational Phase

The operational phase will commence after the pit preparation is complete. The emission inventory will calculate accordingly the possible hourly emission rate per mining pit based on each specific timeframes.

The beneficiation plant's emission inventory and calculations will be presented separately from the mining activities. However the hourly emission rates will be dependent on the mining activity of the mine. It should be noted that due to the variability of the mining pits during the lifetime of the project the transfer of material to the beneficiation plant and to the market will also be calculated separately. Thus, the Operational Phase is divided into different stages:

- Stage 1 – Active pit mining
- Stage 2 – Transport of material
- Stage 3 – Beneficiation plant

- Stage 4 – Stockpiling of overburden and product

5.2.5.2.1 Stage 1 – Active pit mining

The emission inventory at each mining pit will consist out of the following emission sources:

- Drilling of holes for Explosives;
- Blasting of overburden and coal;
- Dragline mining method;
- Bulldozing of overburden and coal in mining pit;
- Loading of Hauling vehicles inside mining pit;
- Wheel generated dust from vehicles and machinery active in mining pit and service roads; and
- Wind erosion of exposed ground inside the mining pit.

The emission calculations for each emission factor will be based on either the US EPA AP-42 or Australian Government National Pollution Inventory Manual for Mining (NPI).

The major sources identified in during the mining at each pit are the transfer of material onto hauling trucks, mining operations and wind erosion on exposed ground.

5.2.5.2.2 Stage 2 – Transport of material

The emission inventory for the transfer of material from each mining pit to the beneficiation plant to the market consists out of the following emission sources:

- Wheel generated dust from hauling and general vehicles travelling on service roads to and from the plant and travelling to market; and
- Wind erosion on unpaved roads.

The emission calculations for each emission factor will be based on either the US EPA AP-42 or Australian Government National Pollution Inventory Manual for Mining (NPI).

The main sources identified are the wheel generated dust from heavy hauling trucks and from wind erosion on unpaved roads.

5.2.5.2.3 Stage 3 – Beneficiation plant

The emission inventory for the beneficiation plant consists out of the following emission sources:

- Unloading of hauling vehicles at plant;
- Wheel generated dust from vehicles and machinery operational at plant;
- Crushing and Screening of coal;
- Material handling at stockpiles;
- Stockpiling of waste rock and product; and
- Wind erosion over the plant area.

The emission calculations for each emission factor will be based on either the US EPA AP-42 or Australian Government National Pollution Inventory Manual for Mining (NPI).

The main sources identified to emit pollutants to the atmosphere are wind erosion on stockpiles and ground surface area of plant, crushing and screening and material handling (unloading of hauling trucks).

5.2.5.2.4 Stage 4 – Stockpiling of overburden and product

The emission inventory for the stockpiling of overburden consists out of the following emission sources:

- Unloading of hauling vehicles at location;
- Wheel generated dust from vehicles and machinery operational on and at the location; and
- Wind erosion from overburden stockpile.

It should be noted, that this stage focuses on the storing of overburden and the building of the overburden stockpile. This does not include the removal of overburden for the rehabilitation process for each inactive mining pit.

The emission calculations for each emission factor will be based on either the US EPA AP-42 or Australian Government National Pollution Inventory Manual for Mining (NPI).

The main sources identified to emit pollutants to the atmosphere are wind erosion and material handling (unloading of hauling trucks).

5.2.5.3 Rehabilitation Phase

The rehabilitation of the mining pits will commence when there is no further plans to mine at the site. The rehabilitation phase entails that backfilling of the mining shafts and open pit area starts and active mitigation and rehabilitation measures are in place. There is however emission generation related to the rehabilitation phase, including:

- Material handling (loading and unloading of hauling vehicles);
- Wheel generated dust from hauling vehicles (travelling from stockpile to open pit area); and
- Wind erosion.

The different mitigation measures will be applied to the modelling simulations and the best possible measure will be decided on.

5.2.6 AMBIENT NOISE

5.2.6.1 Construction Phase

The noise impact from construction activities are predicted to be as follows:

- Source noise levels from many of the construction activities will be high. Noise levels from all work areas will vary constantly and in many instances significantly over short periods during any day working period.
- Exact daytime period and night-time period continuous equivalent sound pressure levels are not possible to calculate with certainty at this stage as the final construction site layout,

work programme for the various components, work modus operandi and type of equipment have not been finalised. Working on a worst case scenario basis, it is estimated that the ambient noise level from general construction activities could negatively affect noise sensitive sites within a distance of 1500 metres of the construction site. Night-time construction could have a significant impact on noise sensitive sites within a radius of 3000 to 3500 metres of the construction site.

- There are likely to be some noise nuisance effects during the day from intermittent loud noises on people living in the area. If there is any night-time construction, fairly significant impacts will be experienced.
- Construction traffic could be of the order of 200 vehicles per day at times. There will be a noise nuisance factor associated with the bypass of trucks. Noise impact will be significant if night-time deliveries are allowed.

5.2.6.2 Operational Phase

With the development of the mine the noise climates at the immediate areas surrounding the mine will alter significantly. The main noise sources at the mine will be from operations at the opencast pits, beneficiation plant, adit headgear, ventilation shafts, stockpiles, dumps and the coal haul trucks. It is estimated that the noise from the various operations at the mine could be of the following order at the given offsets from the source:

Offset distance (m)	Noise from Source (dBA)				
	Open Cast Pits	Beneficiation Plant	Adit Headgear	Ventilation Shafts	Stockpiles & Dumps
500	62.0	61.2	56.1	46.8	57.2
1000	55.0	54.3	49.2	39.9	50.2
2000	50.7	46.7	41.8	<35.0	42.7
3000	42.6	41.7	37.0		37.8
4000	38.9	37.9	<35.0		<35.0
5000	35.9	<35.0			
5500	<35.0				

Where relevant, the cumulative effects of the noise sources will be addressed.

5.2.6.3 Mine Generated Traffic

With regard to work trips, business trips and general deliveries, the mine could generate approximately 150 vehicle trips per day. This is the two way traffic volume excluding the number of product export truck trips. It is estimated that there could be of the order of 150 to 200 product export truck trips (two-way) per day. The total volume of traffic generated by the Fuleni Project onto its new access road will be relatively small in comparison to the total background volume of traffic that will be attracted to this route, and will only raise the noise climate along this route marginally. The same is true of the mine traffic in relation to the traffic on National Route N2. However, there will be some degree of impact with the bypass of each truck, thereby creating a noise nuisance at NSRs close to the external haul route.

5.2.6.4 Blasting

Blasting may be required as part of the civil works to clear obstacles or to prepare foundations. Drilling and blasting during the opencast operations could also be a significant source of noise pollution.

However, blasting will not be considered during the EIA modelling for the following reasons:

- Blasting is highly regulated, and control of blasting to protect human health, equipment and infrastructure will ensure that any blasts will use minimum explosives and will occur in a controlled manner.
- Blasting is a highly specialised field, and various management options are available to the blasting specialist. Options available to minimise the risk to equipment, people and infrastructure include:
 - The use of different explosives that have a lower detonation speed, which reduces vibration, sound pressure levels as well as air blasts.
 - Blasting techniques such as blast direction and/or blast timings (both blasting intervals and sequence).
 - Reducing the total size of the blast.
 - Damping materials used to cover the explosives.
- People are generally more concerned over ground vibration and air blast levels that might cause building damage than the impact of the noise from the blast. This is normally associated with close proximity mining/quarrying.
- Blasts will be an infrequent occurrence, with a loud but a relative instantaneous character. Potentially affected parties normally receive sufficient notice (siren), and the knowledge that the duration of the siren noise as well as the blast will be over relative fast result in a higher acceptance of the noise.

5.2.6.5 Conclusions

The following may be concluded in respect of noise impacts:

- The Fuleni Project site lies in a relatively quiet rural area to the west of Mtubatuba. Much of the housing in this area, namely the dispersed (low density) huts fall into this rural noise zoning.
- The residual noise climates of the formal residential areas and villages are typical of a suburban environment, while the noise climate in the agricultural sectors of the study area is typical of a rural residential environment.
- The areas close to the main roads, the railway lines and other mining operations in the study area are already degraded with regard to rural residential and suburban residential living.
- There is a potential for noise nuisance impacts during the construction phase.
- The mine operations will introduce a very loud noise source with a large footprint (in extent) into the area.
- The character of the noise generated by the proposed mine is foreign to the existing noise climate in the immediate vicinity and the area to the east, north and south of the mine.

- There are measures that can be introduced to mitigate some of the impact of the operational noise, but in general the development of the mine will alter the noise profile and character of the area significantly, especially to the east of the development property. Adverse noise conditions can be expected especially at night.

5.2.7 VISUAL AND AESTHETIC

5.2.7.1 Regional Overview and the Visual Character

The Fuleni Project falls in an area consisting of low growing trees and scrubs and grasslands. The NOMRA area has been transformed by anthropogenic activities such as rural housing and agricultural activities. The majority of the areas where the infrastructure and mining activities are planned are still natural areas.



Figure 66: Landscape character

5.2.7.2 Sensitive Receptors

The number of observers and their perception of the development will have an impact on the VIA. The perception of viewers is difficult to ascertain as there are many variables to consider. It is necessary to identify areas of high viewer incidence and to classify certain areas according to the observer's visual sensitivity towards the project. It is also necessary to generalize the viewer sensitivity to the development in some degree, as there are many variables when trying to determine the perception of the observer. This includes regularity of sightings, cultural background, state of mind, purpose of the sighting etc. which would create a myriad of options.

Fuleni is located in a high density rural setting with the various homesteads located to the north, east and south of the proposed infrastructure and mining areas. The sensitive receptor map is depicted in Figure 2. The Hluhluwe-iMfolozi Nature Reserve is located to the north-west of the Fuleni Project area.

The Fuleni Project will be visible for two types of viewers will therefore be observers e.g. the rural community and the tourists visiting the nature reserve.

Due to the topography the visual impact will be located to the north, east and south. The visibility of the infrastructure and mining areas will be limited to the west. The locality of the project is located far from the major transport routes and will therefore not be visible to the N2 road users.



Figure 67: Photomontage of Fuleni Project area

5.2.7.3 Visual Distance/Observer Proximity

Intuition suggests that visual impact decreases as distance increases. Hull and Bishop (1988) indicate that as the distance doubles, the visible scale of an object reduces four times.

A large number of sensitive receptors, including schools are located within a 10 km radius of the proposed mining development. Figure 68 indicates the sensitive receptors located within 5km, 10km and 15km from the infrastructure and mining operations.

Possible viewing points were identified at various intervals in the area. The infrastructure and mining area lies on a north-south axis. To better evaluate the possible impact the open pits were divided in a north and southern area. It should be noted that the entire area will not be mine at once but will be mined in a phased approach with consecutive rehabilitation taking place. Therefore the impact calculated is a worst case scenario, if rehabilitation is not done as mining progresses.

Secondary viewing areas have also been calculated, however due to the distance from the mining operations the impact on the areas will be limited.

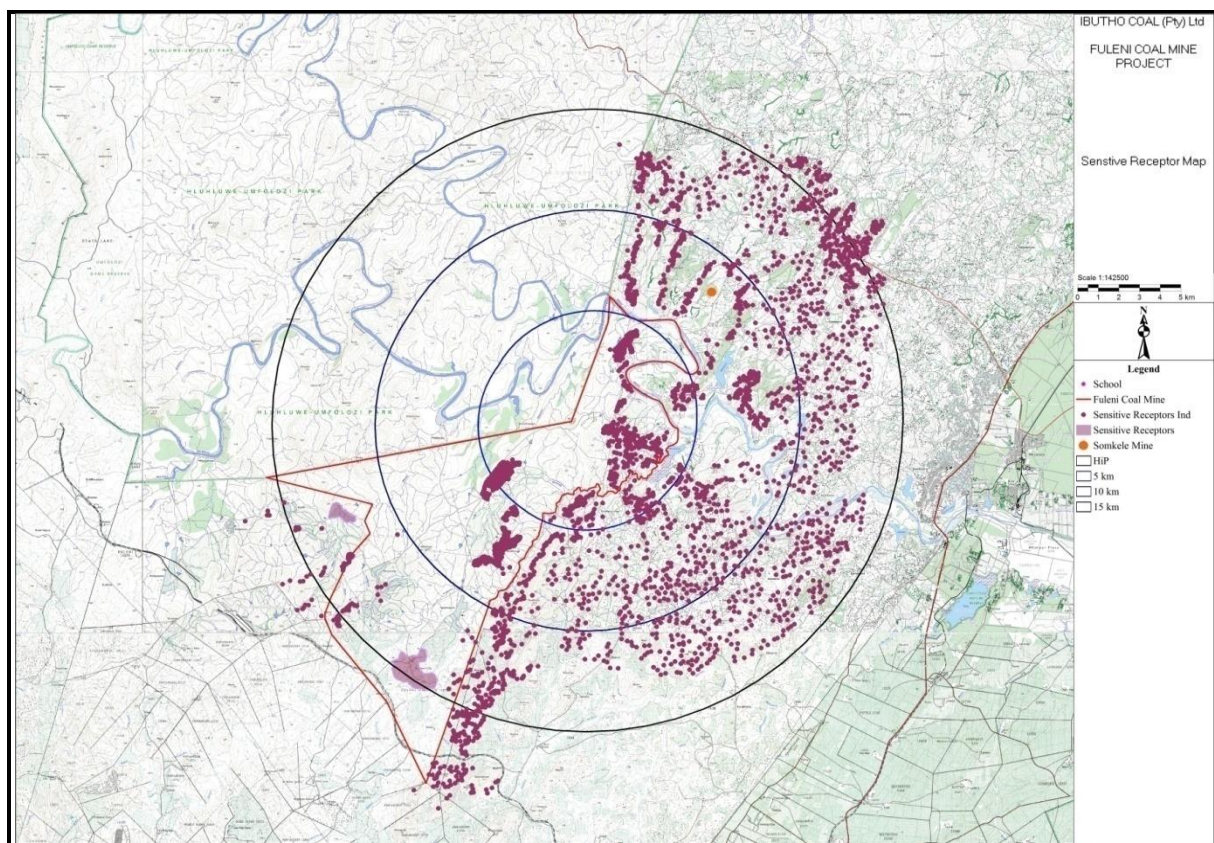


Figure 68: Visual distance

5.2.7.4 Visual Exposure

Potential visual exposure is determined by means of a viewshed analysis of the proposed infrastructure and mining development and depends on the position of the object related to the viewer. The viewshed analysis is used to determine what can be seen from a particular location in the landscape and also determines from where within the surroundings the proposed infrastructure can possibly be seen. The extent of the impact of Fuleni will be centered on the opencast mining areas, processing plant, conveyors and the haul roads.

A preliminary line of sight analysis was conducted through the drawing of a graphic line between two points on a surface that shows where along the line the view is obstructed. In Google Earth a series of points are taken along the perimeter of the proposed infrastructure and the visibility of each point is calculated across the study area through the use of the Google Earth Elevation Profile function. The function only evaluates the topography of the area and land cover (vegetation) is not taken into account. To ensure the line of sight is fully assessed the height of the proposed infrastructure as well as other existing infrastructure and features (e.g. rural housing etc) are taken into account by incorporating the height of the structures and other features into the analysis through the use of the altitude function in Google Earth. The altitude function provides the opportunity to insert three dimensional objects in Google Earth and using this in the line of sight analysis. With GIS, the contours of the area are then investigated to ensure a correlation between the line of sight drawn from Google Earth and the topography of the area.

Various points surrounding the proposed opencast areas and the mine infrastructure were used to conduct the viewshed analysis. The topography forms a shield around the operations. Due to a ridge to the west of the mining area, the Hluhluwe-iMfolozi Nature Reserve is shielded from the visual impact of the mining activities.



Figure 69: Elevation profile of the northern mining areas

An elevation profile through the southern mining areas shows that the topography buffers the mining operations to both the east and the west. The visual impact of the southern mining operations is limited to approximately 3 km to the east and to 2 km to the west. Once again the mining operations will not be visible in the Hluhluwe-iMfolozi Nature Reserve.

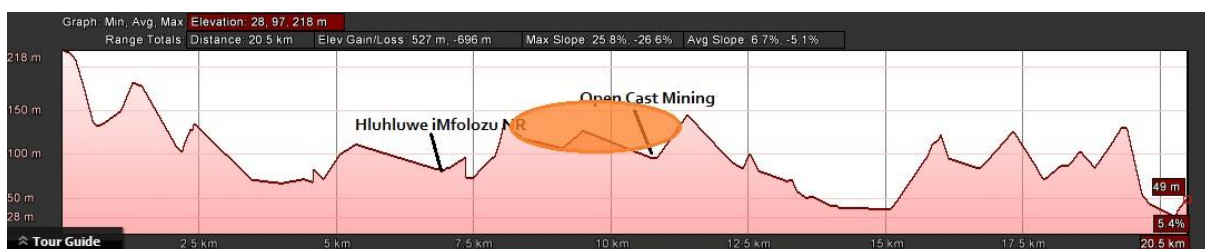


Figure 70: Elevation profile of the southern mining areas

An elevation profile from the southern mining areas indicates a possible secondary viewing area. However the distance from the mining areas will limit the impact.

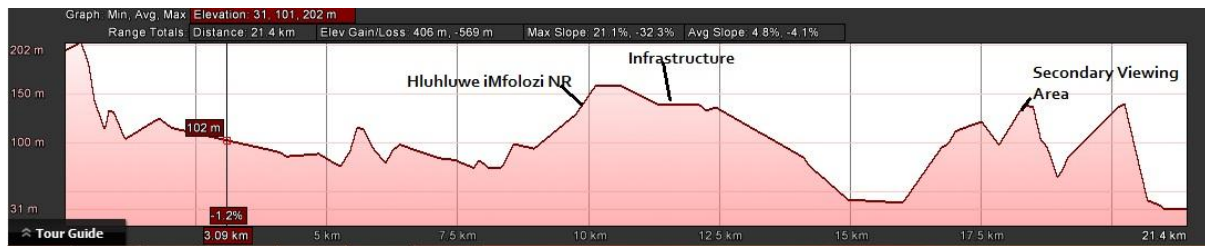


Figure 71: Possible secondary viewing area of the southern mining areas

Various north-south elevation profiles were taken to conclude on the potential visual impact. A north-south elevation profile through all the mining areas is indicated below.



Figure 72: Elevation profile through mining areas from north to south

A full viewshed analysis will be conducted during the EIA Phase.

5.2.7.5 Lighting

Skyward orientated lighting (up light) or lighting that is not directed in a specific direction often causes “skyglow”, which is a form of light pollution. This is the night-time brightening of skies, particularly over urban areas, caused by scattering (redirecting) of light in the atmosphere back towards the ground. The glow is caused by the scattering of artificial light by water droplets and dust in the air. The stray light mostly comes from poorly designed and improperly aimed light, and from light reflected from over-lit areas. This effect is currently very noticeable at night and in the early morning at mining operations (ASSA, 2012).

The effects of lighting are especially problematic in rural areas. Fuleni is a rural area with little or no night time lighting currently impacting on the project area. The impact from the mining development and mining operations during night time hours will have a big lighting impact in such a rural area. Other current lighting impacts include Somkhele mining operations and lodges located in the area. There are no street lights in the area. The impact of lighting in the area will be perceived negative high to medium without mitigation. Tourist in the wilderness area of the nature reserve will perceive the lighting impact as negative high.

5.2.7.6 Factors impacting on the Sense of Place

Apart from visibility of static components such as the processing plant, stockpiles and infrastructure, the following secondary effects of mining operations adversely affect the quality of the landscape and the sense of place on a wider scale:

- **Transport:** The roads in the area are not paved and needs upgrading before it can be utilised for coal transport. The volume of traffic on the roads is quite low and it is evident on the amount of pedestrians utilising the entire road surface. The type of vehicles may invoke negative perceptions from residents and other road users, especially where these are considered to be causing road deterioration, accidents and dust pollution.
- **Dust:** Dust is an inevitable result of transportation of coal. Although mitigation measures can be put in place to minimize this, it must still be considered as a possibility which might negatively influence sensitive viewers.
- **Noise:** This could potentially have a huge impact on the sense of place, especially during night-time.

Rehabilitation is extremely important to limit the impact on the sense of place. Rehabilitation must occur concurrent to the mining activities and effort must be made to restore the environment to pre-mining conditions as soon as possible.

During the construction phase, effort must be made to avoid bright colours with high reflection values. Grey to olive green colours in a matt finish contribute to the assimilation of features with natural backgrounds. This should be effective from distances of 3km and beyond. Further studies with regard to predominant colour reflection for this area should be considered.

5.2.7.7 Conclusions

Fuleni will be located in a high density rural area where limited development has occurred. The intrinsic visual impact of mining and processing operations is normally high, especially where it is placed in an undeveloped natural area. The Fuleni Project could therefore potentially have a large impact on the sense of place of the area.

From the preliminary assessment above, the following can be concluded:

- The visual impact for the mining operations and the infrastructure is fairly localised due to the topography of the area. The core area of visual impact is within 3-7 km from the activity. Visibility is therefore limited to the sensitive receptors in the area.
- The impact on the Hluhluwe-iMfolozi Nature Reserve is limited.
- The activities will not be visible from tourist and main roads.
- The nature and the intensity of visual impacts is limited to a small area, however the duration of the impact as well as the probability of occurrence is quite high. Rehabilitation of the open cast areas and the stockpiles is very important to limit the visual impact.

5.2.8 CUMULATIVE IMPACTS

The potential cumulative impact associated with the Fuleni Project will be investigated during the EIA phase, and will include the impact on the following environmental aspects:

- Bulk water requirements
- Bulk power requirements
- Vegetation clearance
- Land use / land capability
- Groundwater impact zone (quality and quantity)
- Surface water run-off (yield impact)
- Ambient air quality and noise levels

The following cumulative socio-economic impacts need to be considered:

- Community health impacts
- Heritage and cultural impacts
- Increased regional economic development and job creation
- Regional community development and investment (Social and Labour Plan)
- Increased traffic along provincial roads
- Social Capital and Services
- Infrastructure requirements and housing
- Water and sanitation
- Subsistence farming practices

The impact will be quantified as far as possible based on available information; however, not all information will be readily available due to possible confidentiality and the level of technical detail. The cumulative impact will therefore not be determined to the same level as the impact associated with the Fuleni Project.

5.3 CONCERNS RAISED BY IAPS

The relevant queries and concerns raised by IAPs so far include the following:

Employment:

- The number of job opportunities to be created.
- The shareholding, make-up and BEE status of the applicant mining company.

Consultation:

- More direct consultation with the relevant rural communities required.
- The community needed to play a bigger role in terms of information sharing.

Environmental:

- Close proximity to Hluhluwe-iMfolozi Game Reserve
- Visual impacts
- Water resource impacts
- Blasting and air quality impacts
- Strict licensing and permit procedures need to be followed

Social and socio-economics:

- Avoidance of creating expectations.

6 LAND USE OR DEVELOPMENT ALTERNATIVES

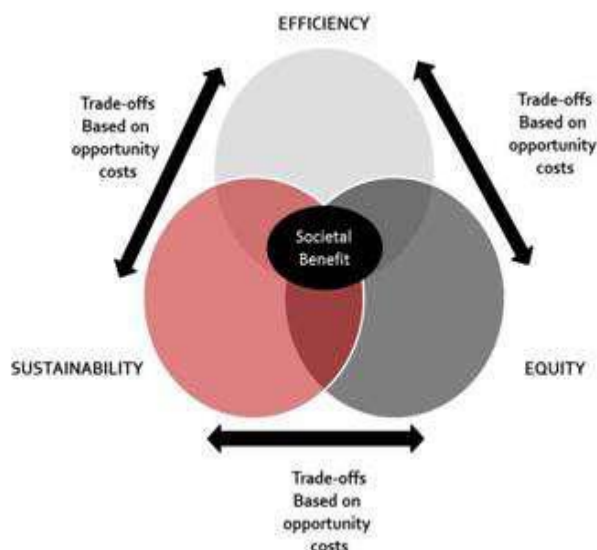
6.1 LAND USE ALTERNATIVE

The existing land use can be described as rural residential, either in a scattered pattern or clustered into small villages. Subsistence agriculture is practiced.

The proposed site is bordered to the north-west by the Hluhluwe-iMfolozi Game Reserve which is administered by Ezemvelo KZN Wildlife. The Somkhele Mine lies to the north of the proposed Fuleni Project.

The way forward is to collect site specific data to determine the comparative feasibility of each one of the alternatives and also the impact on local activities. A macro-economic study is also planned to determine the macro-economic indicators and assist in identifying the best alternative land use option.

The basic function of this specialist study would be to determine whether the Fuleni Project will enhance net societal welfare. At a broad level, investigating impacts on overall welfare requires considering the efficiency, equity and sustainability of the project. Keeping these principles in mind, the core concept applied by the economist when considering trade-offs is “opportunity cost” – the net benefit that would have been yielded by the next best alternative. This is the net benefit that would have been yielded by the next best alternative (for example, if farming is the next best alternative for a piece of land, then the foregone benefit associated with it will be the opportunity cost of any other land use). It is vital information if decision makers are to understand the trade-offs involved in projects. A key part of considering opportunity costs is commonly to highlight the impacts of doing nothing i.e. the “no-go alternative” or also known as the “economic baseline”.



It shows how efficiency, equity and sustainability combine to impact on societal welfare and how trade-offs need to be made between these issues, taking cognizance of opportunity costs.

The principle of efficiency raises the issue of whether alternative forms of a project would constitute a more efficient use of resources.

The equity principle requires the consideration of whether the project results in outcomes that can be considered “fair”. Investigating the distribution of impacts is required to clearly indicate who is impacted on, in what way and for what period.

Sustainability related issues include a consideration of whether the project is likely to be financially viable over the long term and whether it will be ecologically sustainable. Risks to the long-term success of the project, including factors such as changing interest and exchange rates, become important here.

The economic study will thus, for the mining and beneficiation operations, product transport and other associated infrastructure, include:

- Evaluate economic trade-offs between:
 - community use (i.e. rural settlements and communal land use); and
 - bio-experience (i.e. conservation / ecotourism) land use activities.
- Assess the influence of the planned development (i.e. resource use restrictions, and especially rights to use and benefit from resources) on the magnitude and adaptability of land use activities and livelihood systems.
- Assess the vulnerability of land use activities to disease emergence.

The key issues that will be considered and addressed by the specialist can be summarized as follows:

- Environmental and social externalities that are not accounted for in financial costs and benefits, but must be addressed in terms of economic costs and benefits.
- The economic sustainability of the project over the medium term.
- Degree of fit with economic development planning in the area (i.e. does the project compliment economic and spatial plans).
- Linkage effects that allow a project to generate added benefits in the form of employment, incomes, increased production.

Macro-economic risks (i.e. whether the project has the potential to impact on exchange rates, balance of payments, interest rates or local factor and product prices).

The finalization of the baseline studies should clarify the existence of any economic threats to existing land use / enterprises or high risk areas which will be elaborated upon in the EIA/EMP report.

Should the proposed mining activities have negative effects, still to be identified by the environmental impact modelling, possible land use alternatives for the current practices must be considered.

6.2 DEVELOPMENT ALTERNATIVES

Infrastructure to support the mining activities has been laid out and engineered to best suit the topography and mining pit layouts, and is described in Section 4 of this report. However, the final positions and alternatives can still be influenced by the EIA and stakeholder engagement process.

6.2.1 LOCATION OF FULENI CHPP

At the commencement of the investigations, 4 alternative locations for the beneficiation area were identified. These locations were selected on the basis of topography, contiguous available area, distance from proposed open cast pits, storm-water catchments, distance from nearest dwellings and distance from product delivery route.

- Alternative A: Alternative A was positioned to the West of Pit4 and was discarded due to its proximity to the National Park boundary.
- Alternative B: Alternative B was positioned to the South-East of Pit 3 and was discarded due to the site falling within an ecologically sensitive area.
- Alternative C: Alternative C was positioned to the East of Pit 4 and was discarded because it would entail the re-location of the local community.
- Alternative D: Alternative D is the site selected due to its minimum impact on the sensitive areas and because it require the least storm-water management. This is the site as shown on the various plans.

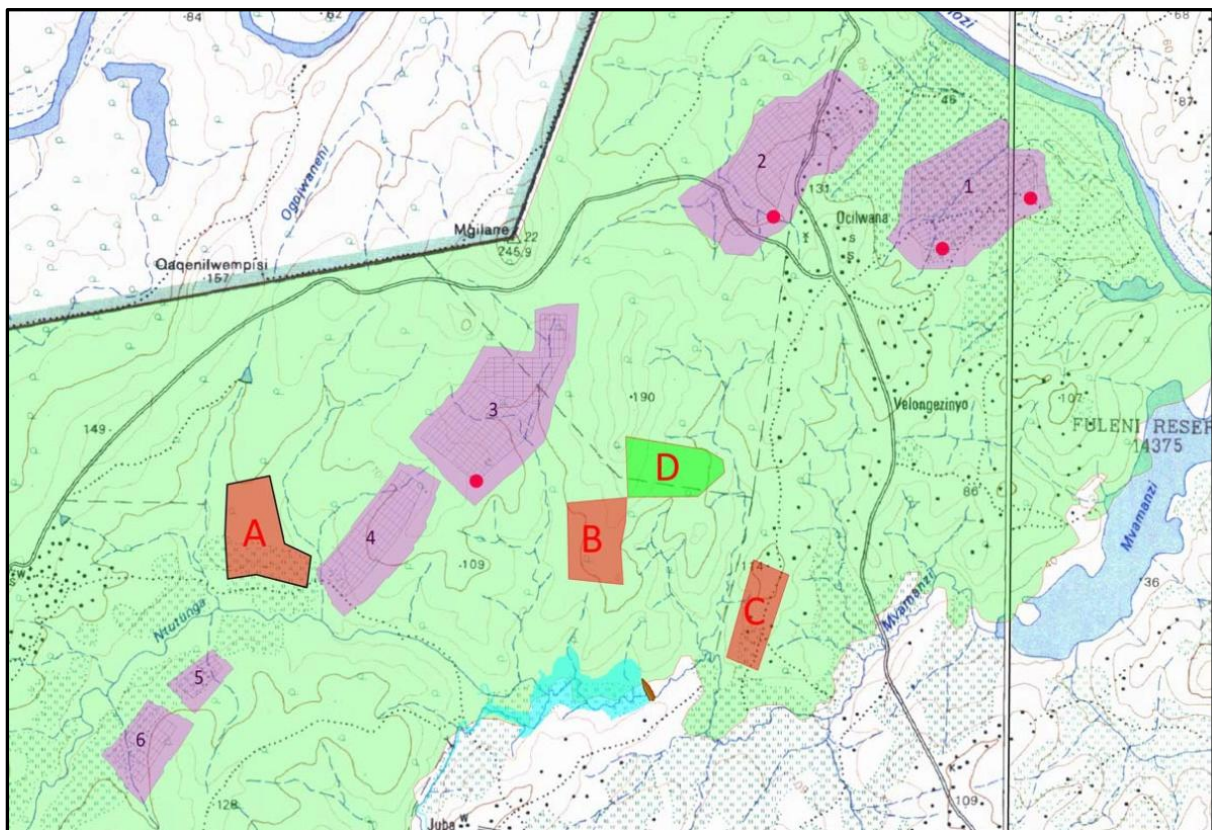


Figure 73: Alternative locations investigated for the Fuleni CHPP

6.2.2 PRODUCT HAULAGE

Five alternative routes for haulage of product from the mine to Richards Bay are being investigated, but the final route has not yet been decided. The roads that will be used as the access route to and from the mine will need to be upgraded.

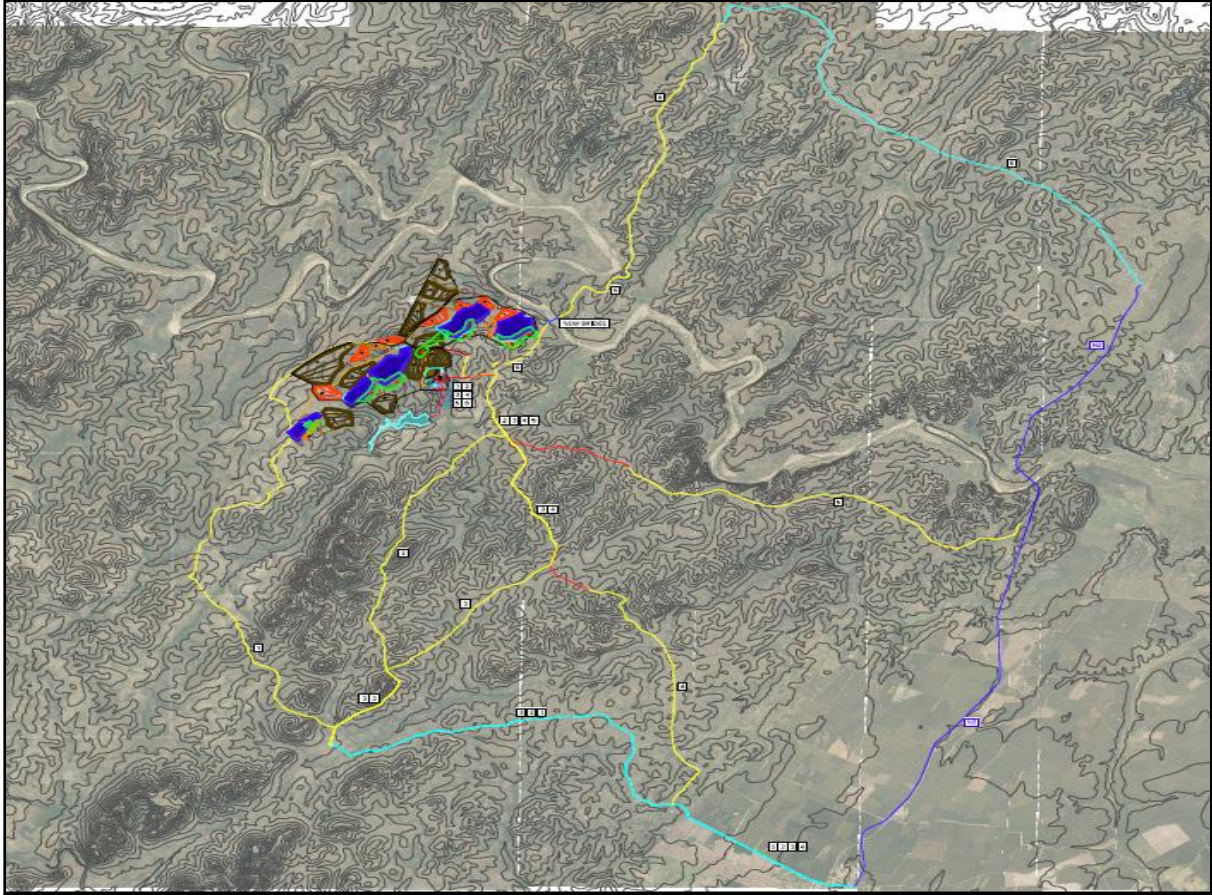


Figure 74: Alternative routes for product haulage

6.2.3 WATER SOURCES

The following water sources have been investigated:

- Direct abstraction from the Mfolozi River: The Mfolozi River is a water-stressed river and it is unlikely that the DWA will grant a permit to abstract water directly from the river.
- Boreholes: From the various geotechnical investigations it was shown that there is little likelihood of finding sufficient underground water for the mine.
- Off-channel storage from the Mfolozi River: Off-channel storage utilising flood water from the Mfolozi River. A desktop study revealed that the topography of the area did not lend itself to any viable or economical solution using this idea.
- Supply dam on the Utuntunga Stream: The Utuntunga Stream, which passes about 1 km south of the plant area and flows into the Mfolozi River, appears to be a viable source if some storage is provided. The position of the Supply Dam is shown in Figure 56.

In addition to the above, an additional source of water is the rainfall falling on the site, together with the re-use of water draining from the site. Treated sewage effluent will also be recycled via the Polcon Dams.

6.2.4 MINE RESIDUE MANAGEMENT

6.2.4.1 Slurry Management

Two options were evaluated:

- Surface slurry ponds
- Inclusion of filter press within the system

The inclusion of a filter press within the process would facilitate increased recycling of water, reduce the risk of spillages and acid-mine drainage and limit the impact on air quality as the residue will be consolidated. Thus, even though this would mean a higher capital cost input, from an environmental perspective this is the preferred option.

6.2.4.2 Discard Management

Three options were evaluated for the management of the mine residue (discard and slurry) associated with the proposed project. Two surface facilities were looked at, namely surface discard dumps and slurry facilities and a co-disposal facility catering for both. The third option that was evaluated is in-pit disposal of mine residue during rehabilitation of the opencast pits.

From a groundwater perspective, the in-pit disposal is the option that would (potentially) cause the least impact owing to the fact that the acid-forming residue could be placed at the bottom of the pit, allowing the residue to be inundated with water. This would reduce the potential for oxidation and the formation of acid-mine drainage.

In-pit disposal would also facilitate a free-draining final profile which from a visual and end-land use perspective is the preferred option. Surface residue facilities would have a huge visual impact as well as long-term maintenance issues.

Due to constraints in the mining schedule and the bulking factor of the overburden, a temporary discards stockpile will be constructed at the plant area to accommodate the surplus discard until such time as sufficient pit space is available for in-pit disposal.

6.3 PROPOSALS BY IAPS ON ALTERNATIVE OPTIONS

No alternative options were proposed by stakeholders on the Fuleni Project to date. A concerted effort will be made during the various engagement sessions planned for the EIA Phase to stimulate two-way engagement on specific issues, including alternative development / land use options.

7 STAKEHOLDER ENGAGEMENT

7.1 INTRODUCTION

Public participation provides the opportunity for IAPs to participate on an informed basis, and to ensure that their needs and concerns are considered during the impact assessment process. The Public Participation Process is aimed at achieving the following:

- Provide opportunities for IAPs and the authorities to obtain clear, accurate and understandable information about the expected environmental and socioeconomic impacts of the proposed development;
- Establish a formal platform for the public with the opportunity to voice their concerns and to raise questions regarding the project;
- Utilise the opportunity to formulate ways for reducing or mitigating any negative impacts of the project, and for enhancing its benefits;
- Enable project proponent to consider the needs, preferences and values of IAPs in their decisions;
- Clear up any misunderstandings about technical issues; and
- Provide a proactive indication of issues which may inhibit project progress resulting in delays, or which may result in enhanced and shared benefits.

7.2 IAP NOTIFICATION AND CONSULTATION – SCOPING PHASE

The summary record of IAP notification and consultation during the Scoping Phase is attached as Appendix 1.

8 PLAN OF STUDY

8.1 SPECIALIST STUDIES

8.1.1 SOIL, LAND USE AND CAPABILITY

A study of the diagnostic soil horizons and soil forms for the area, including an assessment of effective profile depth and the classification of soils according to the South African Soil Classification System (MacVicar et al, 1991) will be conducted. The areas that comprise the mining area, as well as the areas where infrastructure are envisaged to be built will be surveyed on a 150 m grid. This comprises a total of 651 ha. A buffer area, comprising a further 651 ha and surrounding the areas impacted by mining and infrastructure, will also be surveyed on a 150 m grid. A soil map, land use map, land capability map, wetland map and soil utilisation map will be compiled for the rest of the mining area using the land type data of the ARC and predictive soil mapping.

- An assessment of the pedohydrological functioning of the area in order to shed light on the water storage capacity of the soils and plant available water, as well as to aid in the delineation of wetland systems will be conducted. Characteristics that will be noted include:
 - Fe(II)/Fe(III) layered double hydroxides (green rusts) that is indicative of moderate conditions of reductions and soils that are moist for prolonged periods;
 - The accumulation of ferrihydrate, lepidocrocite, goethite and hematite in vesicular nodules (mottling) owing to the reduction of Fe(III) to Fe(II), under conditions of a fluctuating water table;
 - The occurrence of grey colours, especially where mottling is not present, as a further indication of Fe mobilisation and semi-permanent or permanent conditions of water saturation;
 - The occurrence of bleached soil horizons that indicate lateral drainage of water;
 - The occurrence of uniform red and yellow colouration that is indicative of well drained areas;
 - Signs of Mn mobilisation and/or precipitation as indicating a fluctuating water table;
 - The occurrence of smectite clays that lead to swelling and shrinking characteristics in soil and that is conducive to water flow in the dry state but not in the wet state;
 - Texture of the soil horizons as a means to assess the water holding capacity, saturated water content and saturated hydraulic conductivity;
 - Textural changes, and other aspects, in the soil profile that will influence saturated and unsaturated flow of water;
 - Occurrence of layers, such as the rocks, ferricrete and/or calcrete, which impede water flow; and
 - Occurrence of concretions, stones or pebbles in the soil horizons and the effect on water holding capacity, saturated water content and saturated hydraulic conductivity.
- Representative soil samples will be collected and subjected to the following chemical and physical analyses:
 - pH and EC (electrical conductivity): Directly influences plant growth and crop yield;

- Exchangeable/weakly complexed fraction of major cationic plant nutrients – calcium (Ca), sodium (Na), magnesium (Mg), potassium (K);
- Plant available phosphorus (P) and nitrogen content;
- Organic carbon content; and
- Soil particle size distribution (texture including clay content).
- Mitigation measures, as well as a rehabilitation plan, to be put in place during and after mining in order to minimize the impact of mining on the environment will be proposed.

8.1.2 BIODIVERSITY

8.1.2.1 Faunal Assessment

Prior to the faunal field assessment use will be made of topographical and aerial maps to identify “areas of faunal interest” regarded as representative of the different habitat units within the study area. Attention will also be given to data from national and provincial databases, such as the KwaZulu-Natal Nature Conservation Management Act (Act No 5 of 1999) and the recent South African National Biodiversity Assessment (NBA) report of 2011 (which includes the recent BGIS dataset which has been compiled by South African National Biodiversity Institute (SANBI)). Special emphasis will be placed on habitat that may support faunal species of concern that are listed in the KwaZulu-Natal Nature Conservation Management Act (Act No 5 of 1999), NBA 2011 report and IUCN.

The latest NBA 2011 report provides an assessment of South Africa’s biodiversity and ecosystems, including headline indicators and national maps for terrestrial environments. The NBA 2011 report was led by SANBI in partnership with a range of organisations, including the Department of Environmental affairs (DEA), Council for Scientific and Industrial Research (CSIR) and SANParks (South African National Parks). The NBA 2011 data includes a summary of spatial biodiversity priority areas that have been identified through systematic biodiversity plans at a national, provincial and local level which are ideal for investigating vast areas such as new mining areas.

Thus, all relevant authorities are to be consulted regarding conservational species lists, as well as all the latest available literature utilised to gain a thorough understanding of the study area and its surrounding habitats. This information and further literature reviews will then be used to determine the potential biodiversity lists for the proposed development site and surrounding areas. This information incorporated (amongst others) data on vegetation types, faunal habitat suitability and biodiversity potential coupled to this information.

Prior to the field visit, a record of the faunal RDL and protected species as well as habitat that may support these species will be acquired from the KwaZulu-Natal Nature Conservation Management Act (Act No 5 of 1999) and from the NBA (2011).

During the detailed field assessment, focus will be placed on the occurrence of RDL and/or protected faunal species which are known to occur in the area. Furthermore, a detailed inventory of faunal species encountered through either direct observation and/or field signs will be compiled.

8.1.2.1.1 Mammals

Small mammals are unlikely to be directly observed in the field because of their nocturnal/crepuscular and cryptic nature. A simple and effective solution to this problem is to use Sherman traps. A Sherman trap is a small aluminium box with a spring-loaded door. Once the animal is inside the trap, it steps on a small plate that causes the door to snap shut, thereby capturing the individual. Trapping will take place within relatively undisturbed small mammal habitat identified throughout the study area. In the event of capturing a small mammal during the night, the animal would be photographed and then set free unharmed early the following morning. Traps will be baited with a universal mixture of oats, peanut butter, fish paste and syrup.

Medium and larger faunal species will be recorded during the field assessment with the use of visual identification as well as where, spoor, call, or dung samples can be positively identified.

8.1.2.1.2 Avifauna

Field surveys will be undertaken using a pair of Vespa 7x50 binoculars and bird call identification (vocalisation) practices. The Birdlife South Africa avifaunal database for EIA reports along with Southern African Bird Atlas Project 2 (www.sabap2.org) data will be used to compare with birds identified during the field survey within the study area. Unique avifaunal habitat will also be noted.

8.1.2.1.3 Reptiles

Reptile species encountered will be identified. Specific attention will be paid to priority areas which may provide habitat for RDL reptile species such as rocky outcrops.

8.1.2.1.4 Amphibians

Amphibian species flourish in and around wetland and riparian areas. Priority areas most suited for amphibian species will be investigated. During the field assessment stage, visual identification along with other identification aids such as call identification will be used. Any habitat encountered that may provide suitable habitat for RDL amphibian species will be noted.

8.1.2.1.5 Invertebrates, scorpions and spiders

At specific priority areas, and if applicable, sweep nets will be used to capture and help identify invertebrate species. Insects that will be captured in the sweep nets will be placed inside an emergence box enabling easy identification. An emergence box is a black plastic box which holds all invertebrate species captured. The box is sealed with a lid thus making the box dark. At one side of the box there is a hole where sunlight filters into the box. At this hole there is a transparent plastic container which contains 30% ethanol concentrate. The netted and boxed insects seek out the sunlight and are captured in the plastic container. This method ensures that a diverse range of general invertebrates are identified and allows for comprehensive invertebrate collection. In addition where applicable, pit fall traps will be used at priority areas. The pit fall traps will be left over night and throughout the day to capture ground dwelling invertebrates.

8.1.2.1.6 Red Data species assessment

Given the restrictions of field assessments to identify all the faunal species that possibly occur on a particular property, the Red Data Sensitivity Index (RDSIS) has been developed to provide an indication of the potential red data faunal species that could reside in the area, while simultaneously providing a quantitative measure of the subject property's value in terms of conserving faunal diversity. The RDSIS is based on the principles that when the knowledge of the species' historical distribution is combined with a field assessment that identifies the degree to which the property supports a certain species habitat and food requirements, inferences can be made about the chances of that particular species residing on the property. Repeating this procedure for all the potential red data faunal species of the area and collating this information then provides a sensitivity measure of the property that has been investigated.

RDSIS Score	RDL faunal importance
0-20%	Low
21-40%	Low-Medium
41-60%	Medium
60-80%	High-Medium
81-100%	High

8.1.2.1.7 Sensitivity mapping

All results obtained during the literature review as well as field assessments will be used to map each habitat unit according to sensitivity. A Geographic Information System (GIS) will be used to project these features onto aerial photographs and topographic maps. The sensitivity map should guide the design and layout of the proposed mining development.

8.1.2.2 Floral Assessment

8.1.2.2.1 General methodology

In order to accurately determine the desktop level Present Ecological State (PES) of the study area and capture comprehensive data with respect to floral taxa the following methodology was used:

- Maps, aerial photographs and digital satellite images were consulted in order to determine broad habitats, vegetation types and potentially sensitive sites.
- A literature review with respect to habitats, vegetation types and species distribution was conducted.
- Relevant data bases considered during the assessment of the study area included South African National Biodiversity Institute (SANBI) Threatened Species Programme (TSP) and Pretoria Computer Information Systems (PRECIS) and the SANBI Biodiversity Geographic Information Systems (GIS) database (BGIS).

8.1.2.2.2 Field surveys

The overall vegetation survey will be conducted by first identifying different habitat units and then analysing the floral species composition. Vegetation analyses will be conducted within areas that are

perceived to best represent the various plant communities. Species will be recorded and a species list will be compiled for each habitat unit. These species lists will also be compared with the vegetation expected to be found within the *Northern Zululand Sourveld* and the *Zululand Lowveld* vegetation types, which will serve to provide an accurate indication of the ecological integrity and conservational value of each habitat unit.

8.1.2.2.3 Transects

All transects will be located within what may be considered to be open grassland habitat. A walking stick will be used that will be placed at 1m intervals and the plant species or biophysical feature falling closest to the point of the stick will be identified. These data points will be developed along 100m long transect lines, making for 100 data points along a single transect. Species lists will be compiled and species composition analysed along the selected transect lines, where after the data will be analysed and the percentage contribution of the various floral species for each transect line will be calculated. These species lists are then to be compared with the vegetation expected to be found in the *Northern Zululand Sourveld* and the *Zululand Lowveld* vegetation types, which will assist in providing an accurate indication of the ecological integrity and conservational value of each assessment unit.

If the species composition is quantitatively determined and characteristics of all components of the floral community are taken into consideration, it is possible to determine the PES of the portion of land represented by an assessment point/ transect line. Any given grass species is specifically adapted to certain growth conditions. This sensitivity to specific conditions make grasses good indicators of veld conditions. This section will summarise the dominant floral species identified within each transect with their associated habitats and optimal growth conditions with reference to the table below.

Description of Grass species classes and the ecological condition indicated	
Pioneer	Hardened, annual plants that can grow in very unfavourable conditions. In time improves growth conditions for perennial grasses.
Subclimax	Weak perennials denser than pioneer grasses. Protects soils leading to more moisture, which leads to a denser stand, which deposits more organic material on the surface. As growth conditions improve climax grasses are replaced by subclimax grasses.
Climax	Strong perennial plants adapted to optimal growth conditions.
Decreaser	Grasses abundant in good veld.
Increaser I	Grasses abundant in underutilized veld.
Increaser II	Grasses abundant in overgrazed veld.
Increaser III	Grasses commonly found in overgrazed veld.

8.1.2.2.4 Vegetation Index Score

The Vegetation Index Score (VIS) was designed to determine the ecological state of each habitat unit defined within an assessment site. This enables an accurate and consistent description of the PES concerning the subject property in question. The information gathered during these assessments also significantly contributes to sensitivity mapping, leading to a more truthful representation of ecological value and sensitive habitats.

Each defined management unit is assessed using separate data sheets and all the information gathered then contributes to the final VIS score. The VIS is derived using the following formulas:

$$\text{VIS} = [(\text{EVC}) + (\text{SI} \times \text{PVC}) + (\text{RIS})]$$

Where:

- EVC is extent of vegetation cover;
- SI is structural intactness;
- PVC is percentage cover of indigenous species and
- RIS is recruitment of indigenous species.

The final VIS scores for each habitat unit are then categorised as follows:

Vegetation Index Score	Assessment Class	Description
25	A	Unmodified, natural
20 to 24	B	Largely natural with few modifications.
15 to 20	C	Moderately modified
10 to 15	D	Largely modified
5 to 10	E	The loss of natural habitat extensive
<5	F	Modified completely

8.1.2.2.5 Red Data species assessment

During the field assessment, the presence of protected and/or RDL floral species will be investigated. Furthermore, all floral species of medicinal value will be recorded. Alien and invasive species will also be recorded. In addition, vegetation communities/habitat units will be assessed in detail, along with the overall veld condition and habitat integrity of these units.

8.1.2.2.6 Sensitivity mapping

All sensitive features and or habitats (including localities of RDL/protected floral species, wetlands, rivers and ridges) will be mapped utilising a Geographical Positioning System (GPS) and a sensitivity map will be compiled. This sensitivity map will aim to guide the design of the proposed mining development in order to have the least ecological impact on the receiving environment.

8.1.3 WETLAND ASSESSMENT

8.1.3.1 National Wetland Classification System

All wetland features encountered within the study area will be assessed using the Classification System for Wetlands (hereafter referred to as the 'Classification System') and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis et al., 2013).

A summary of Levels 1 to 4 of the Classification System for Inland Systems are presented below.

Table 36: Classification structure for Inland Systems, up to Level 3

WETLAND / AQUATIC ECOSYSTEM CONTEXT		
LEVEL 1: SYSTEM	LEVEL 2: REGIONAL SETTING	LEVEL 3: LANDSCAPE UNIT
Inland Systems	DWA Level 1 Ecoregions OR NFEPA WetVeg Groups OR Other special framework	Valley Floor
		Slope
		Plain
		Bench (Hilltop / Saddle / Shelf)

Table 37: Hydrogeomorphic (HGM) Units for Inland Systems, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	B	C
River (Channel)	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional stream	Active channel
		Riparian zone
	Upper foothill rivers	Active channel
		Riparian zone
	Lower foothill rivers	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
Channelled valley-bottom wetland	(not applicable)	(not applicable)
		(not applicable)
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
		(not applicable)
Floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

8.1.3.1.1 Inland systems

For the purposes of the Classification System, Inland Systems are defined as an aquatic ecosystem that have no existing connection to the ocean (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but which are inundated or saturated with water, either permanently or periodically.

It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

8.1.3.1.2 Level 1: Ecoregions

For Inland Systems, the regional spatial framework that has been included at Level 2 of the Classification System is that of DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans et al., 2005). There are a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland. DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

8.1.3.1.3 Level 2: NFEPA Wet Veg Groups

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) groups vegetation types across the country according to Biomes, which are then divided into Bioregions – composite spatial terrestrial units defined on the basis of similar biotic and physical features and processes at the regional scale (Mucina and Rutherford, 2006).

To categorise the regional setting for the wetland component of the NFEPA project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting Bioregions into smaller groups through expert input (Nel et al., 2011). There are currently 133 NFEPA WetVeg Groups, and it is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

8.1.3.1.4 Level 3: Landscape Units

At Level 3 of the Classification System for Inland Systems, a distinction is made between four Landscape Units on the basis of the landscape setting (i.e. topographical position) within which a Hydrogeomorphic (HGM) Unit is situated, as follows (Ollis et al., 2013):

- Slope: An inclined stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley.
- Valley floor: The base of a valley, situated between two distinct valley side-slopes.
- Plain: An extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land.
- Bench (hilltop/saddle/shelf): An area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately perpendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat

areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

8.1.3.1.5 Level 4: Hydrogeomorphic Units

Eight primary HGM Types are recognised for Inland Systems at Level 4A of the Classification System, on the basis of hydrology and geomorphology (Ollis et al., 2013), namely:

- Channel (River): A linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.
- Channelled valley-bottom wetland: A valley-bottom wetland with a river channel running through it.
- Unchannelled valley-bottom wetland: A valley-bottom wetland without a river channel running through it.
- Floodplain wetland: The mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank.
- Depression: A landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates.
- Wetland Flat: A level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat.
- Seep: A wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the Classification System to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for “channel”, “flat” and “valleyhead seep”) is used, for example, in the tools developed as part of the Wetland Management Series including WET-Health (Macfarlane et al., 2008) and WET-EcoServices (Kotze et al., 2009).

Healthy wetlands are known to provide important habitats for wildlife and to deliver a range of important goods and services to society. Management of these systems is therefore essential if these attributes are to be retained within an ever changing landscape. The primary purpose of this assessment is to evaluate the ecophysical health of wetlands, and in so doing promote their conservation and wise management.

At Level 4B of the classification system, certain of the primary HGM Units can further be divided into sub-categories on the basis of longitudinal geomorphological zonation or localised landform, as follows:

- Channels (including their banks) are divided into six primary longitudinal zones and three zones associated with a rejuvenated longitudinal profile, according to the geomorphological zonation scheme of Rowntree & Wadeson (2000). The sub-categories are Mountain Headwater Stream, Mountain Stream, Transitional River, Upper Foothill River, Lower Foothill

River, and Lowland River (i.e. the primary zones); and Rejuvenated Bedrock Fall, Rejuvenated Foothill River, and Upland Floodplain River (i.e. the zones associated with a rejuvenated long profile).

- Channelled and unchannelled valley-bottom wetlands are divided into 'valley-bottom flats' and 'valley-bottom depressions'.
- Floodplain wetlands are divided into 'floodplain depressions' and 'floodplain flats'.

8.1.3.2 WET-Health

Two levels of assessment are provided by WET-Health:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where a large number of wetlands need to be assessed at a very low resolution;
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment.

A set of three modules has been synthesised from the set of processes, interactions and interventions that take place in wetland systems and their catchments: hydrology (water inputs, distribution and retention and outputs), geomorphology (sediment inputs, retention and outputs) and vegetation (transformation and presence of introduced alien species).

Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described under the Classification System for Wetlands and other Aquatic Ecosystems.

8.1.3.2.1 Quantification of Present State of a wetland

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. This takes the form of assessing the spatial extent of impact of individual activities and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The impact scores and Present State categories are provided below.

Table 38: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands

Description	Combined impact score	PES Category
Unmodified, natural.	0-0.9	A
Largely natural with few modifications. A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2-3.9	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 - 10	F

8.1.3.2.2 Assessing the anticipated trajectory of change

As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change.

Table 39: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland

Change Class	Description	HGM change score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

8.1.3.2.3 Overall health of the wetland

Once all HGM Units have been assessed, a summary of health for the wetland as a whole needs to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM Unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provides a summary of impacts, Present State, Trajectory of Change and Health for individual HGM Units and for the entire wetland.

8.1.3.3 Ecological Importance and Sensitivity (EIS)

The method used for the Ecological Importance and Sensitivity (EIS) determination was adapted from the method as provided by DWA (1999) for floodplains. The method takes into consideration PES scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS category for the wetland feature or group being assessed.

A series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The median of the determinants is used to assign the EIS category as listed below:

Table 40: EIS Category definitions

EIS Category	Range of Median	Recommended Ecological Category
Very high	>3 and ≤4	A
High	>2 and ≤3	B
Moderate	>1 and ≤2	C
Low/marginal	>0 and ≤1	D

8.1.3.4 Recommended Ecological Category (REC)

“A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability, but carries a higher risk of ecosystem failure.”

The Recommended Ecological Category (REC) was determined based on the results obtained from the VEGRAI, Wet-IHI, WET-Health calculations, reference conditions and Ecological Importance and Sensitivity (EIS) of the resource; followed by realistic recommendations, mitigation, and rehabilitation measures to achieve the desired REC.

A wetland may receive the same category for the REC as the Present Ecological State (PES), if the wetland is deemed in good condition, and it must therefore remain in good condition. Otherwise, an appropriate REC should be assigned in order to prevent any further degradation as well as to enhance the PES of the wetland feature.

Table 41: Description of REC classes

Category	Description
A	Unmodified, natural
B	Largely natural with few modifications
C	Moderately modified
D	Largely modified

8.1.3.5 Wetland Delineation

For the purposes of this investigation, a wetland habitat is defined in the National Water Act (1998) as including the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas.

The wetland zone delineation took place according to the method presented in the final draft of “A practical field procedure for identification and delineation of wetlands and riparian areas” published by the DWA in February 2005. The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

- The presence of water at or near the ground surface;
- Distinctive hydromorphic soils;
- Vegetation adapted to saturated soils; and
- The presence of alluvial soils in stream systems.

By observing the evidence of these features, in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWAF, 2005).

Riparian and wetland zones can be divided into three zones (DWAF, 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant part of the rainy season and the temporary zone surrounds the seasonal zone and is only saturated for a short period of the year, but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soils and the growth of wetland vegetation. The object of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland area.

8.1.4 AQUATIC ASSESSMENT

The assessment of the PES of the system, as well as possible impacts due to the proposed development, will be based on comparisons between observed conditions and the theoretical reference conditions based on desktop information reviews, and from historical data for the area.

The sections below describe the methodology which will be used to assess the aquatic ecological integrity of the various sites based on water quality, in-stream and riparian habitat condition and biological impacts and integrity.

8.1.4.1 Visual Assessment

The assessment site will be investigated in order to identify visible impacts on the site, with specific reference to impacts from surrounding activities and any effects activities occurring upstream in the catchment. Both natural constraints placed on ecosystem structure and function, as well as anthropogenic alterations to the system, will be identified by observing conditions and relating them to professional experience. Photographs of each site will be taken to provide visual indications of the conditions at the time of assessment. Factors which will be noted in the site specific visual assessments include the following:

- Stream morphology;
- In-stream and riparian habitat diversity;
- Stream continuity;
- Erosion potential;
- Depth flow and substrate characteristics;
- Signs of physical disturbance of the area; and
- Other life forms reliant on aquatic ecosystems.

8.1.4.2 Physico Chemical Water Quality Data

On site testing of biota specific water quality variables will take place. Parameters which will be measured include pH, electrical conductivity, dissolved oxygen concentration and temperature. The results of on-site biota specific water quality analyses will be used to aid in the interpretation of the data obtained during the assessment. Results will be discussed against the guideline water quality values for aquatic ecosystems (DWAF 1996 vol. 7).

8.1.4.3 Habitat Suitability

The Invertebrate Habitat Assessment System (IHAS) will be applied according to the protocol of McMillan (1998). This index will be used to determine specific habitat suitability for aquatic macro-invertebrates, as well as to aid in the interpretation of the results of the South African Scoring System version 5 (SASS5) scores. Scores for the IHAS index will be interpreted according to the guidelines of McMillan (1998) as follows:

- <65%: habitat diversity and structure is inadequate for supporting a diverse aquatic macro-invertebrate community.
- 65%-75%: habitat diversity and structure is adequate for supporting a diverse aquatic macro-invertebrate community.
- >75% habitat diversity and structure is highly suited for supporting a diverse aquatic macro-invertebrate community.

8.1.4.4 Habitat Integrity

It is important to assess the habitat of each site, in order to aid in the interpretation of the results of the community integrity assessments by taking habitat conditions and impacts into consideration. The general habitat integrity of the site will be discussed based on the application of the Intermediate Habitat Integrity Assessment for (Kemper; 1999). The Intermediate Habitat Integrity Assessment (IHIA) protocol, as described by Kemper (1999), will be used for site specific assessments. This is a simplified procedure, which is based on the Habitat Integrity approach developed by Kleynhans (1996). The IHIA is conducted as a first level exercise, where a comprehensive exercise is not practical. The Habitat Integrity of each site will be scored according to 12 different criteria which represent the most important (and easily quantifiable) anthropogenically induced possible impacts on the system. The in-stream and riparian zones will be analysed separately, and the final assessment will be made separately for each, in accordance with Kleynhans' (1999) approach to Habitat Integrity Assessment. Data for the riparian zone are, however, primarily interpreted in terms of the potential impact on the in-stream component. The assessment of the severity of impact of modifications is based on six descriptive categories with ratings. Analysis of the data will be carried out by weighting each of the criteria according to Kemper (1999). By calculating the mean of the in-stream and riparian Habitat Integrity scores, an overall Habitat Integrity score can be obtained for each site. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitats of the site. The method classifies Habitat Integrity into one of six classes, ranging from unmodified/natural (Class A), to critically modified (Class F).

Table 42: Classification of Present State Classes in terms of Habitat Integrity [Based on Kemper 1999]

Class	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural, with few modifications. A small change in natural habitats and biota may have taken place but the basic ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Extensively modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances, basic ecosystem functions have been destroyed and the changes are irreversible.	<20

8.1.4.5 Aquatic Macro-Invertebrates

Aquatic Macro-invertebrates will be sampled using the qualitative kick sampling method called SASS5 (South African Scoring System version 5) (Dickens and Graham, 2001). The SASS5 method has been specifically designed to comply with international accreditation protocols. This method is based on the British Biological Monitoring Working Party (BMWP) method and has been adapted for South African conditions by Dr. F. M. Chutter. The assessment was undertaken according to the

protocol as defined by Dickens & Graham (2001). All work will be done by an accredited SASS5 practitioner.

The SASS5 method was designed to incorporate all available biotypes at a given site and to provide an indication of the integrity of the aquatic macro-invertebrate community through recording the presence of various macro-invertebrate families at each site, as well as consideration of abundance of various populations, community diversity and community sensitivity. Each taxon is allocated a score according to its level of tolerance to river health degradation (Dallas, 1997).

This method relies on churning up the substrate with your feet and sweeping a finely meshed SASS net, with a pore size of 1000 micron mounted on a 300 mm square frame, over the churned up area several times. In stony bottomed flowing water biotopes (rapids, riffles, runs, etc.) the net downstream of the assessor and the area immediately upstream of the net is disturbed by kicking the stones over and against each other to dislodge benthic invertebrates. The net is also swept under the edge of marginal and aquatic vegetation to cover from 1-2 meters. Identification of the organisms will be made to family level (Thirion et al., 1995; Davies & Day, 1998; Dickens & Graham, 2001; Gerber & Gabriel, 2002).

Interpretation of the results of biological monitoring depends, to a certain extent, on interpretation of site-specific conditions (Thirion et al., 1995). In the context of this investigation it would be best not to use SASS5 scores in isolation, but rather in comparison with relevant habitat scores. The reason for this is that some sites have a less desirable habitat or fewer biotopes than others do. In other words, a low SASS5 score is not necessarily regarded as poor in conjunction with a low habitat score. Also, a high SASS5 score, in conjunction with a low habitat score, can be regarded as better than a high SASS5 score in conjunction with a high habitat score. A low SASS5 score, together with a high habitat score, would be indicative of poor conditions. The IHAS Index is valuable in helping to interpret SASS5 scores and the effects of habitat variation on aquatic macro-invertebrate community integrity.

Classification of the system will take place by comparing the present community status to reference conditions which reflect the best conditions that can be expected in rivers and streams within a specific area and reflect natural variation over time. SASS and ASPT reference conditions will be obtained from Dallas (2007). Reference conditions are stated as a SASS score of 125 and an ASPT score of 6. Sites will be classified according to the classification system for the Eastern Escarpment Mountains Ecoregion according to Dallas (2007), as well as the classification system of Dickens & Graham 2001.

Table 43: Definition of Present State Classes in terms of SASS scores as presented in Dickens & Graham (2001)

Class	Description	SASS Score%	ASPT
A	Unimpaired. High diversity of taxa with numerous sensitive taxa.	90-100 80-89	Variable >90
B	Slightly impaired. High diversity of taxa, but with fewer sensitive taxa.	80-89 70-79 70-89	<75 >90 76-90
C	Moderately impaired. Moderate diversity of taxa.	60-79	<60

		50-59 50-79	>75 60-75
D	Largely impaired. Mostly tolerant taxa present.	50 - 59 40-49	<60 Variable
E	Severely impaired. Only tolerant taxa present.	20-39	Variable
F	Critically impaired. Very few tolerant taxa present.	0-19	Variable

8.1.4.6 Fish Community Integrity

Whereas macro-invertebrate communities are good indicators of localized conditions in a river over the short-term, fish being relatively long-lived and mobile;

- are good indicators of long-term influences;
- are good indicators of general habitat conditions;
- integrate effects of lower trophic levels; and
- are consumed by humans (Uyset al., 1996).

The Fish Assemblage Integrity Index (FAII) will be applied according to the protocol of Kleynhans (1999). Fish species identified will be compared to those expected to be present at the site, which will be compiled from a literature survey including Skelton 2001. Fish samples will be collected by means of a fixed generator driven electro-fishing device.

Table 44: Definition of Present State Classes in terms of FAII scores according to the protocol of Kleynhans (1999)

Class	Description	Relative FAII score (% of expected)
A	Unmodified, or approximates natural conditions closely.	90-100
B	Largely natural, with few modifications.	80-89
C	Moderately modified. A lower than expected species richness and the presence of most intolerant species.	60-79
D	Largely modified. A clearly lower than expected species richness and absence of intolerant and moderately tolerant species.	40-59
E	Seriously modified. A strikingly lower than expected species richness and a general absence of intolerant and moderately intolerant species.	20-39
F	Critically modified. An extremely lowered species richness and an absence of intolerant and moderately intolerant species.	<20

8.1.5 SURFACE WATER

The main objective of the Surface Water Impact Assessment is to develop a storm water management strategy that would separate clean water and dirty water and control polluted water sources for the life of the project. The mine closure systems are not considered at this stage of the project.

The storm water management strategy will conform to the requirements in the applicable legislation (i.e. the National Water Act and Government Notice GN704 as described in Section 2 of this report). In addition, the methodologies and systems described in DWA's Best Practice Guidelines will be applied, where applicable.

Flood-zones for the 1:100 year return period will be determined and indicated on the infrastructure layout maps. This will only be done after the infrastructure footprints have been finalised in order to identify the relevant affected streams.

The surface water assessment will include proper engineering principles by providing conceptual designs of mitigation measures to ensure that the impact of the mining activity on the environment is limited to designated areas. This will include the provision of lined pollution control dams to contain dirty water. Clean water streams will be diverted by canals and berms to natural water courses and storm water control dams. The conceptual designs are also dependant on the availability of the infrastructure layouts.

The surface water plan will incorporate guidelines to implement preventative measures in the case of extreme flood events exceeding the 1:50 year recurrence period.

During the EIA Phase of the study, another round of baseline water quality samples will be obtained in the wet period for inclusion in the water quality monitoring plan, still to be developed. The monitoring of primary pollution markers may be done on a monthly basis and results will be captured to be incorporated into a quarterly report over the lifespan of the project, which will provide a real time reflection/indication of the activities impacting on the surface water environment. It is however of importance that the monitoring points are only selected after the infrastructure layout plan is available to identify the correct and representative sampling points and determine the frequency of sampling required.

8.1.6 GROUNDWATER

The plan of study for the remainder of the geohydrological investigation can be summarised as follows:

- Additional monitoring boreholes will be proposed to cover all the proposed infrastructure of the project.
- Known or potential sources of groundwater contamination will be identified and assessed.
- Numerical flow and mass transport models will be constructed with the PMWIN 8 (Processing Modflow for Windows 8) software. A comprehensive conceptual model is essential in the construction of a sound numerical flow model. The conceptual model will be postulated after obtaining, processing and interpreting all groundwater and related

information and geology of the area. The model grid will be constructed to include the entire Fuleni mine lease area and measured groundwater hydraulic heads will be used in the calibration process. Once the mine layout and schedule are finalized the flow model (MODFLOW) will predominantly be used to simulate the groundwater level impacts caused by mine dewatering, while the groundwater quality impacts (pollution plumes) will be simulated with the mass transport model (MT3DMS).

- Possible storage/decant volumes, time-to-fill and decant positions will be calculated with the use of numerical model simulations and analytical calculations using the finalised mine layout and schedule.
- Management options (such as lowering the water level within the mine void below the decant elevation) will also be discussed should the results show a high potential for decanting.
- The numerical model will also be used to estimate annual average groundwater seepage rates to the underground workings as part of the environmental groundwater balance.
- Acid Base accounting (ABA) will be conducted on carbonaceous material sampled from the purposely-drilled groundwater monitoring boreholes to determine the acid generating potential of the anthracite coal and overburden.
- All potential impacts from groundwater sources and sinks for the project will be described and rated. The ratings will be made before and after mitigation measures are implemented.
- Management and mitigation options will be proposed.
- A groundwater monitoring protocol to monitor the baseline and potential impacts in and around the project area will be provided in the geohydrological report.
- All the data, interpretation techniques, methodologies and results will be included in the report.

8.1.7 AIR QUALITY

The proposed methodology which will be followed during the air quality impact assessment is provided as follows:

- Determine the atmospheric dispersion potential for the area being assessed;
- Identification of sensitive receptors within close proximity to the proposed operations;
- Identification of other sources within the area impacting on ambient air quality; and
- In order to assess the possible cumulative air quality impacts, monitored ambient and meteorological data will be sourced for the area under investigation. If there is no ambient monitored data available, a qualitative assessment will be undertaken which will evaluate the possible impacts of other polluting sources in the area.

Dispersion modelling will be undertaken using the US-EPA approved AERMOD Dispersion Model. This model is based on the Gaussian plume equation and is capable of providing ground level concentration estimates of various averaging times, for any number of meteorological and emission source configurations (point, area and volume sources for gaseous or particulate emissions).

The AERMOD View model can be used extensively to assess pollution concentrations and deposition from a wide variety of sources. AERMOD View is a true, native Microsoft Windows application and runs in Windows 2000/XP and NT4 (Service Pack 6).

The AERMOD modelling capabilities are summarised as follows:

- AERMOD may be used to model primary pollutants and continuous releases of toxic hazardous waste pollutants;
- AERMOD model can handle multiple sources, including point, volume, area and open pit source types. Line sources may also be modelled as a string of volume sources or as elongated area sources;
- Source emission rates can be treated as constant or may be varied by month, season, hour of day, or other periods of variation, for a single source or for a group of sources;
- The model can account for the effects aerodynamic downwash due to nearby buildings on point source emissions;
- The model contains algorithms for modelling the effects of settling and removal (through dry deposition) of large particulates and for modelling the effects of precipitation scavenging from gases or particulates;
- Receptor locations can be specified as gridded and/or discrete receptors in a Cartesian or polar coordinate system;
- AERMOD incorporates the COMPLEX1 screen model dispersion algorithms for receptors in complex terrain;
- The model uses real-time meteorological data to account for the atmospheric conditions that affect the distribution of air pollution impact on the modelling area; and
- Output results are provided for concentration, total deposition, dry deposition, and/or wet deposition flux.

Input data to the AERMOD model includes: source and receptor data, meteorological parameters, and terrain data. The meteorological data includes: wind velocity and direction, ambient temperature, mixing height and stability class.

The uncertainty of the AERMOD model predictions is considered to be equal to 2, thus it is possible for the results to be over predicting by double or under predicting by half, it is therefore recommended that monitoring be carried out at the proposed mining locations during operation to confirm the modelled results, to finally ensure legal standards are maintained.

The emissions inventory will need to be developed to determine the emissions generated from each source. This is likely to be undertaken using the US-EPA AP42 emission factors. These emission factors will be calculated based on standard operating conditions for various industries, and activities, and are used as an accepted alternative if no site specific or monitored data are available. The inventory will be developed based on the mine and plant operations and will require information relating to processes for mineral concentrate, tonnages processed and mining activity information.

The different scenarios the dispersion modelling will investigate is presented in the table below. However, this is not a definite list and more scenarios can be added to the list.

Code	Description
Construction Phase	
C01	Construction of beneficiation plant and all associated infrastructure
C02	Preparation of each mining pit area
Operational Phase	
P01	Stage 1 – Active pit mining
P02	Stage 2 – Transport of material
P03	Stage 3 – Beneficiation plant
P04	Stage 4 – Stockpiling of overburden and product
Rehabilitation phase	
R01	Rehabilitation of each mining pit area
R02	Rehabilitation of the beneficiation plant
Cumulative Study	
Cumulative study according to the timeframes of the mining schedules	

Once these impacts have been quantified, appropriate management measures can be suggested to best mitigate the predicted impacts. These modelled results will similarly allow for the assessment of compliance to local and International Standards.

8.1.8 ENVIRONMENTAL NOISE

The purpose of an environmental noise impact investigation and assessment is to determine and quantify the acoustical impact on the surrounding environment and identified noise sensitive receptors.

The general procedure used to determine the noise impact is guided by the requirements of the Code of Practice SANS 10328:2008: Methods for Environmental Noise Impact Assessments. A comprehensive assessment of all noise impact descriptors (standards) will be undertaken. The noise impact criteria used specifically take into account those as specified in the South African National Standard SANS 10103:2008, The Measurement and Rating of Environmental Noise with Respect to Annoyance and Speech Communication as well as those in the National Noise Control Regulations.

The investigation includes the following:

- Determination of the existing situation (prior to development).
- Identification of noise sensitive receptors in close proximity to the project and along the transport route(s).
- Determination of the situation during the construction phase and the operational phase.
- Assessment of the change in noise climate and impact.
- Identification of mitigation measures.

The overall study area will be subdivided into a number of smaller study areas (discrete noise zones) which relate to the proposed project analysis areas, i.e. underground infrastructure areas, surface workings/processing plant and product transport. Where appropriate, the cumulative effects of the noise generated by combinations of these areas will be taken into consideration.

The results of the measurements and calculations shall be used to evaluate the noise impacts associated with the proposed Fuleni Project and a risk score will be awarded to the environmental

impact. The rating of the environmental impact shall be used in order to recommend mitigation measures for the risk.

8.1.9 HERITAGE RESOURCES

A full Phase 1 HIA should be undertaken for this project and the report submitted to Amafa in fulfillment of the requirements of the NHRA. The methodology is described below:

8.1.9.1 Site Survey

eThembeni staff members undertook an initial site meeting with other project members on 31 May 2013. Future fieldwork will be guided by international and local standards.

8.1.9.2 Database and Literature Review

We were able to extract archaeological site data for the project area and surrounds from HIA reports recorded in the SAHRIS database. A concise account of the archaeology of the broader study area was compiled from sources including those listed in the bibliography.

8.1.9.3 Assessment of Heritage Resource Value and Significance

Heritage resources are significant only to the extent that they have public value, as demonstrated by the following guidelines for determining site significance developed by Heritage Western Cape (HWC 2007) and utilised during this assessment.

8.1.9.3.1 Grade I Sites (National Heritage Sites)

Regulation 43 Government Gazette no 6820. 8 No. 24893 30 May 2003, Notice No. 694 states that:

Grade I heritage resources are heritage resources with qualities so exceptional that they are of special national significance should be applied to any heritage resource which is -

- a) Of outstanding significance in terms of one or more of the criteria set out in section 3(3) of the NHRA;
 - b) Authentic in terms of design, materials, workmanship or setting; and is of such universal value and symbolic importance that it can promote human understanding and contribute to nation building, and its loss would significantly diminish the national heritage.
- Is the site of outstanding national significance?
 - Is the site the best possible representative of a national issue, event or group or person of national historical importance?
 - Does it fall within the proposed themes that are to be represented by National Heritage Sites?
 - Does the site contribute to nation building and reconciliation?
 - Does the site illustrate an issue or theme, or the side of an issue already represented by an existing National Heritage Site – or would the issue be better represented by another site?
 - Is the site authentic and intact?

- Should the declaration be part of a serial declaration?
- Is it appropriate that this site be managed at a national level?
- What are the implications of not managing the site at national level?

8.1.9.3.2 Grade II Sites (Provincial Heritage Sites)

Regulation 43 Government Gazette no 6820. 8 No. 24893 30 May 2003, Notice No. 694 states that:

Grade II heritage resources are those with special qualities which make them significant in the context of a province or region and should be applied to any heritage resource which -

- a) is of great significance in terms of one or more of the criteria set out in section 3(3) of the NHRA; and
- (b) enriches the understanding of cultural, historical, social and scientific development in the province or region in which it is situated, but that does not fulfil the criteria for Grade 1 status.

Grade II sites may include, but are not limited to –

- (a) places, buildings, structures and immovable equipment of cultural significance;
- (b) places to which oral traditions are attached or which are associated with living heritage;
- (c) historical settlements and townscapes;
- (d) landscapes and natural features of cultural significance;
- (e) geological sites of scientific or cultural importance;
- (f) archaeological and palaeontological sites; and
- (g) graves and burial grounds.

The cultural significance or other special value that Grade II sites may have, could include, but are not limited to –

- (a) its importance in the community or pattern of the history of the province;
- (b) the uncommon, rare or endangered aspects that it possess reflecting the province's natural or cultural heritage
- (c) the potential that the site may yield information that will contribute to an understanding of the province's natural or cultural heritage;
- (d) its importance in demonstrating the principal characteristics of a particular class of the province's natural or cultural places or objects;
- (e) its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group in the province;

- (f) its importance in demonstrating a high degree of creative or technical achievement at a particular period in the development or history of the province;
- (g) its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons; and
- (h) its strong or special association with the life or work of a person, group or organization of importance in the history of the province.

8.1.9.3.3 Grade III (Local Heritage Resources)

Regulation 43 Government Gazette no 6820. 8 No. 24893 30 May 2003, Notice No. 694 states that:

Grade III heritage status should be applied to any heritage resource which

- (a) fulfils one or more of the criteria set out in section 3(3) of the NHRA; or
- (b) in the case of a site contributes to the environmental quality or cultural significance of a larger area which fulfils one of the above criteria, but that does not fulfill the criteria for Grade 2 status.

8.1.9.3.4 Grade IIIA

This grading is applied to buildings and sites that have sufficient intrinsic significance to be regarded as local heritage resources; and are significant enough to warrant any alteration being regulated. The significances of these buildings and/or sites should include at least some of the following characteristics:

- Highly significant association with a
 - historic person
 - social grouping
 - historic events
 - historical activities or roles
 - public memory
- Historical and/or visual-spatial landmark within a place
- High architectural quality, well-constructed and of fine materials
- Historical fabric is mostly intact (this fabric may be layered historically and/or past damage should be easily reversible)
- Fabric dates to the early origins of a place
- Fabric clearly illustrates an historical period in the evolution of a place
- Fabric clearly illustrates the key uses and roles of a place over time
- Contributes significantly to the environmental quality of a Grade I or Grade II heritage resource or a conservation/heritage area

Such buildings and sites may be representative, being excellent examples of their kind, or may be rare: as such they should receive maximum protection at local level.

8.1.9.3.5 Grade IIIB

This grading is applied to buildings and/or sites of a marginally lesser significance than grade IIIA; and such marginally lesser significance argues against the regulation of internal alterations. Such buildings and sites may have similar significances to those of a grade IIIA building or site, but to a lesser degree. Like grade IIIA buildings and sites, such buildings and sites may be representative, being excellent examples of their kind, or may be rare, but less so than grade IIIA examples: as such they should receive less stringent protection than grade IIIA buildings and sites at local level and internal alterations should not be regulated (in this context).

8.1.9.3.6 Grade IIIC

This grading is applied to buildings and/or sites whose significance is, in large part, a significance that contributes to the character or significance of the environs. These buildings and sites should, as a consequence, only be protected and regulated if the significance of the environs is sufficient to warrant protective measures. In other words, these buildings and/or sites will only be protected if they are within declared conservation or heritage areas.

8.1.9.4 Assessment of Development Impacts

A heritage resource impact may be defined broadly as the net change, either beneficial or adverse, between the integrity of a heritage site with and without the proposed development. Beneficial impacts occur wherever a proposed development actively protects, preserves or enhances a heritage resource, by minimising natural site erosion or facilitating non-destructive public use, for example. More commonly, development impacts are of an adverse nature and can include:

- destruction or alteration of all or part of a heritage site;
- isolation of a site from its natural setting; and / or
- introduction of physical, chemical or visual elements that are out of character with the heritage resource and its setting.

8.1.10 VISUAL IMPACT ASSESSMENT

During the Scoping Phase key concerns and issues relating to potential visual impacts arising from the project were identified. A full VIA will be conducted during the EIA Phase.

8.1.10.1 Methodology

The landscape around us is an important part of people's lives, contributing to individual, community and national identity and offering a wide variety of benefits in terms of quality of life, well-being and economic activity. It is constantly changing. Many different pressures have progressively altered familiar landscapes in the past and will continue to do so in the future, creating new landscapes. Many of these drivers of change arise from the requirement for development to meet the needs of a growing and changing population

A Visual Impact Assessment (VIA) entails a process of data collection, spatial analysis, visualisation and interpretation to describe the quality of the landscape before development takes place and then

identifying possible visual impacts after development. Assessing visual impacts are difficult as it is very subjective because a person's perception is affected by more than only the immediate environmental factors (Oberholzer, 2005).

The methodology for this VIA is based on a spatial analysis of the area, using GIS, Google Earth images, photographs and all available data on the infrastructure planned including the designs, layout and proposed rehabilitation of the infrastructure.

The VIA methodology comprised the following key activities:

- ***Desktop Study addressing visual character of the project site and immediate surrounding area***

The desktop study included an assessment of the current state of the environment of the area including the climate of the area, topography, land uses and land cover with data obtained from the websites of the South African National Biodiversity Institute (SANBI) and Agricultural Research Council (ARC) Institute for Soil, Climate and Water. The landscape character, from a visual and aesthetical point of view, is formed by vegetation and topography and the way in which it has been transformed by human activity.

- ***Visual Absorption Capacity***

Visual absorption capacity ("VAC") is an indication of the relative ability of the landscape to assimilate the changes brought about by the new development e.g. the ability of natural features such as trees or high ground to screen or hide an object where it would have been visible otherwise (Oberholzer, 2005). An environment with a high VAC has the ability to readily absorb manmade structures.

Design of structures can assist with VAC through colour, shape and lighting.

- ***Identification of the project view catchment***

Visibility is a function of line of sight and forms the basis of the VIA as only visible structures will influence the visual character of the area. Visibility is determined by conducting a viewshed analysis which calculates the geographical locations from where the proposed power line might be visible. This is done by creating a digital terrain model (DTM) from the 20m contour data. The viewshed analysis calculates the areas on the DTM surface that have a line of sight towards fixed points on the proposed power line.

- ***Visual Distance/ Sensitive Receptors***

The number of observers and their perception of the development will have an impact on the VIA. The perception of viewers is difficult to ascertain as there are many variables to consider. It is necessary to identify areas of high viewer incidence and to classify certain areas according to the observer's visual sensitivity towards the project. It is also necessary to generalize the viewer sensitivity to the development in some degree, as there are many variables when trying to determine the perception of the observer (Oberholzer, 2005). This includes cultural background, state of mind, reason for the sighting and how often the object is viewed in a set period etc. which would create a myriad of options.

- **Visual Impact Index**

The data accumulated through the above mentioned assessment process is then interpreted through a risk assessment process. In addition, the acceptability of the visual impacts in relation to the environmental and scenic resources of the area is assessed in line with a guideline document developed by the Committee on Environmental Impacts of Wind Energy Projects (USA National Research Council) in 2007.

8.1.11 SOCIO- AND MACRO-ECONOMIC ASSESSMENT

The focus of the economic impact analysis is macro-economic, stressing linkages between the project and the remainder of the relevant economy. Environmental externalities may affect other economic sectors and are included in the tools of the macro-economic impact assessment. Also, the local, regional and national socio-economic impact is assessed.

The socio- and macro-economic research specialist consultant will:

- Prepare a site description and analysis. This should describe the site and factors impacting on economic factors in the area. This analysis will profile the demographic and economic characteristics of the surrounding uThungulu District Municipality and Mfolozi Local Municipality focusing on the communities situated immediately adjacent.
- Review planning and local economic development (LED) frameworks. This would entail a review and consideration of the local spatial development and economic development plans, as well as planned and proposed development projects. Special consideration will be given to any existing or planned new developments that may conflict with the proposed mine.
- Assess the positive and negative economic impacts of the planned mining operations on the surrounding areas.
- Prepare a written report to summarise findings from the aforementioned tasks.

8.1.11.1 Methodology

- To give effect to the study objective the impact of the proposed developments will be investigated, quantified and assessed in terms of the following:
 - Macro/strategic perspective. Assess the macro or strategic role of the proposed mining operations in the local economy;
 - Location specific. The geographical location and context in terms of the economic dynamics of both the immediate community and the broader community, i.e. the surrounding uThungulu District Municipality and Mfolozi Local Municipality with a focus on the surrounding communities; and
 - Sectoral. This will entail upstream and downstream impact analysis, i.e. from raw materials to finished product and the impact both within and across industrial and economic sectors.
- These impacts will be considered in both direct and indirect terms. Types of impacts to be examined would include direct impacts (in terms of revenue, employment and

remuneration) and indirect impacts (expenditure in related and supporting industries, suppliers and further job creation).

- Assess the potential impacts based on assessment criteria to be discussed with the lead consultants.
- Based on the findings of the above, make recommendations as to mitigation measures for the identified impacts.

8.1.11.2 Desk-top Review of Data and other Sources

The study requires a thorough understanding of large-scale socio-economic trends and projects in the affected areas (the surrounding uThungulu District Municipality and Mfolozi Local Municipality) as well as an acute knowledge of market conditions and developments directly adjacent to and impacting the proposed developments. The study will require that the team members examine a number of data sources. Those anticipated at this stage include:

- a baseline assessment of key economic activities linked to the mine municipal and/or other planning and LED framework documents pertaining to the surrounding uThungulu District Municipality and Mfolozi Local Municipality leading to a comprehensive assessment of LED projects currently in place in surrounding communities and an economic assessment of each project;
- a comprehensive assessment of small, medium and micro enterprises (SMMEs) that will benefit from business relations with the proposed mine including an assessment of the number of individuals likely to be involved either as proprietors or as employees in each SMME;
- more detailed documentation of current and future likely developments in the study area, including the proposed new anthracite coal mine at a sufficient level of detail to estimate numbers of employees and other relevant economic impacts arising from the development; and
- data available at the enumerator level for the surrounding uThungulu District Municipality and Mfolozi Local Municipality including gross domestic product (by sector), income and demographic statistics.

8.1.11.3 Interviews and other Primary Research

Primary research will take the form of one-on-one interviews with key individuals from existing enterprises in and near to the study area. Information from proposed developers will inform expected norms of turnover and employment. Information from existing operators in the area will inform perceived negative impacts resulting from the development of the framework plan as well as the current levels of employment in the area. No other primary research is anticipated.

8.1.11.4 Spatial and Socio-Economic Overview

This section will describe the general spatial, social and economic characteristics of the sites and contextual area in which the sites fall. This will include an overview of the residential, business (commercial), industrial and transport environments of the area, focusing in more detail on the areas expected to impact directly on the sites.

Close attention will be given to alternative sources of employment and revenue, which will be determined by looking at known new developments including the proposed new anthracite coal mine at Fuleni.

8.1.11.5 Economic Analysis and Follow-up

Critical to the study is an understanding of the economic significance of the proposed mining development to relevant stakeholder groups. In this regard the following questions will be answered in the study:

- From an economic point-of-view, what will the new mine mean to affected communities (residential tourism and businesses) in the area? Of particular importance is the role that the proposed new mining developments will play in terms of turnover, employment and remuneration.
- What will the new mine mean to the relevant municipalities, in terms of economic value added and increased tax revenue? What are the multiplier effects of additional economic activity resulting from the new mine?
- What does the proposed new mine mean in a broader socio-economic context?

Based on the above information, as collected, an analysis of socio-economic linkages will be integrated to provide an overview of the economic impact of the proposed mine closure.

8.1.11.6 Report Writing

A report incorporating the above elements will be produced. The envisaged report will be based upon the following outline table of contents:

- Background and overview
- Spatial context
- Economic context - affected communities
- Social impacts
- Economic impacts
- Conclusions

8.2 RISK ASSESSMENT METHODOLOGY

Risk is a combination of the probability, or frequency of occurrence of a hazard and the magnitude of the consequence of the occurrence (Nel 2002). Risk estimation (RE) is concerned with the outcome, or consequences of an intention, taking account of the probability of occurrence and can be expressed as $P \text{ (probability)} \times S \text{ (severity)} = RE$. Risk evaluation is concerned with determining significance of the estimated risks and also includes the element of risk perception. Risk assessment combines risk estimation and risk evaluation (Nel 2002).

The risk assessment methodology that will be used during the EIA Phase to estimate the risk and determine the impact significance is tabled below.

Table 45: Impact Rating methodology

RISK IMPACT METHODOLOGY					
DURATION					
Short term	6 months				1
Construction	36 months				2
Life of project	32 years				3
Post Closure	Post closure or during decommissioning and downscaling				4
Residual	Beyond the project life				5
EXTENT					
Site specific	Site of the proposed development				1
Local	Farm and surrounding farms				2
District	Mfolozi Local Municipality				3
Regional	uThungulu District Municipality				4
Provincial	KwaZulu Natal				5
National	Republic of South Africa				6
International	Beyond RSA borders				7
PROBABILITY					
Almost Certain	100% probability of occurrence – is expected to occur				5
Likely	99% - 60% probability of occurrence – will probably occur in most circumstances				4
Possible	59% - 16% chance of occurrence – might occur at some time				3
Unlikely	15% - 6% probability of occurrence – could occur at some time				2
Rare	<5% probability of occurrence – may occur in exceptional circumstances				1
SEVERITY					
Critical	Total change in area of direct impact, avoidance or replacement not an option, detrimental effects, huge financial loss				5
Major (High)	> 50% change in area of direct impact, relocation required and possible, extensive injuries, long term loss in capabilities, off-site release with no detrimental effects, major financial implications				4
Moderate (medium)	20 – 49% change, medium term loss in capabilities, rehabilitation / restoration / treatment required, on-site release with outside assistance, high financial impact				3
Minor	10 – 19% change, short term impact that can be absorbed, on-site release, immediate contained, medium financial implications				2
Insignificant (low)	< 10 % change in the area of impact, low financial implications, localised impact, a small percentage of population				1
RISK ESTIMATION (Nel 2002)					
RE (Risk Estimation) = P (Probability) X S (Severity)					
	SEVERITY				
PROBABILITY	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Critical (5)
Almost certain (5)	L 5	M 10	H 15	VH 20	VH 25
Likely (4)	L 4	M 8	H 12	H 16	VH 20
Possible (3)	L 3	M 6	M 9	H 12	H 15
Unlikely (2)	VL 2	L 4	M 6	M 8	M 10
Rare (1)	VL 1	VL 2	L 3	L 4	L 5
VH	Very High – immediate action required, Countermeasures and management actions to mitigate risk must be implemented immediately, alternatives to be considered				20 – 25
H	High risk – specific management plans required, determine if risk can be reduced by design and management in planning process, if cannot, alternatives to be considered, senior management responsibility				12 – 16
M	Moderate risk – management and monitoring plans required with responsibilities outlined for implementation, middle management responsibility				6 – 10
L	Low risk – management as part of routine requirements				3 – 5
VL	Very Low risk – no management required				1 - 2

RISK IMPACT METHODOLOGY	
Mitigation - The impacts that are generated by the development can be minimised if measures are put in place to reduce them. These measures are mitigation measures to ensure that the development takes into consideration the environment and the impacts that are predicted so that development can co-exist with the environment as a basis for planning.	
Determination of Significance; without mitigation - Significance is determined through a synthesis of impact characteristics as described in the above paragraphs. It provides an indication of the importance of the impact in terms of both tangible and intangible characteristics. The significance of the impact “without mitigation” is the prime determinant of the nature and degree of mitigation required.	
IMPACT SIGNIFICANCE	
IS (Impact Significance) = D (Duration) + E (Extent) + S (Severity) X P (Probability)	
Insignificant	The impact is non-existent or insubstantial, is of no or little importance to any stakeholder and can be ignored.
Low	The impact is limited in extent, even if the intensity is major; whatever its probability of occurrence, the impact will not have a significant impact considered in relation to the bigger picture; no major material effect on decisions and is unlikely to require management intervention bearing significant costs.
Moderate	The impact is significant to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.
High	The impact could render development options controversial or the entire project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in project decision-making.
Very high	Usually applies to potential benefits arising from projects.
Determination of Significance; with mitigation - Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the necessary mitigation measures.	

8.3 PUBLIC PARTICIPATION

8.3.1 OBJECTIVES OF PUBLIC PARTICIPATION

The fundamental objectives of the public participation process are as follow:

- Meet legal and formal requirements;
- Identify public concerns and values;
- Improve decision-making. Public involvement can often produce better “technical decisions” than a strictly technically oriented decision process;
- Establish and maintain good relationships with IAPs;
- Provision and sharing of information throughout the process;
- Find and build common ground and move from extremes; and
- Stimulate two-way engagement on specific issues. In many cases, not all IAPs wish to be involved in every issue of the project all of the time. Most IAPs are partially involved, and therefore prefer to be only included in key elements of the process.

8.3.2 PRINCIPLES OF PUBLIC PARTICIPATION

The public participation process should endeavor to embrace the following principles:

- Inclusive involvement of stakeholders and IAPs.
- Integration of public issues/knowledge and technical assessments.
- Mutual respect for each other’s knowledge, abilities and inputs.
- Consideration of alternatives.

- Flexibility of the public participation process to adapt to different circumstances.
- Transparency of the process and information availability.
- Accountability of commitments made.
- Accessibility to information.
- Efficiency of the Public Participation Plan.
- Suitability of scale of involvement.
- Feedback to and from stakeholders.

8.3.3 METHODS OF PUBLIC PARTICIPATION

The following methods will be utilised throughout the Public Participation process:

- Advertisements and Notices;
- Authority meetings;
- Community meetings;
- Public Meetings and/or Open Days;
- Community Group Presentations;
- Community Forums;
- Electronic and email correspondence; and
- Other Methods.

8.3.4 PUBLIC PARTICIPATION PLAN

8.3.4.1 Overview of Process

Figure 75 indicates the process integrating the public participation methods and procedures required.

8.3.4.2 Commenting Periods on Project Reports

- Scoping Report
 - A period of 45 days will be provided for comments and inputs.
 - Notice of availability through letters/sms/email to all registered IAPs.
 - Availability of hard copy reports at specified locations.
 - Availability of CD's with reports at specified locations or on request.
 - Comments to be logged into CRR.
- Environmental Impact Assessment and Management Programme
 - A period of 60 days will be provided for comments and inputs.
 - Notice of availability through letters/sms/email to all registered IAPs.
 - Availability of hard copy reports at specified locations.
 - Availability of CD's with reports at specified locations or on request.
 - Comments to be logged into CRR.
- Decision-making
 - Distribution of Record of Decision to all registered IAPs.
 - Responses to Comments / Issues raised.

- All issues raised throughout the public participation process will be logged into the CRR which will be updated throughout the project process. The CRR will be made available to registered IAPs with the Scoping Report and again with the EIA/EMP report.

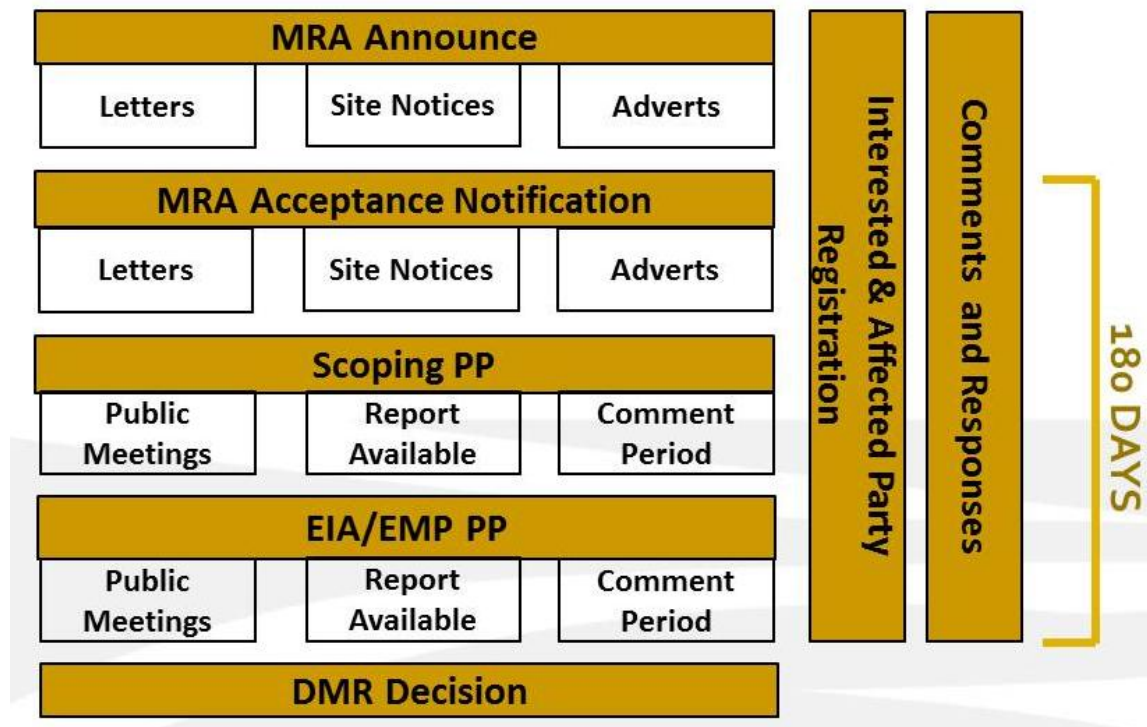


Figure 75: Public Participation Process

8.3.4.3 Feedback to Registered Interested and Affected Parties

Feedback on the project progress will be provided to registered IAPs at the following opportunities:

- Availability of Information Documents.
- Availability of reports.
- Scheduling of meetings.
- Record of Decisions by Authorities.

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10 APPENDICES

APPENDIX 1: STAKEHOLDER ENGAGEMENT RECORDS

APPENDIX 2: SPECIES LISTS