GREATER SOUTPANSBERG CHAPUDI PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT

AND

ENVIRONMENTAL MANAGEMENT PROGRAMME

DMR References: **LP 30/5/1/2/2/10043 MR**
LP 30/5/1/2/2/10046 MR
LP 30/5/1/2/2/10048 MR
LP 30/5/1/2/2/10049 MR
LP 30/5/1/2/2/10052 MR
LP 30/5/1/2/2/10055 MR
LP 30/5/1/2/2/10056 MR
LP 30/5/1/2/2/10059 MR

DECEMBER 2013

GREATER SOUTPANSBERG

CHAPUDI PROJECT

SECTION 1

ENVIRONMENTAL IMPACT ASSESSMENT

REGULATION 50

PROJECT DETAILS

Name of Project	**Greater Soutpansberg - Chapudi Project**
DMR Reference Numbers	LP 30/5/1/2/2/10043 MR
	LP 30/5/1/2/2/10046 MR
	LP 30/5/1/2/2/10048 MR
	LP 30/5/1/2/2/10049 MR
	LP 30/5/1/2/2/10052 MR
	LP 30/5/1/2/2/10055 MR
	LP 30/5/1/2/2/10056 MR
	LP 30/5/1/2/2/10059 MR
Name of Applicant	
LP 30/5/1/2/2/10043 MR	Chapudi Coal (Pty) Ltd
LP 30/5/1/2/2/10046 MR	Kwezi Mining Exploration (Pty) Ltd
LP 30/5/1/2/2/10048 MR	Chapudi Coal (Pty) Ltd
LP 30/5/1/2/2/10049 MR	Kwezi Mining Exploration (Pty) Ltd
LP 30/5/1/2/2/10052 MR	Kwezi Mining Exploration (Pty) Ltd
LP 30/5/1/2/2/10055 MR	Kwezi Mining Exploration (Pty) Ltd
LP 30/5/1/2/2/10056 MR	Kwezi Mining Exploration (Pty) Ltd
LP 30/5/1/2/2/10059 MR	Kwezi Mining Exploration (Pty) Ltd
Responsible person	Baldwin Khosa
Designation	Regulatory Affairs Manager
Physical address	The Campus Gabba Building (2nd floor) 57 Sloane Street Bryanston
Postal Address	PO Box 69517 Bryanston 2021
Telephone	011 575 4363
Facsimile	086 562 1335
E-mail	Baldwin.khosa@coalofafrica.com

Environmental Consultant	Jacana Environmentals cc
Responsible person	Marietjie Eksteen
Physical address	7 Landdros Mare Street, Polokwane
Postal Address	PO Box 31675, Superbia, 0759
Telephone	(015) 291 4015
Facsimile	(015) 291 5035
E-mail	marietjie@jacanacc.co.za

Public Participation Consultant	Naledi Development Restructured (Pty) Ltd
Responsible person	Lizinda Dickson
Physical address	143 Zambezi Avenue, Sinoville
Postal Address	PO Box 13509, Sinoville, 0129
Telephone	(012) 543 9093
Facsimile	(012) 543 9619
E-mail	lizinda@naledidev.co.za

Impact specialist consultants

Soil and land use capacity	Gudani Consulting - EcoSoil Consortium
Surface and Groundwater	WSM Leshika Consulting (Pty) Ltd
Biodiversity	Phaki Phakanani Environmental Consultants
Aquatic systems	Scientific Aquatic Services
Noise	Gudani Consulting
Air Quality	Royal Haskoning DHV
Heritage Resources	Mbofho Consulting and Projects
Socio-Economic	Naledi Development Restructured (Pty) Ltd
Macro-Economic	Mosaka Economic Consultants cc

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

Glossary of Terms

TERM / ABBREVIATION	MEANING
ABA	Acid Base Accounting
AGIS	Agricultural Geo-referenced Information System
AMD	Acid Mine Drainage
AQA	National Environmental Management: Air Quality Act 39 of 2004
ARD	Acid Rock Drainage
ARS	Acute Respiratory Syndrome
BCM/h	Bank Cubic Meters per hour
Biome	A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate
BMWP	British Biological Monitoring Working Party
CARA	Conservation of Agricultural Resources Act 43 of 1983
CBA	Cost Benefit Analysis
CLN	Customer Load Network
CoAL	Coal of Africa Limited
COPT	Chronic Obstructive Pulmonary Disease
CRR	Comments and Response Report
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
DWS	Discouraged Work Seekers
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
ESS	Ecosystem Services

TERM / ABBREVIATION	MEANING
EUR	Expanded Unemployment Rate
FAII	Fish Assemblage Integrity Index
FZ	Fractured Zone
GDP	Gross Domestic Product
GPS	Global Positioning system
GSP	Greater Soutpansberg Project
HIA	Heritage Impact Assessment
IAP	Interested and Affected Party
IDP	Integrated Development Plan
IHAS	Invertebrate Habitat Assessment System
IHIA	Intermediate Habitat Integrity Assessment
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
K2C	Kruger to Canyon Biosphere
LCC	Land Claims Commissioner
LEDET	Limpopo Department of Economic Development, Environment and Tourism
LEMA	Limpopo Environmental Management Act 7 of 2003
LM	Local Municipality
LMB	Limpopo Mobile Belt
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
Mbcm	Million Bank Cubic Metres
MIA	Mining Infrastructure Area
MPRDA	Mineral and Petroleum Resources Development Act 28 of 2002
MRA	Mining Right Application
MSA	Middle Stone Age
Mtpa	Million Tonnes Per Annum
MTS	Main Transmission Station

TERM / ABBREVIATION	MEANING
MSC	Mining Consulting Services
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
NGDB	National Groundwater Database
NHRA	National Heritage Resources Act 25 of 1999
NMD	Neutral Mine Drainage
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
POC	Probability of occurrence
PRECIS	Pretoria Computer Information Systems
QDS	Quarter Degree Square
RBCT	Richards Bay Coal Terminal
RDL	Red Data List
RDM	Resource Directed Measures
RE	Risk estimation
REC	Recommended Ecological Category
RHP	River Health Programme
RLT	Rapid Load-Out Terminal
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
SoER	State of the Environment Report

TERM / ABBREVIATION	MEANING
SSC	Species of Special Concern
SUR	Strict Unemployment Rate
TDS	Total Dissolved Solids
TFR	Transnet Freight Rail
TOPS	Threatened or Protected Species
TWQ	Target Water Quality
UNESCO	United Nations Education, Science and Cultural Organizations
VBR	Vhembe Biosphere Reserve
WBR	Waterberg Biosphere Reserve
WMA	Water Management Area
WQO	Water Quality Objective
WQT	Water Quality Threshold
WZ	Weathered Zone

1 DESCRIPTION OF THE BASELINE ENVIRONMENT

1.1 PROJECT LOCATION

The Chapudi Project forms part of the Greater Soutpansberg Projects (GSP) situated to the north of the Soutpansberg in the Limpopo Province. Figure 1 depicts the locality of the various GSP projects, from which it is evident that they are within close vicinity of each other, permitting possible rationalisation of infrastructure.

Based on the prospecting rights held in the Chapudi Project area, Chapudi Coal (Pty) Ltd (Chapudi) and Kwezi Mining Exploration (Pty) Ltd (Kwezi) submitted similar applications for New Order Mining Rights (NOMRs) in terms of Section 22 of the Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA). The objective is to have a consolidated project with economically minable blocks which are contiguous.

Therefore, in parallel to the NOMR applications, the applicants will be applying for the consent of the Minister of Mineral Resources, to:

- Simultaneously with the granting of the NOMRs, cede certain of the mining rights from Kwezi to Chapudi in terms of Section 11 of the MPRDA; and
- After cession of the mining rights, consolidate these into one mining right for the Chapudi Project in terms of Section 102 of the MPRDA.

Coal of Africa Limited (CoAL) is a shareholder of MbeuYashu (Pty) Ltd, with a shareholding of 74%. The remaining 26% is held by Rothe Investments (Pty) Ltd, a Black Economic Empowerment company as contemplated in the Mining Charter. MbeuYashu in turn holds a 100% shareholding in Chapudi and Kwezi.

The Chapudi Project has shown a robust return in challenging market conditions. The primary product, hard coking coal, has demand in both South Africa and internationally, whilst the secondary thermal product (Eskom grade) adds significant value as a product booster. Coupled with the rest of the assets in the province, the Chapudi Project is uniquely placed to contribute significantly and responsibly to developing Limpopo's mineral wealth, as well as participation in industrial growth as planned by the provincial government.

The Chapudi Project is situated in the magisterial district of Vhembe, in the Limpopo Province, approximately 20 km (direct) and 35 km (via road) north-west of the town Makhado in the Makhado Local Municipal area. Musina is situated approximately 65 km to the north – refer to Figure 2 and Figure 3. Musina and Makhado are connected by well developed road infrastructure.

The N1 national road pass the mining right application (MRA) area (Wildebeesthoek and Chapudi Sections) in the east with the R523 running through the site from east to west. Both of these roads carry sufficient traffic to impact on the ambient sound levels a distance away from these roads. There is an undefined road just west of the Waterpoort Station that appears to carry heavy traffic. The Makhado-Musina railway line runs in a north-south direction through the Chapudi Project area.

Socio-economic activities in the area are mixed between intensive irrigated agriculture, hunting and tourism. The intensive irrigated agricultural activities are focused along the Sand River catchment and neighbouring areas. The land use in the Wildebeesthoek Section of the Chapudi Project is predominantly hunting, game farming and ecotourism. The Chapudi Section has a combination of hunting/game farming and irrigated / dry land agriculture. The Chapudi West Section has portions of intensive agriculture, while the further south-west portions are utilised for conservation, hunting and ecotourism.

The majority of the intensive agricultural area is utilised for predominantly vegetable production and is known as the winter pantry (production area) of South Africa. Some of the properties are also focused on mixed farming, with a mixture of livestock, game and irrigated agriculture. A number of pack houses for fresh commodities are operational in the region. The fresh produce markets remain a major outlet for fresh produce. Direct marketing is also a popular marketing outlet and producers deliver direct to chain stores such as Woolworths, Pick 'n Pay etc.

Hunting, game trading and eco-tourism is an established socio-economic driver in the area. There are a number of properties utilized for trophy (for local and foreign tourists) and biltong hunting with ecotourism spin-off activities.

1.1.1 COMMUNITY DESCRIPTION

The communities located within the vicinity of the Chapudi Project are:

- Waterpoort Town: Waterpoort Town is located on the farms Dorpsrivier 696 MS and Bergwater 697 MS and consists of a general dealer, bottle store, filling station, post office, police station and Mondi packing material warehouse. Less than 5 houses are located within the town and are limited to workers in the above economic activities.
- Soja Village: A 'Share Block Scheme' Village is partially located on the northern border of the farm Kliprivier 692 MS and the farm Koedoesveld 666 MS in close proximity to the old So-Ja mineral baths. There are 47 houses on this property with 11 permanent residents. The remaining houses are used over the weekends and during the holidays.
- Waterpoort Property Labour Tenant Village: The Labour Tenant Village is situated in two locations east of the D854 road on the farm Waterpoort 695 MS within the MRA area. Approximately 20 extended families reside in two locations on the property.
- Mamvuka Village: The Mamvuka Village is situated east of the N1 and outside the MRA area. The village is under the leadership of the Musekwa Traditional Leadership.

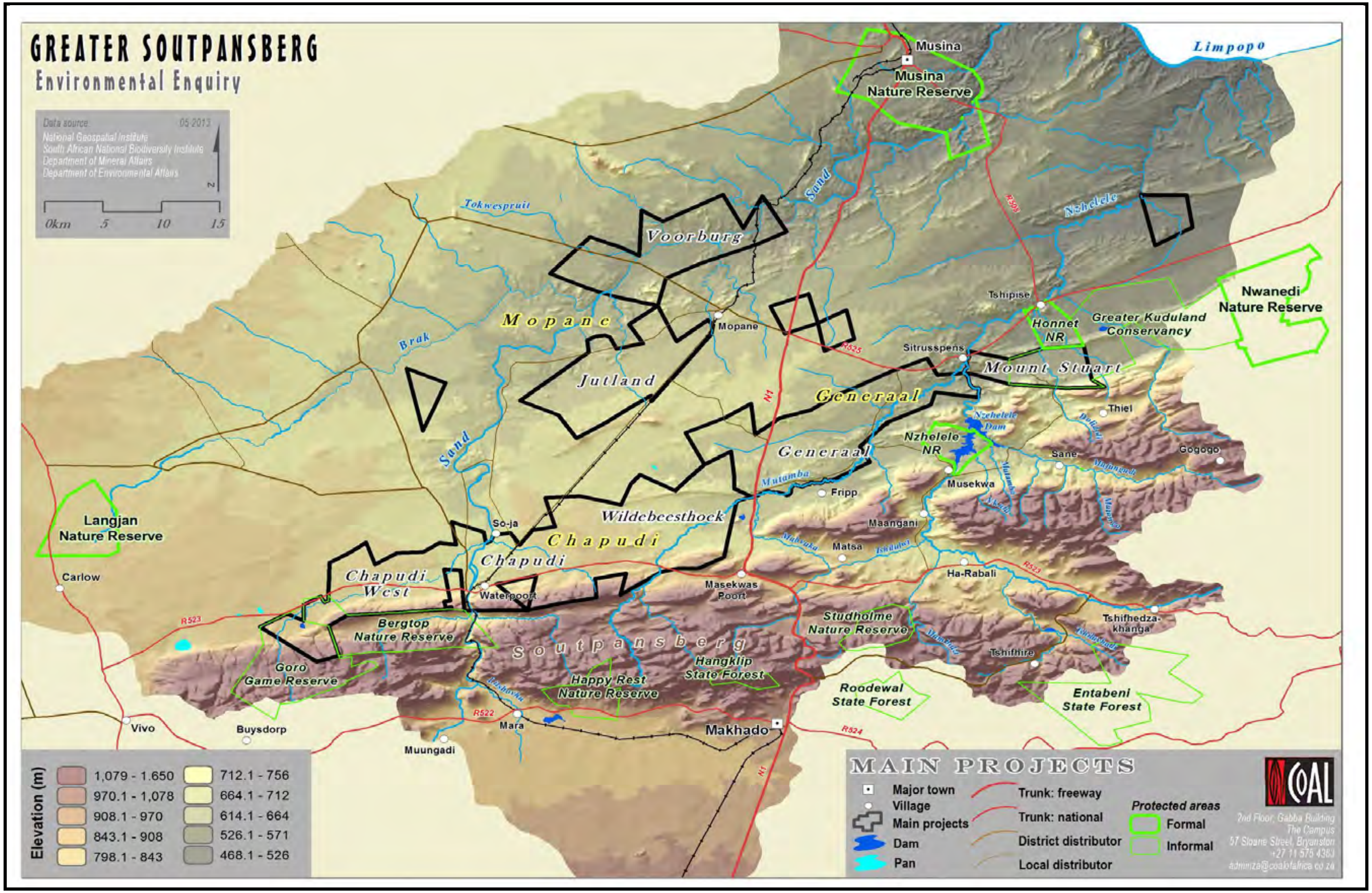


Figure 1: Location of Greater Soutpansberg Projects

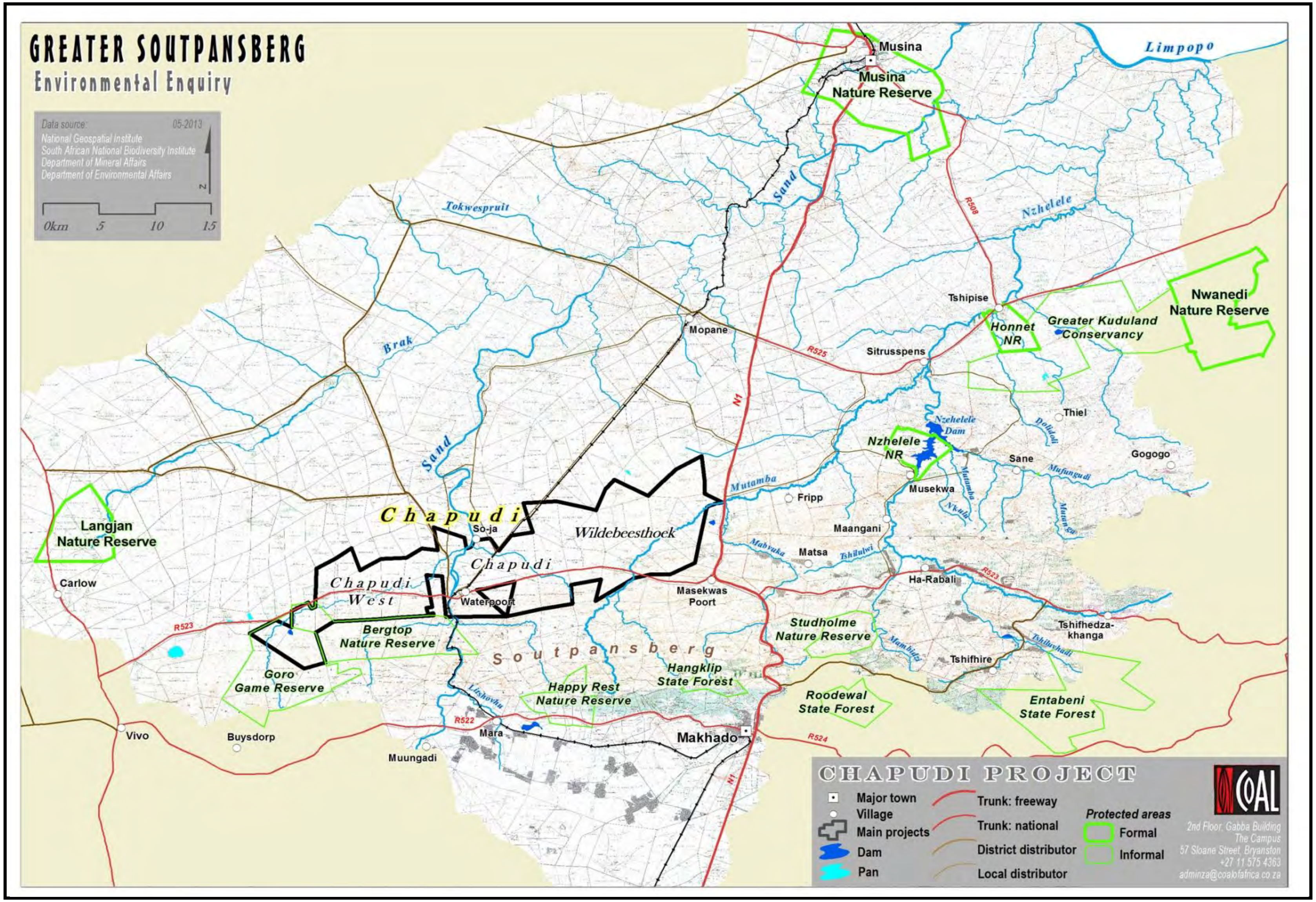


Figure 2: Chapudi Project – Locality Map

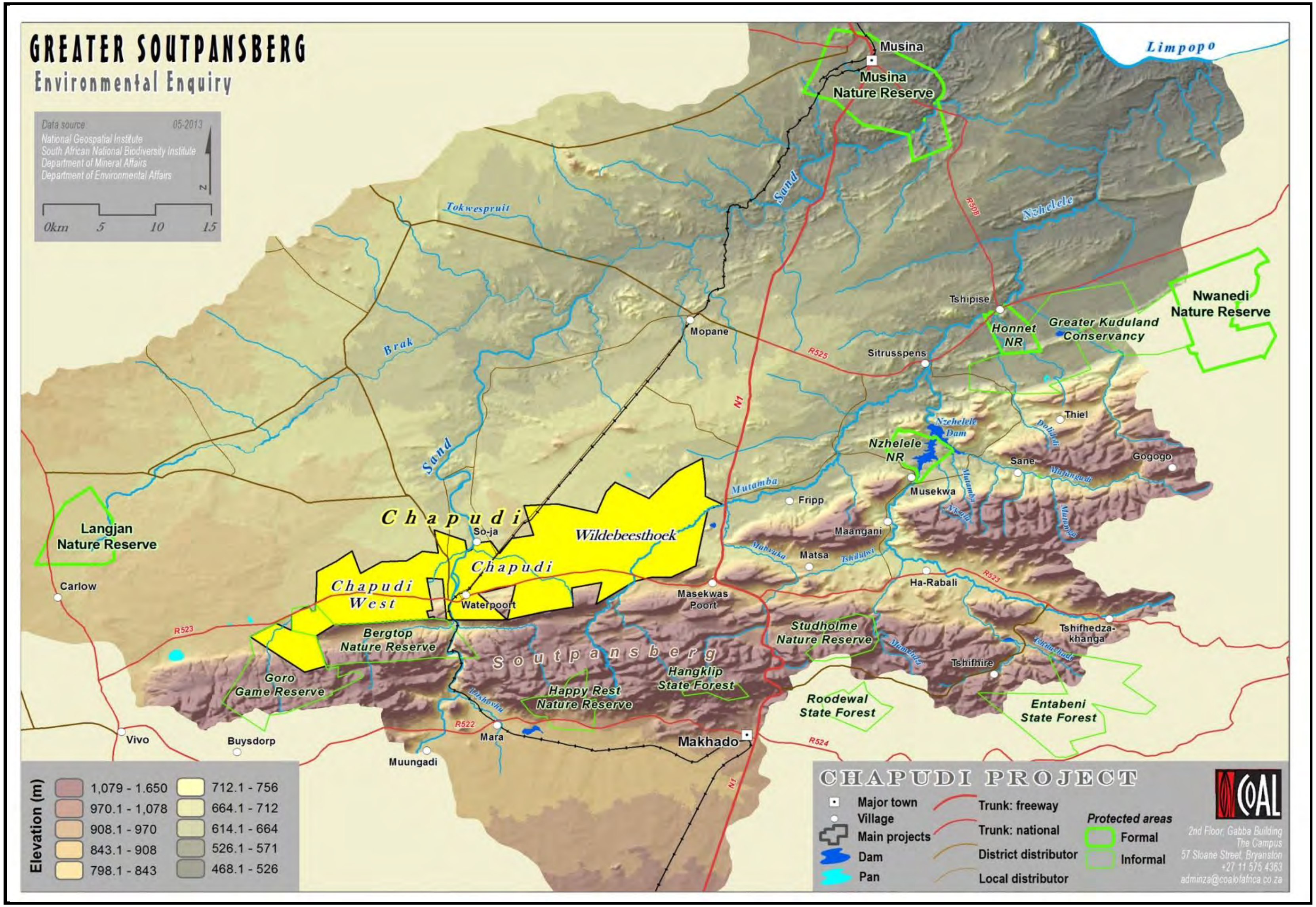


Figure 3: Location of Wildebeesthoek, Chapudi and Chapudi West Sections

1.1.2 SURFACE OWNERSHIP

The area covered by the NOMR applications includes forty-two (42) farms as listed in Table 1 below. The majority of the properties are privately owned. The properties included in the NOMR applications are shown in Figure 4.

1.1.3 LAND CLAIMANTS / TRADITIONAL AUTHORITY

MbeuYashu has consulted with the Regional Land Claims Commissioner (LCC) in Limpopo regarding the gazetted land claims for the farms covered by the Chapudi Project and its surrounds.

Table 1 below depicts the claims which have been submitted to the Regional LCC by the various communities. This information has been mapped (refer to Figure 5) to show its relevance to the project. According to the Regional LCC the land claimants of the area include the Mulambwane, Tshivhula and Leshivha Communities, whilst the Musekwa Community claimed two farms.

A request has been sent to the Regional LCC for pronouncement on the report which was compiled by the University of Venda on the land claims in the area. To date, no response has been received.

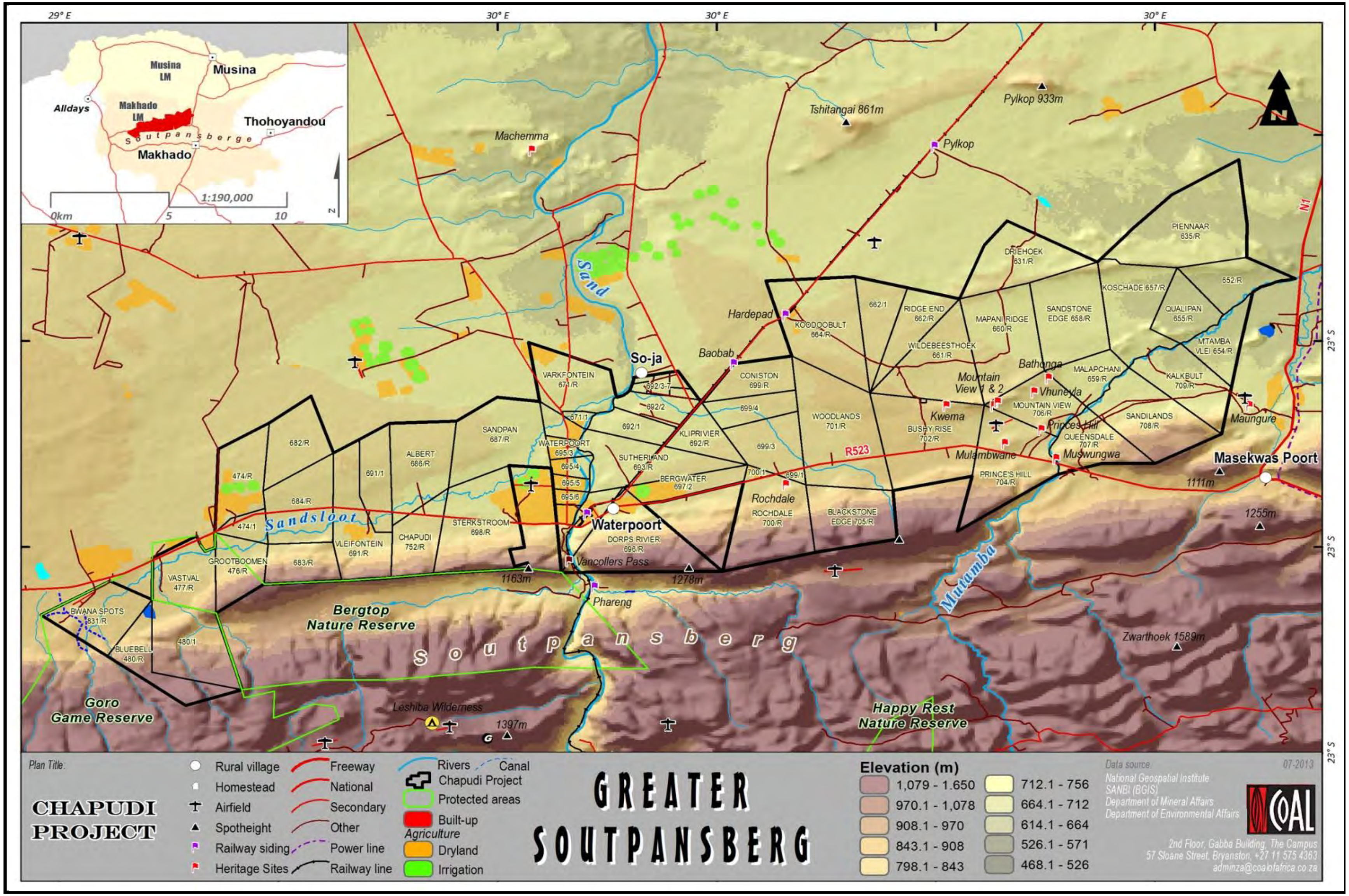


Figure 4: Surface properties included in Chapudi NOMR applications

Table 1: Surface properties included in NOMR application

DMR Ref No	Applicant	Farm	Portion	Landowner	Title Deed Number	Extent (ha)	Land Claimant
10048MR	Chapudi	Bergwater 697MS	Ptn 2	Tiverton Trading (Pty) Ltd	T93081/1999	373.8220	Mulambwane
		Bergwater 712MS	All	Tiverton Trading (Pty) Ltd	T93081/1999	320.8223	Mulambwane
10046MR	Kwezi	Waterpoort 695MS	Ptn 3	Sitapo Boerdery (Pty) Ltd	T89566/1995	111.1891	Lishivha and Tshivhula
		Waterpoort 695MS	Ptn 4	Sitapo Boerdery (Pty) Ltd	T115328/2002	133.9760	Lishivha and Tshivhula
		Waterpoort 695MS	Ptn 5	Sitapo Boerdery (Pty) Ltd	T111308/1995	91.1991	Lishivha and Tshivhula
		Waterpoort 695MS	Ptn 6	Sitapo Boerdery (Pty) Ltd	T111308/1995	80.4429	Lishivha and Tshivhula
10052MR	Kwezi	Koodoobult 664MS (Consolidated with Koodoobult 859 MS)	RE	Lambert Hendrik Fick	T1175/1969	1337.5956	Mulambwane
		Koschade 657MS (Was Mapani Kop 656MS)	All	Manupont 124 (Pty) Ltd	T25701/2000	981.4594	No Land Claimant
		Queensdale 707MS	All	Hector Kincaid-Smith	T54501/1997	629.9835	Mulambwane
		Ridge End 662MS	RE	Johannes Adolf Hartzenberg	T42665/1986	518.5167	No Land Claimant
		Ridge End 662MS	Ptn 1	Lambert Hendrik Fick	T1175/1969	518.5636	No Land Claimant
		Sandstone Edge 658MS	All	Berta Trust	T151461/1999	1076.9748	Tshivhula
10059MR	Kwezi	Bushy Rise 702MS	RE	Pieter Brink Schlesinger	T7576/1994	1423.1088	Mulambwane
		Bushy Rise 702MS	Ptn 1	Pieter Brink Schlesinger	T79931/2002	4.2827	Mulambwane
		Kalkbult 709MS	All	Manupont 124 (Pty) Ltd	T25701/2000	767.9352	Ramalamula MJ and Musekwa
		Sterkstroom 689MS	RE of Ptn 2				Lishivha
		Sterkstroom 689MS	RE of Ptn 3				Lishivha
10049MR	Kwezi	Bluebell 480MS	RE	EMW Lewende Trust	T3770/2012	774.8067	No Land Claimant
		Bluebell 480MS	Ptn 1	Jannie & Annette Moolman Family Trust	T120197/2001	774.8080	No Land Claimant
		Grootboomen 476MS	All	Grootboomen Eiendomme (Pty) Ltd	T15043/1992	530.7700	Tshivhula
		Melrose 469MS	All	Michael Albertus Otto	T13567/1974	724.4219	No Land Claimant
		Vastval 477MS	RE	Manupont 124 (Pty) Ltd	T25701/2000	656.1604	Tshivhula
		Vastval 477MS	RE of Ptn 1	Lambert Hendrik Fick	T1175/1969	1337.5956	Tshivhula

DMR Ref No	Applicant	Farm	Portion	Landowner	Title Deed Number	Extent (ha)	Land Claimant
		Vastval 477MS	Ptn 2	Hector Kincaid-Smith	T54501/1997	5.1392	Tshivhula
10055MR	Kwezi	Driehoek 631MS	All	Berta Trust	T96632/2001	873.7311	Mulambwane
		Pienaar 635MS	RE				Mulambwane
		Pienaar 635MS	Ptn 1				Mulambwane
10056MR	Kwezi	Chapudi 752MS	All	Andre Francois Pauer	T34286/2012	562.6216	Tshivhula
		Grootvlei 684MS	All				Mulambwane
		Sandpan 687MS	Ptn 1	Sitapo Boerdery (Pty) Ltd	T23533/2008	551.8550	Lishivha
		Sandpan 687MS	Ptn 2			546.7829	Lishivha
		Varkfontein 671MS	RE	Varkfontein Boerdery (Pty) Ltd	T94633/1999	719.7845	Leshiba
		Varkfontein 671MS	Ptn 1	Varkfontein Boerdery (Pty) Ltd	T94633/1999	58.8559	Leshiba
		Albert 686MS	All	Andre Francois Pauer	T32092/2009	898.8390	Tshivhula/Leshiba
		Blackstone Edge 705 MS	All	Brink Schlessinger Family Trust	T2586/1999	860.3178	Mulambwane
		Castle Koppies 652MS (Consolidated with Mutamba 668 MS)	All			554.0363	Ramalamula MJ, Musekwa & Mulambwane
		Coniston 699Ms	RE	Koedoepan Boerdery cc	T13086/2001	624.3370	Mulambwane
		Coniston 699Ms	Ptn 1	Business Zone 260 cc	T154140/2001	44.8778	Mulambwane
		Coniston 699Ms	Ptn 3	Koedoepan Boerdery cc	T13086/2001	597.5219	Mulambwane
		Coniston 699Ms	Ptn 4	Mulambwane Communal Pro Assoc (Roelof Jacobus Venter)	T32489/2012	385.4394	Mulambwane
		Dorpsrivier 696MS	RE	Consolidated with Dorpsrivier 723 MS		1192.9633	Mulambwane
		Enfield 512MS (Incorporates Enfield 474MS and Brosdoorn 682MS)	Ptn 1	Grootboomen Eiendomme (Pty) Ltd	T15043/1992	173.0195	
		Kliprivier 692MS	RE	Fanya Trust	T2546/2011	366.0353	Mulambwane
		Kliprivier 692MS	Ptn 1	NT Truck & Car Leasing (Pty) Ltd	T62265/1995	342.6128	Mulambwane
		Kliprivier 692MS	RE of Ptn 2	Ektos Inv (Pty) Ltd	T112806/2003	340.3610	Mulambwane
		Kliprivier 692MS	RE of Ptn 3	Anru Trust	T10098/2011	33.2425	Mulambwane

DMR Ref No	Applicant	Farm	Portion	Landowner	Title Deed Number	Extent (ha)	Land Claimant
		Kliprivier 692MS	Ptn 4	Fanya Trust	T54237/2008	26.7157	Mulambwane
		Kliprivier 692MS	Ptn 5	Fanya Trust	T54237/2008	34.2638	Mulambwane
		Kliprivier 692MS	Ptn 6	Oyama & Heinrich Schneider	T85391/2008	42.8260	Mulambwane
		Kliprivier 692MS	Ptn 7	Johannes Petrus de Jager	T57771/2009	42.8244	Mulambwane
		Kliprivier 692MS	Ptn 8	Johannes Petrus de Jager	T57771/2009	34.2606	Mulambwane
		Malapchani 659MS	All	Berta Trust	T51461/1999	416.9927	Mulambwane
10043MR	Chapudi	Mapani Ridge 660MS	All	Berta Trust	T151461/1999	1193.1991	No Land Claimant
		Middelfontein 683MS	All	JG du Preez Trust	T97048/1999	869.5299	No Land Claimant
		Mountain View 706MS	All	Lourens & Noeline Erasmus	T100352/1993	571.2740	No Land Claimant
		M'tamba Vlei 654MS	All	Manupont 124 (Pty) Ltd	T18956/2000	523.5081	No Land Claimant
		Prince's Hill 704MS	RE				Mulambwane
		Prince's Hill 704MS	Ptn 1				Mulambwane
		Qualipan 655MS	All	Manupont 124 (Pty) Ltd	T57287/2000	523.5081	Mulambwane
		Rochdale 700MS	RE	Andy Miles			Mulambwane
		Rochdale 700MS	Ptn 1	Isak Stephanus Wilson	T854/1990	44.8772	Mulambwane
		Sandilands 708MS	All	Manupont 124 (Pty) Ltd	T150263/2002	1071.8156	No Land Claimant
		Sutherland 693MS	RE	Fanya Trust	T8216/2009	575.5112	Tshivhula/Leshiba
		Sutherland 693MS	Ptn 1	Anna Susanna & Johan Christoffel Barwise	T8215/2009	344.9638	
		Vleifontein 691MS	RE	Martha Louisa Susanna Pauer	T2828411/2011	1238.8637	
		Vleifontein 691MS	Ptn 1	Amelia Elizabeth Pauer	T13570/1991	171.3064	No Land Claimant
		Wildebeesthoek 661MS	All	Pieter Willem Adriaan Espach	T40790/1986	1033.9269	No Land Claimant
		Woodlands 701MS	All	Brink Schlessinger Family Trust	T2586/1999	1563.8261	Mulambwane

tbc: To be confirmed

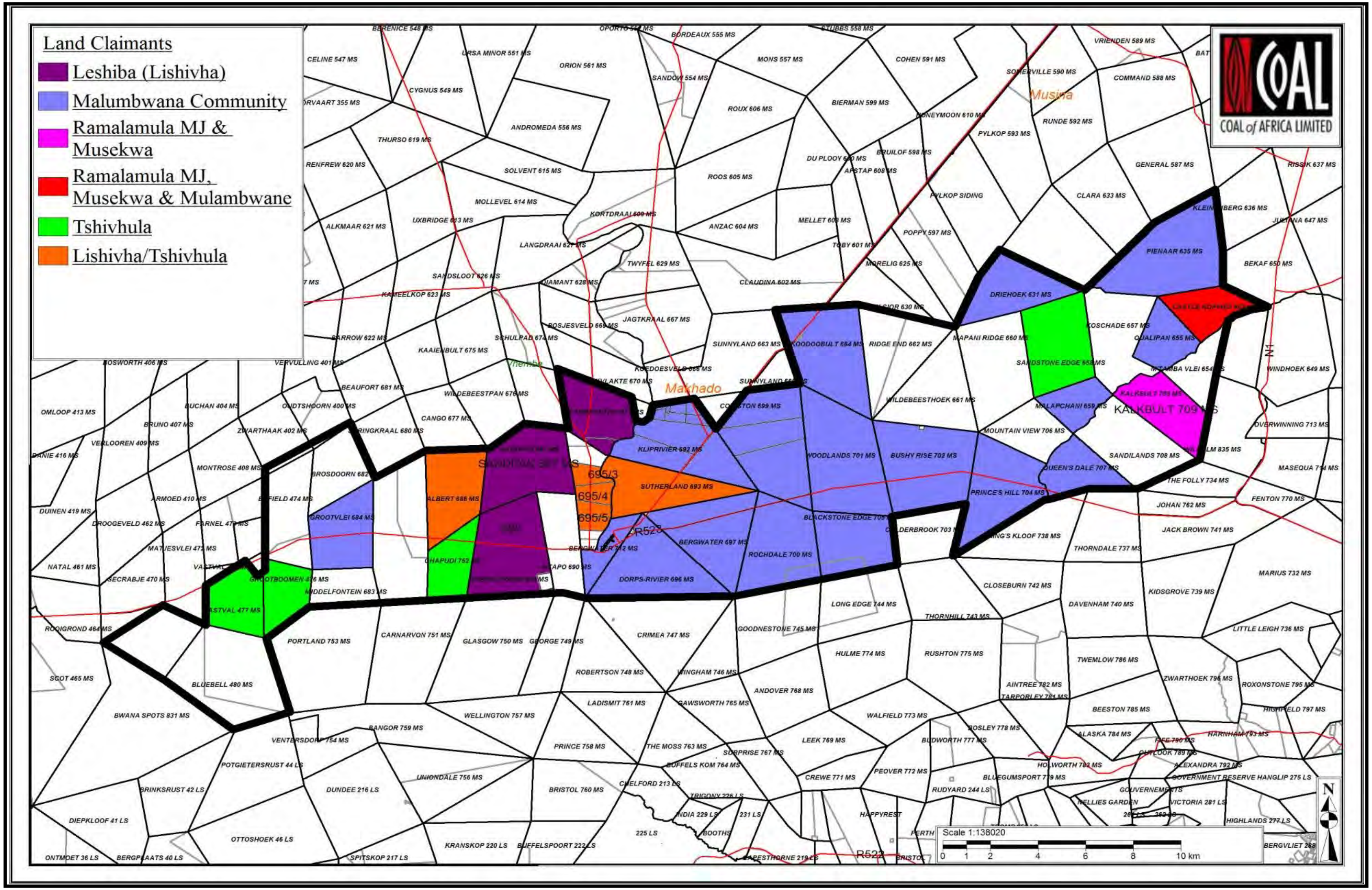


Figure 5: Chapudi Project Land Claimants map

1.2 DESCRIPTION OF THE BIOPHYSICAL ENVIRONMENT

Numerous studies have been conducted on the environment relating specifically to the Chapudi Project since its inception, as well as studies by local agriculture who are big users of the groundwater resource, including:

- Chapudi Coal Project Environmental Sensitivity Report: for Chapudi Coal (Pty) Ltd and Kwezi Mining and Exploration (Pty) Ltd by SRK (2009).
- Chapudi Coal Project Environmental Baseline Report: for Chapudi Coal (Pty) Ltd and Kwezi Mining and Exploration (Pty) Ltd by SRK (2009).
- Pre-Feasibility Study – Agriculture and Game Raching and Community Area: for SRK by AgriConcept (2009).
- Chapudi Coal Project Baseline Climate and Air Monitoring Report: for Chapudi Coal (Pty) Ltd and Kwezi Mining and Exploration (Pty) Ltd by SRK (2009).
- Faunal assessment for the proposed Chapudi Coal Project near Waterpoort, Limpopo province: for SRK by NSS (2009).
- A report on the status quo of the vegetation in the Chapudi area: for SRK by Eco-Agent (Bredenkamp) (2009).
- Baseline Noise Study for the Chapudi Coal Project: for SRK by Malherbe (2009).
- Chapudi Coal Project Baseline Study: Traffic Assessment: for SRK by Africon (2009).
- Soil Survey for Chapudi Coal Project: for SRK by ARC (2009).
- Chapudi Coal Project Report for the Surface Water Baseline Aspects: for Chapudi Coal (Pty) Ltd and Kwezi Mining and Exploration (Pty) Ltd by SRK (2009
- Chapudi Coal Project Environmental Baseline Study: Hydrogeology: for Chapudi Coal (Pty) Ltd and Kwezi Mining and Exploration (Pty) Ltd by SRK (2009).
- Chapudi Coal Project Environmental Baseline Study: Geochemistry: for Chapudi Coal (Pty) Ltd and Kwezi Mining and Exploration (Pty) Ltd by SRK (2009).
- Chapudi Coal Project Environmental Baseline Study: Geology and Geomorphology: for Chapudi Coal (Pty) Ltd and Kwezi Mining and Exploration (Pty) Ltd by SRK (2009).
- Chapudi Coal Project Environmental Baseline Study: Land Use: for Chapudi Coal (Pty) Ltd and Kwezi Mining and Exploration (Pty) Ltd by SRK (2009).
- High Level Hydrogeological Study, Chapudi Project, Limpopo Province: for Rio Tinto by GCS (2005).
- Geology of the Waterpoort Aquifer at Sitapo in the Limpopo Provine: for ZZ2 by AGES (2007).
- Groundwater Risk Assessment of possible Cross Contamination at the Chapudi Mine Project Area: for Rio Tinto by WSM Leshika (2009).

In addition, a number of specialist studies were performed as part of this EIA study, in line with the Plan of Study presented in the Scoping Report for the Chapudi Project, August 2013. These are attached as Annexures as listed below.

Annexure	Aspect	Independent Consultant
ANNEX-1	Soils, Land Use & Capability	Gudani Consulting - EcoSoil Consortium
ANNEX-2	Surface Water	WSM Leshika Consulting (Pty) Ltd
ANNEX-3	Groundwater	WSM Leshika Consulting (Pty) Ltd
ANNEX-4	Biodiversity	Phaki Phakanani Environmental Consultants
ANNEX-5	Aquatic Systems	Scientific Aquatic Services
ANNEX-6	Ambient Noise	Gudani Consulting
ANNEX-7	Air Quality	Royal Haskoning DHV
ANNEX-8	Heritage Resources	Mbofho Consulting and Projects
ANNEX-9	Socio-Economic Aspects	Naledi Development Restructured (Pty) Ltd
ANNEX-10	Macro-Economic Aspects	Mosaka Economic Consultants cc

1.2.1 CLIMATIC DATA

1.2.1.1 Regional Climate

Limpopo Province is situated in a dry savannah sub region, characterized by open grasslands with scattered trees and bushes. Visible manifestations of underlying geology, contributing to slope and the formation of landscapes, comprising the visible features of an area of land, including the physical elements of landforms such as mountains, ridges, hills, plains and water bodies. The southern limit of the MRA area is underlain by the hard and resistant quartzites and conglomerates of the Soutpansberg Group and this give rise to prominent east-west striking mountains and valleys. The Soutpansberg mountain range is a major regional topographic feature and it extends in an east-west direction for a distance of approximately 130 km. The regional climate is strongly influenced by the east-west orientated mountain range which represents an effective barrier between the south-easterly maritime climate influences from the Indian Ocean and the continental climate influences (predominantly the Inter-Tropical Convergence Zone and the Congo Air Mass) coming from the north.

The farm portions in the western MRA area encompass the north-facing slopes of the Soutpansberg characterised by high hills and ridges with flatter, gently undulating topography to the north. The highest altitude is around 1,300 meters above mean sea level with the plains at around 700 to 800 mamsl (SRK, 2009).

The Chapudi Project is located in the hot-arid zone to the north of the Soutpansberg where the rainfall decreases to 400-500 mm. The area is situated in the summer rainfall region and rainfall occurs in the form of heavy thunderstorms or soft rain. The area is characterised as being hot and dry resulting in high evaporation rates and low rainfall. The area is characterized by cool, dry winters (May to August) and warm, wet summers (October to March), with April and September being transition months. Temperature range from 0.9°C to 39.9°C and the area is generally frost free.

The mountains give rise to wind patterns that play an important role in determining local climates. These wind effects include wind erosion, aridification and air warming.

1.2.1.2 Temperature

Average monthly minimum and maximum temperatures for the Tshipise Weather Station (No 0766277 1) some 32 km north-east of the Chapudi Project area is shown in Table 2 below. Average daily maximum and minimum summer temperatures (November to February) at the weather station range between ~33°C and ~20°C, while winter temperatures (May to August) range between ~28°C and ~7°C respectively. The high average temperatures are reflected by the fact that the minimum average daily summer temperature is a high 20°C and the minimum average daily winter temperature does not dip below 7°C.

Table 2: Temperature data for Tshipise for the period from 1994 to 2006

Month	Temperature (° C)			
	Highest Recorded	Average Daily Maximum	Average Daily Minimum	Lowest Recorded
January	42.2	32.8	21.5	12.6
February	41.4	32.3	21.5	14.9
March	42.9	31.5	20.1	13.0
April	40.9	30.1	16.3	5.7
May	42.3	27.9	11.2	1.7
June	34.3	25.6	8.2	-0.4
July	34.1	25.0	7.3	-1.2
August	37.4	27.8	10.3	1.7
September	41.2	27.7	12.9	3.6
October	41.4	29.1	16.5	8.0
November	42.5	32.2	20.1	11.1
December	43.4	33.1	21.0	13.8
Year	43.4	29.6	15.6	-1.2

Source: Weather SA (Station No 0766277 1)

The Department of Agriculture's Agricultural Geo-referenced Information System (AGIS) hosts a wide spectrum of spatial information maps for public use. The two figures below, Figure 6 and Figure 7 indicate the maximum and minimum annual temperature for the region that was obtained from their natural resources atlas on climate.

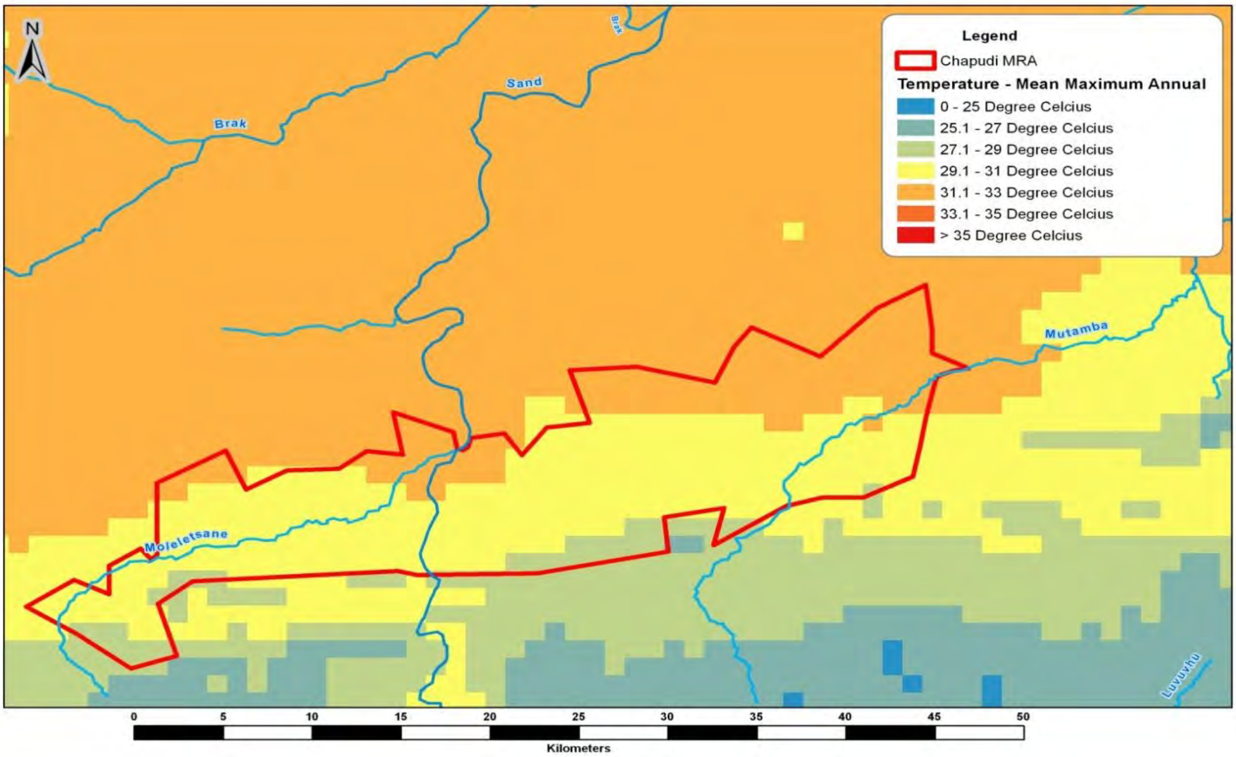


Figure 6: Mean annual maximum temperature

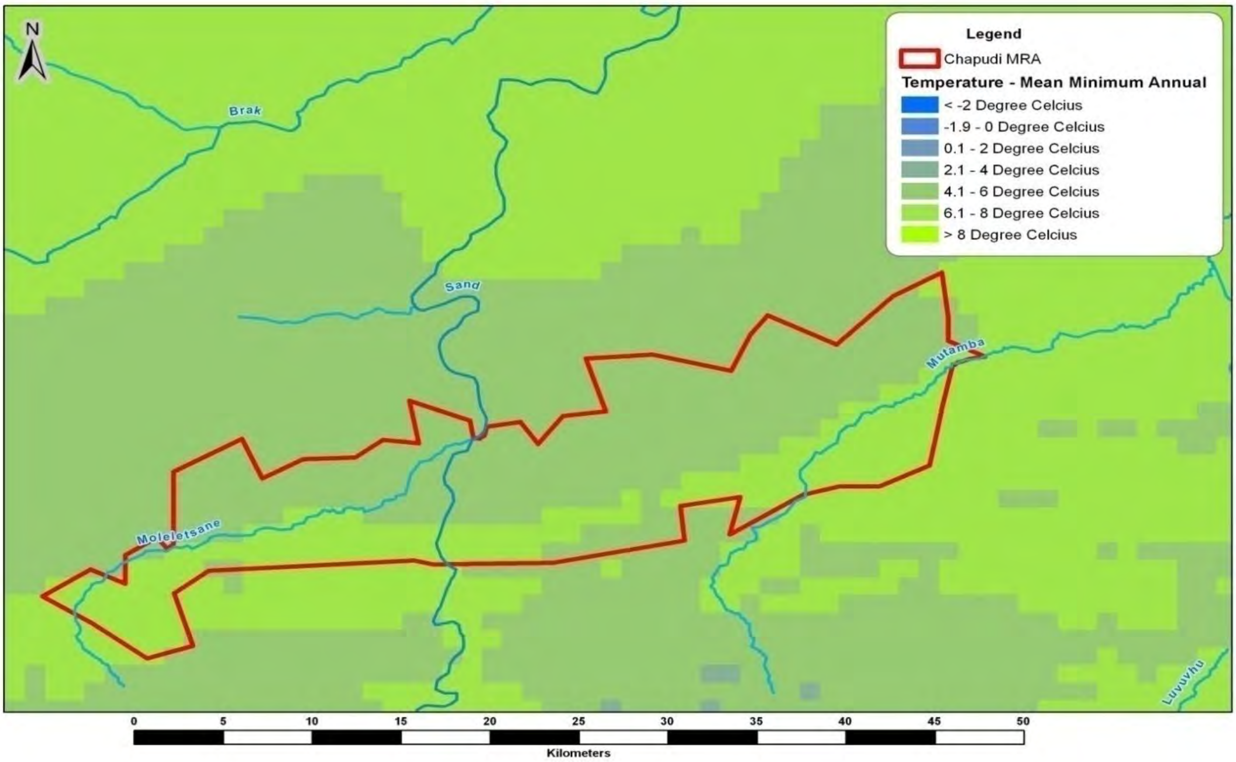


Figure 7: Mean annual minimum temperature

1.2.1.3 Winds

The wind field for the proposed Chapudi Project is presented in Figure 8 below. Wind roses comprise of 16 spokes which represents the direction from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. Based on an evaluation of the meteorological data obtained from the South African Weather Services, the following deductions regarding the prevailing wind direction and wind frequency can be assessed.

Looking at Figure 8 below, the predominant wind direction within the Chapudi Project area is mainly from the south eastern region. Secondary winds originate from the eastern region. At the site, 0.1% of the total wind field accounted for calm conditions over the area.

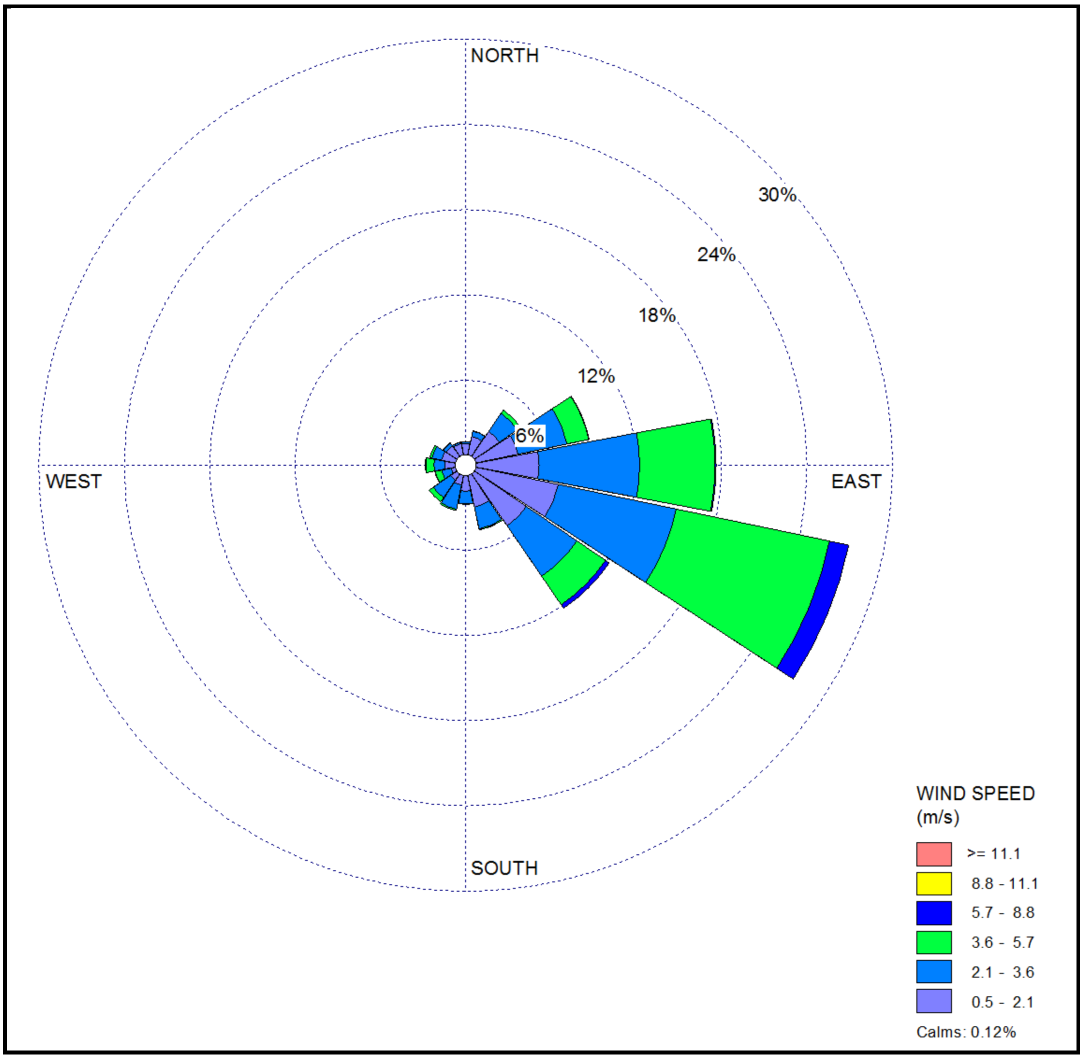


Figure 8: Period wind rose for the Chapudi Project for the period Jan 2009 – Dec 2012

Figure 9 below illustrates the wind frequency distribution for the Jan 2009- Dec 2012 monitoring period. 42.2 % of the time accounted for wind speeds within the range of 0.5 – 2.1 m/s. The second highest wind class 2.1- 3.6 m/s occurred for 33.5% of the time.

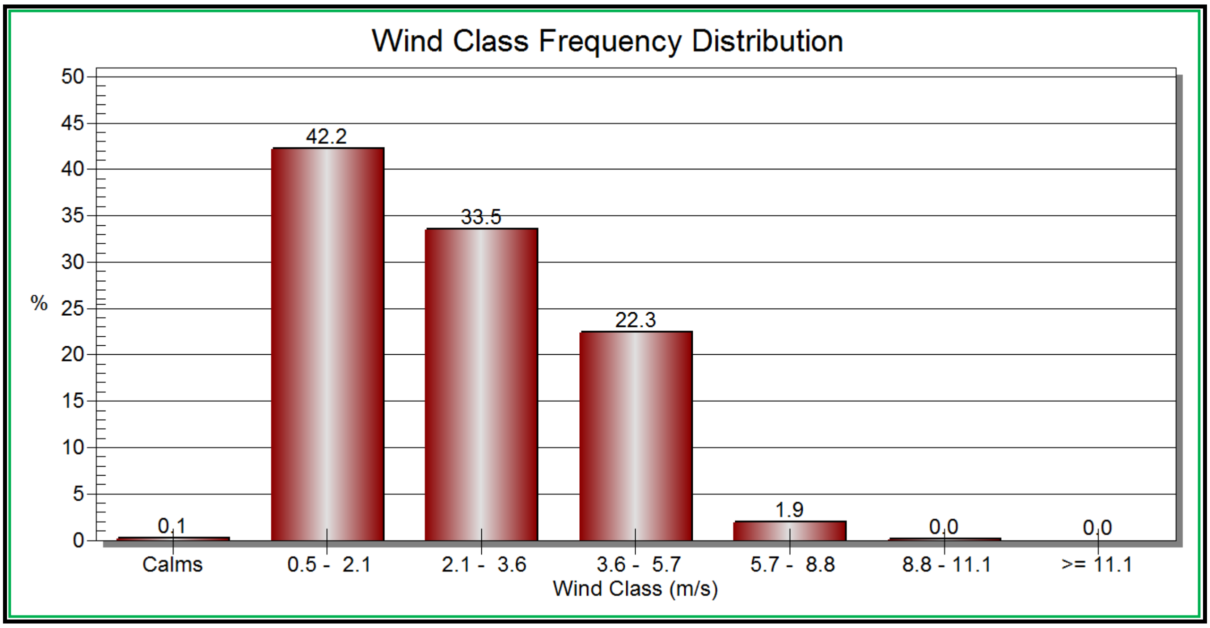


Figure 9: Wind class frequency distribution

Atmospheric stability is commonly categorized into six stability classes. These are briefly described in the table below. 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.

A neutral atmospheric potential neither enhances nor inhibits mechanical turbulences. An unstable atmospheric condition enhances turbulence, whereas a stable atmospheric condition inhibits mechanical turbulence. Majority of the wind class fell within Class F (very stable conditions) which occurred for 34.4% of the time.

A	Very unstable	calm wind, clear skies, hot daytime conditions
B	Moderately unstable	clear skies, daytime conditions
C	Unstable	moderate wind, slightly overcast daytime conditions
D	Neutral	high winds or cloudy days and nights
E	Stable	moderate wind, slightly overcast night-time conditions
F	Very stable	low winds, clear skies, cold night-time conditions

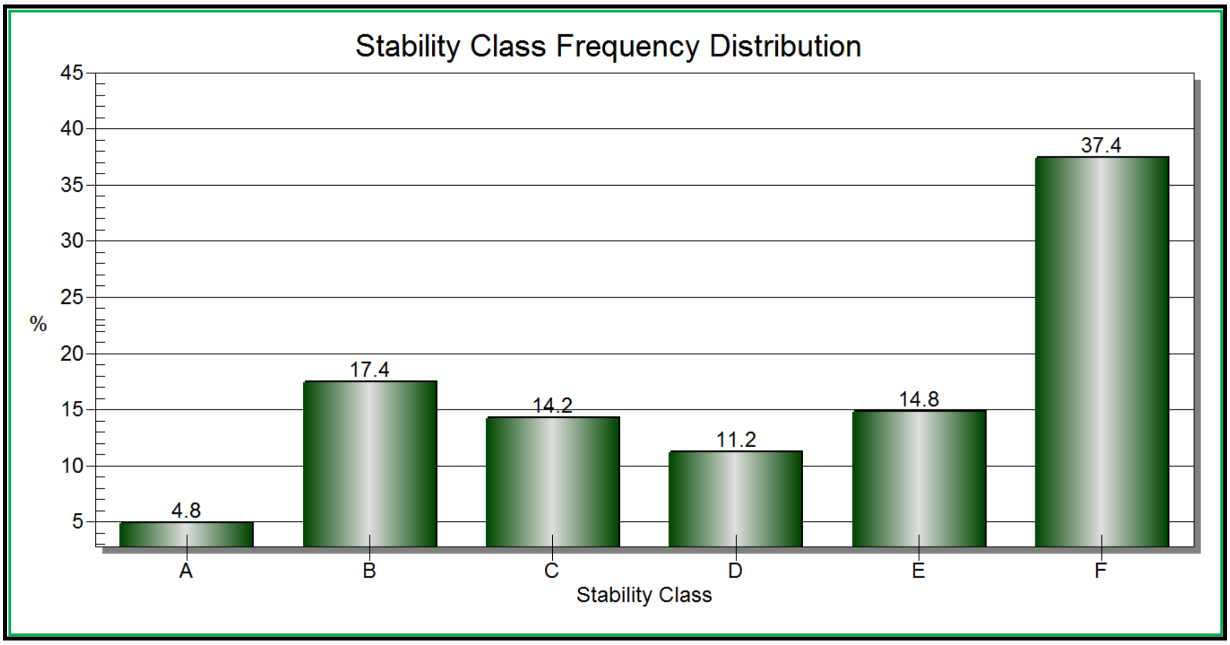


Figure 10: Atmospheric stability class frequency distribution

Due to the high stability levels indicated above, it is likely that an inversion layer will develop, particularly in the early hours of winter mornings. This phenomenon has the possibility of increasing ground level pollution concentrations.

1.2.1.4 Mean Annual Precipitation and Mean Monthly Rainfall

The Chapudi Project is located in both the Sand River Basin (to the west) and the Nzhelele River Basin (to the east). The Sand and Nzhelele Rivers are tributaries of the Limpopo River, located on the northern boundary of the RSA. The major rivers of concern, the Sand and the Moleletsane (Sandsloot) Rivers, fall within the Sand River Basin, while the Mutamba River, which originates just south of the Chapudi Project along the northern slopes of the Soutpansberg, falls within the Nzhelele River Basin. The Sand River originates further to the south along the flanks of the Ysterberg between Polokwane and Mokopane.

The Chapudi Project is located in the hot-arid zone to the north of the Soutpansberg where the rainfall decreases to 400-500 mm. High precipitation occurs on the Soutpansberg which creates high local run-off. The Basin's mean annual precipitation (MAP) distribution is shown in Figure 11 below.

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 run-off events. These events occurred here for example in 1958 (Astrid), 1976 (Danae), 1977 (Emily) and 2000 (Eline) (Van Bladeren and Van der Spuy, 2000).

The project spans across quaternary catchment A71J, A80D and part of A80F as defined in the WR2005 Study (Middleton and Bailey, 2009). The quaternary catchment A71J is located in Rainfall Zone A7C, whereas catchments A80D and A80F fall within Rainfall Zone A8A. The mean monthly precipitation values are given in Table 3 below. The maximum monthly rainfall occurs in January and the lowest in August. The monthly distribution pattern of rainfall in the quaternary catchment is shown in Table 4 and Table 5.

Table 3: Mean monthly rainfall distribution of site rainfall zone A7C and A8A

Rainfall Zone	Mean Monthly Precipitation (% Distribution)											
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
A7C	7.33	15.11	16.81	19.04	16.23	12.55	5.83	2.54	1.25	1.01	0.77	2.39
A8A	6.46	11.81	15.17	20.17	18.66	13.16	5.40	2.29	1.63	1.66	1.15	2.43

(Source: Middleton, B.J. and A.K. Bailey (2009). Water Resources of South Africa, 252005 Study. WRC Rep No TT381. Pretoria)

The absolute monthly rainfall (% distribution x MAP) in the Sand River Basin for the site quaternary catchment is shown in Table 4 below. The average rainfall for the catchment has been determined and the maximum rainfall of 81mm occurs in January and the lowest of 1mm in August. The data in the table is shown in the bar chart below (Figure 12).

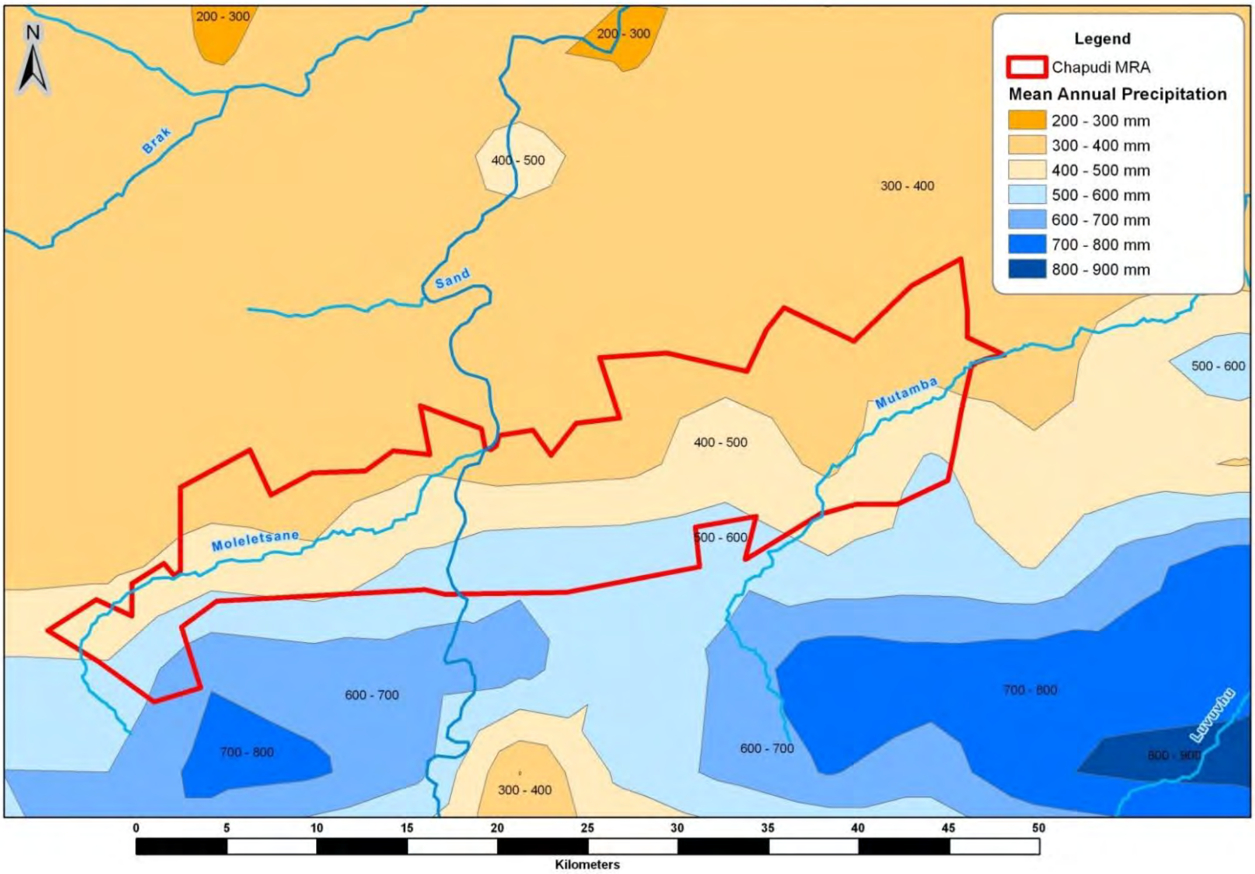


Figure 11: Chapudi Project mean annual precipitation

Table 4: Mean monthly quaternary A71J 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
A71J	396	A7C	29	59	68	81	68	47	21	8	5	3	1	10

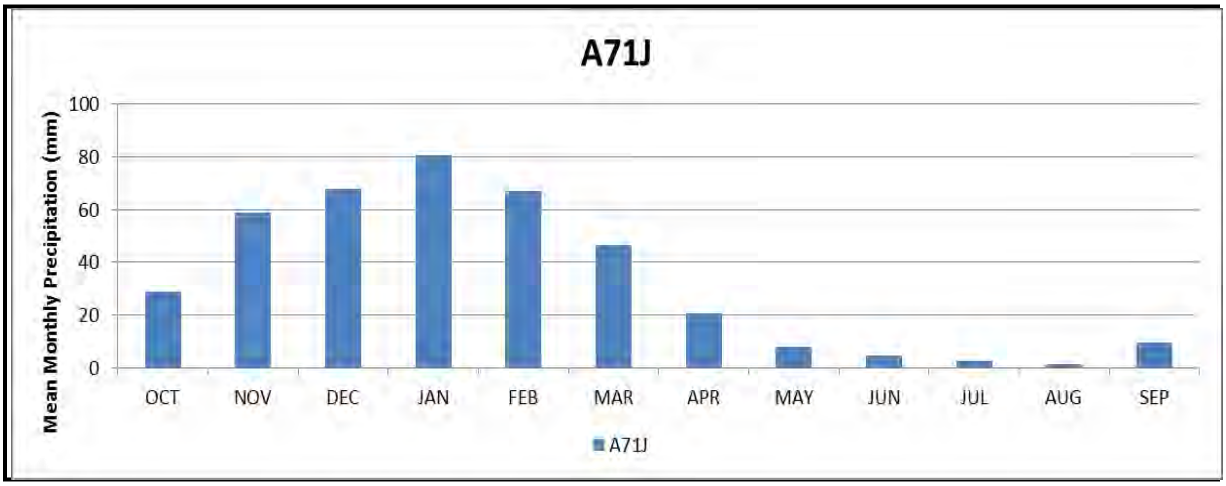


Figure 12: Distribution of mean monthly precipitation in mm

The absolute monthly rainfall (% distribution x MAP) in the Nzhelele River Basin for the site quaternary catchments are shown in Table 5 below. The average rainfall for the catchment has been determined and the maximum rainfall of 125 mm occurs in January and the lowest of 7 mm in August. The data in the table is shown in the bar chart below (Figure 13).

A baseline study of the Chapudi site was conducted in November 2009 by SRK Consulting (Pty) Ltd. In their surface water report, Report Number 395099/SW/1, they utilised data from the Waterpoort rainfall station (0765234AW), which is located in the center of the Chapudi Project area, to approximate a mean annual precipitation from the entire record beginning in October 1977 and ending in October 2008. The mean annual precipitation that they calculated was 389 mm per annum. This correlates to the 396mm mean annual precipitation for rainfall zone A7C and quaternary catchment A71J.

The variability of rainfall further upstream from the Sand River will however have an effect on the surface water runoff for the Sand River itself, but for the local catchments within quaternary catchment A71J, the mean annual precipitation of the quaternary catchment of 396 mm would suffice in terms of surface water runoff calculations.

Table 5: Mean monthly quaternary rainfall for Mutamba River (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
A80D	622	A8A	40	76	94	125	116	82	34	14	10	10	7	15
A80F	388	A8A	25	46	59	78	72	51	21	9	6	6	4	9

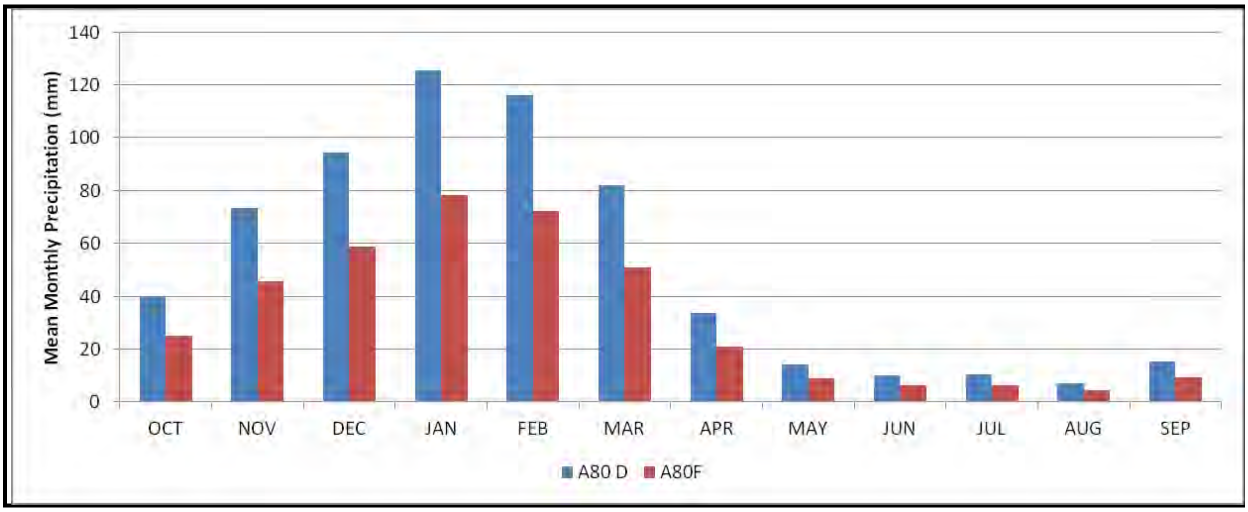


Figure 13: Average rainfall for the Nzhelele catchment in mm

The quaternary catchment in the region of the proposed development as defined in the WR90 Study (Midgley et al, 1994) is shown in Figure 14. The Chapudi Project area is situated within catchments A71J, A80D and A80F.

The surface water runoff calculations for the local catchments within this area were based on the rainfall station Siloam (0766324), which has a mean annual precipitation of 470 mm.

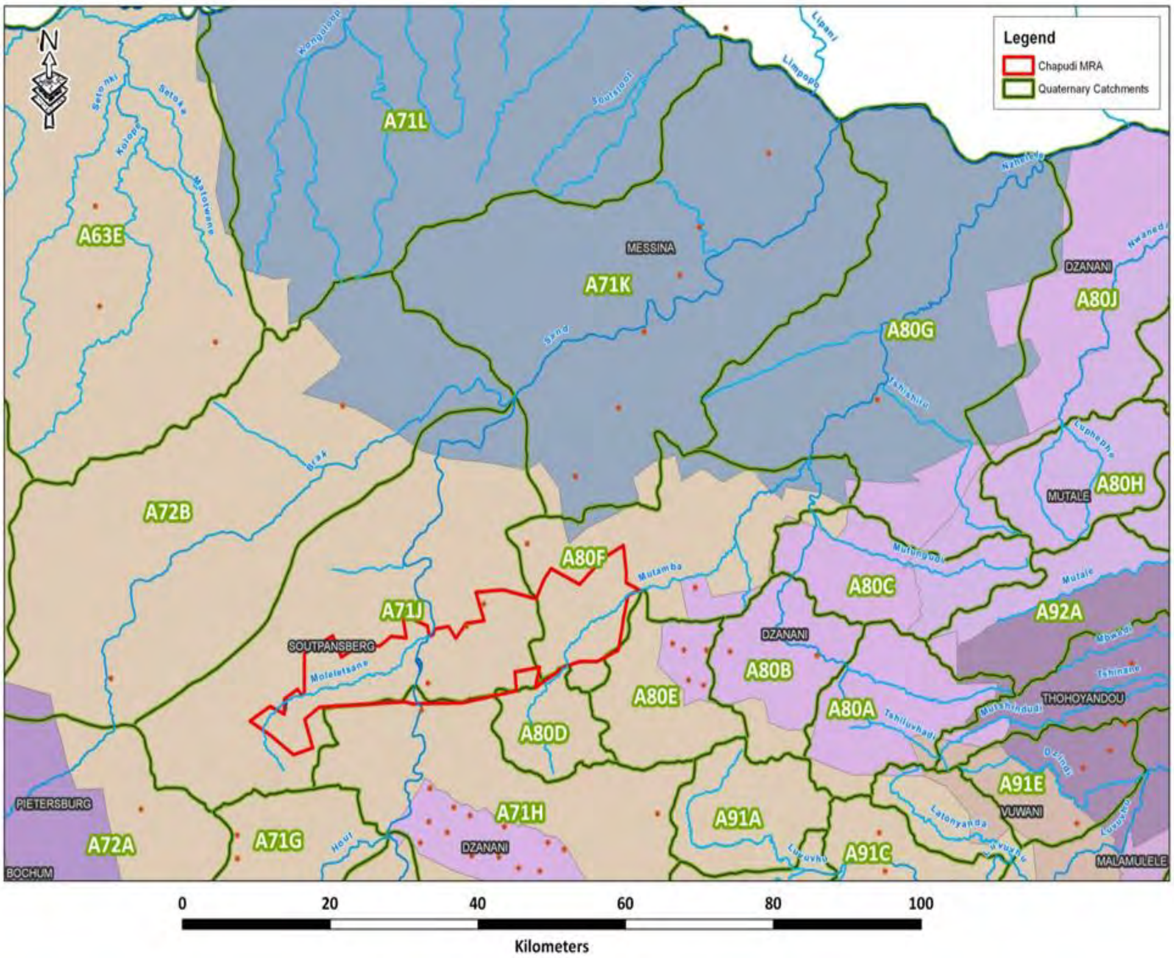


Figure 14: Quaternary catchments affected by the proposed development

1.2.1.5 Run-off and Evaporation

1.2.1.5.1 <u>Sand River runoff</u>

The total net catchment area at the point where the Sand River exits the A71J catchment is 8 499 km^2, approximately 75km directly south of the Limpopo River confluence. The upper reaches of the Sand River originates from the Ysterberg Mountain range in the vicinity of Polokwane and Mokopane, approximately 185 km south of the Chapudi Project area.

The catchment hydrological data of this summer rainfall region are summarized in Table 6 below. Note that catchment A71J includes an endoreic area, i.e. areas which do not contribute run- off to defined continuous streams. The MAR values are based on the net catchment areas shown in the table.

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

Table 6: Catchment data (from WR2005)

Quaternary catchment	Net area (km^2) A	Mean Annual Precipitation (mm) MAP	Mean Annual Run-off (mm) MAR	Mean Annual (gross) Evaporation (mm) MAE (Zone 1B)	Irrigation area (ha)	Forest area (ha)
A71J	905	396	9.69	1800	286	0

The naturalized run-off in the whole of the Sand River upstream of the outlet of quaternary catchment A71J has been compiled from data in WR2005 and the resultant MAR is 57.13 million m^3/a as shown in Table 7. The naturalized unit run-off, based on the net catchment area of 8 499 km^2, amounts to 9.69 mm. Note that the DWA Internal Strategic Perspective (ISP) document gives the unit run-off for the Sand River as a mere 1 mm, but this may be based on current conditions, i.e. it includes for abstractions.

Table 7: Sand River naturalized run-off

Quaternary Catchment (km^2)	Net Catchment Area (km^2)	River(s)	Naturalized MAR (million m^3/a)
A71A	1 144	Sand and Bloed	8.75
A71B	882	Diep and Turfloop	6.25
A71C	1 331	Sand, Dwars and Koperspruit	7.16
A71D	892	Sand	3.73
A71E	893	Hout	4.01
A71F	683	Strydomsloop	2.63
A71G	875	Hout and Mogwatsane	4.46
A71H	894	Sand	11.37
A71J	905	Sand and Moleletsane	8.77
Total Net Catchment	**8 499**	**Total MAR (million m^3/a)**	**57.13**

The mean monthly naturalized run-off data for the affected catchment, A71J, is shown in Table 8.

Table 8: Simulated average naturalized monthly run-off for quaternary catchments A71J

Quaternary Catchment	Area (km^2)	Mean Monthly Natural Run-off (mm)												MAR (mm)
		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	
A71J	905	0.14	0.30	0.42	2.37	4.30	1.42	0.19	0.12	0.11	0.11	0.10	0.10	9.69

1.2.1.5.2 Mutamba River runoff

The total net catchment area where the Mutamba River, a tributary of the Nzhelele River, exits the A80F catchment is 758 km^2. The upper reaches of the Mutamba River originates from the Soutpansberg Mountain range approximately 17 km south of the Chapudi Project.

The catchment hydrological data of this summer rainfall region are summarized in Table 9 below. The MAR values are based on the net catchment areas shown in the table.

Table 9: Catchment data (from WR2005)

Quaternary catchment	Net area (km^2)	Mean Annual Precipitation (mm) MAP	Mean Annual Runoff (mm) MAR	Mean Annual (gross) Evaporation (mm) (Zone 1B) MAE	Irrigation area (ha)	Forest Area (ha)
A80F	491	388	9.69	1750	0	0

The naturalized runoff in the whole of the Mutamba River upstream of the outlet of quaternary catchment A80F has been compiled from data in WR2005 and the resultant MAR is 9.21 million m^3/a as shown in Table 10.

Table 10: Mutamba River naturalised runoff

Quaternary Catchment (km^2)	Net Catchment	River(s)	Naturalized MAR (million m^3/a)
A80D	128	Mutamba	5.84
A80F	491	Mutamba	3.37
Total Net Catchment	**619**	**Total MAR (million m3/a)**	**9.21**

The mean monthly naturalized runoff data for the affected catchment, A80F, is shown in Table 11.

Table 11: Simulated average naturalised monthly runoff for Quaternary catchment A80F

Quaternary Catchment	Area (km^2)	Mean Monthly Natural Runoff (mm)												MAR (mm)
		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	
A80F	491	0.08	0.18	0.37	2.08	2.58	1.10	0.21	0.06	0.06	0.05	0.05	0.04	6.86

1.2.1.5.3 Evaporation

Mean Annual Evaporation data is given in Table 6 and Table 9, while the monthly evaporation pattern (as percentages of the total) is given in Table 12 below. Note that both the Sand River and the Mutamba River fall within the same evaporation zone.

Table 12: Monthly evaporation distribution

Month	Evaporation (%)	Month	Evaporation (%)
October	10.46	April	6.94
November	10.03	May	6.55
December	10.68	June	5.40
January	10.43	July	6.08
February	8.49	August	7.42
March	8.49	September	9.03

Source: WR90, evaporation zone 1B, based on data from Albasini Dam

1.2.2 SOILS

1.2.2.1 Parent Material

The lithology of the area is fine-grained felsic, siliciclastic sedimentary, as well as mafic and ultramafic volcanic rocks. It consists of arenite, gneiss, mudstone, sedimentary sands, shale and basalt.

The mining and infrastructure footprints are mainly on siliciclastic rocks and small areas on fine-grained felsic rocks, consisting of arenites and shales.

The regional parent materials of the area are illustrated in Figure 15 and Figure 16. The following parent materials are found in the area and may have an influence on the soil properties.

- Alluvium, mudstone, sandstone, siltstone, shale and coal of the Clarens Formation and undifferentiated strata of the Karoo Sequence.
- Alluvium, sand and calcrete of the Quaternary System. Basalt of the Letaba Formation and Lebombo Group. Shale, mudstone and sandstone of the Klopperfontein Formation. Both formations of the Karoo Sequence; also leucogneiss and amphibolite.
- Basalt of the Letaba Formation in the Lebombo Group - Karoo Sequence. Leucogneiss, amphibolite, metapelite of the Malala Drift Group.
- Sand of the Quaternary System.
- Quartzite, conglomerate, sandstone and shale of the Stayt Formation, Soutpansberg Group; argillaceous sandstone of the Clarens Formation, Karoo Sequence.
- Sandstone and conglomerate of the Wyllies Poort Formation and Soutpansberg Group.
- Sandstone, shale, basalt and tuff of the Nzhelele Formation. Sandstone, conglomerate of the Wyllies Poort Formation. Both formations of the Soutpansberg Group. Also sandstone, shale and coal of the Karoo Sequence.
- Shale, mudstone and sandstone of the Klopperfontein Formation. Basalt of the Letaba Formation, Lebombo Group, both from the Karoo Sequence. Leucogneiss, amphibolite and metapelite of the Malala Drift Group in the Beit Bridge Complex.
- Shale, mudstone and sandstone of the Klopperfontein Formation. Basalt of the Letaba Formation, Lebombo Group, both from the Karoo Sequence. Leucogneiss, amphibolite and metapelite of the Malala Drift Group in the Beit Bridge Complex.
- Shale, sandstone, siltstone, mudstone and conglomerate of the Karoo Sequence; also Sibasa-Basalt.

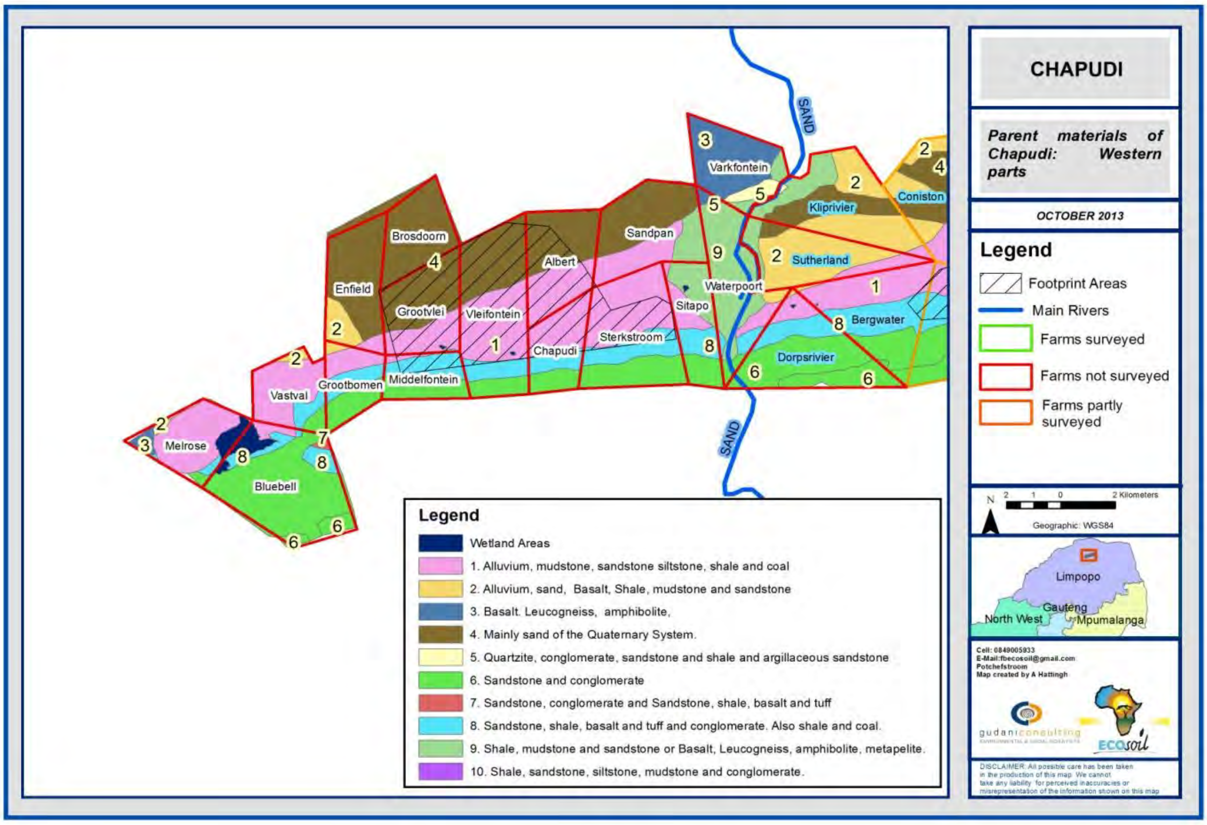


Figure 15: Parent materials of the western parts (Chapudi West Section) of the study area

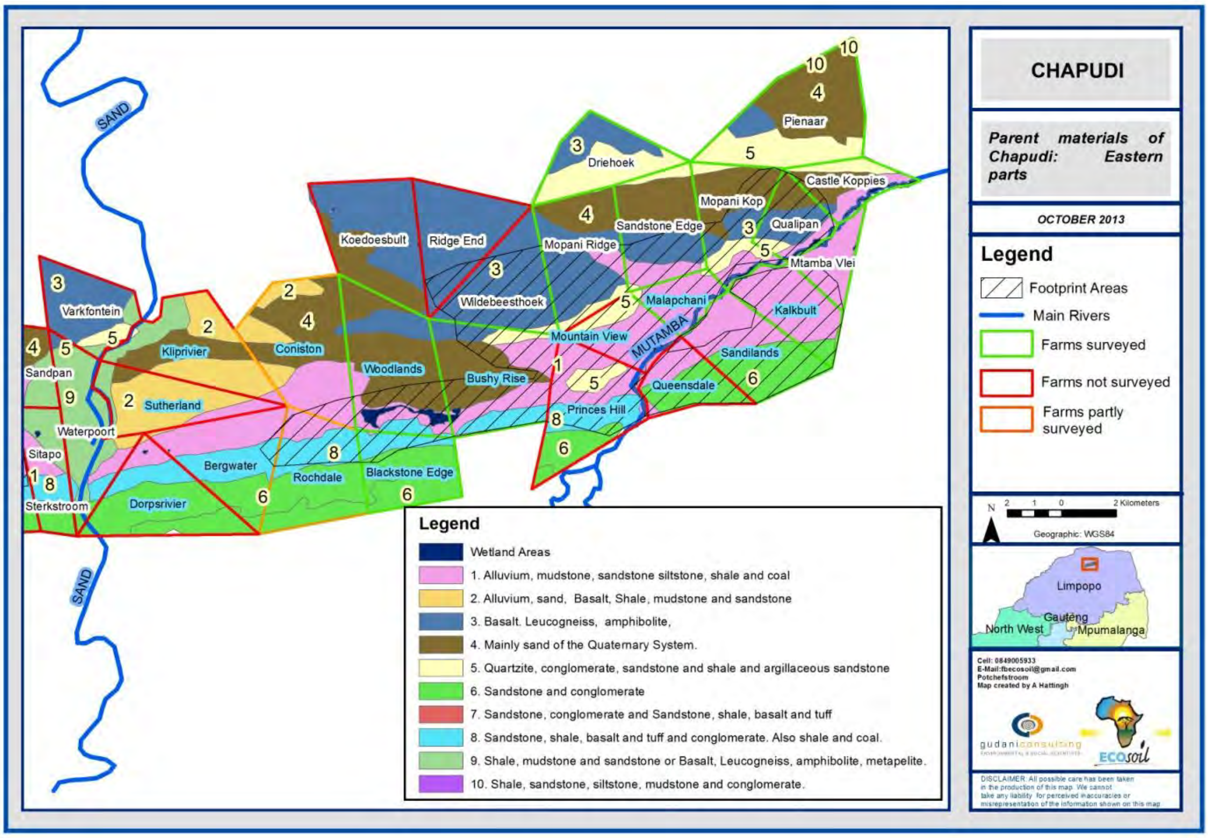


Figure 16: Parent materials of the eastern parts (Chapudi and Wildebeesthoek Sections) of the study area

1.2.2.2 Land Types

Twelve land types are found in the study area (Figure 17 and Figure 18). Land types found in the study area, in the ranking order of area covered, are:

IA151: Miscellaneous land classes

- Freely drained, structure less soils with favourable physical properties, but some areas may have restricted soil depth, excessive drainage, high erodibility, low natural fertility. Irrigation is possible in restricted areas within the land type.
- 8709 ha.
- The parent material is alluvium, mudstone, sandstone siltstone, shale and coal.
- Water holding capacity 81 - 100 mm.

AE305: Red-yellow apedal, freely drained soils

- Red, high base status > 300 mm deep (no dunes). Freely drained, structure less soils. Favourable physical properties. May have restricted soil depth, excessive drainage, high erodibility, low natural fertility.
- 8191 ha.
- Parent material is mainly sand of the Quaternary System.
- Soil depth is generally less than 750mm
- Plant available water content is between 41 - 60 mm, indicating low potential soils.

FC574: Glenrosa and/or Mispah forms (other soils may occur)

- Lime generally present in the entire landscape. Freely drained, structure less soils with restricted soil depth, excessive drainage, high erodibility, low natural fertility, but with favourable physical properties.
- 5207 ha.
- Parent material is basalt Leucogneiss and amphibolite.
- Soil depth less than 450 mm.
- Plant available water content is between 21 - 40 mm, indicating very low potential soils.

FA641: Glenrosa and/or Mispah forms (but other soils may occur)

- Lime rare or absent in the entire landscape. Undifferentiated shallow soils and land classes. Restricted land use options. Soil may receive water runoff from associated rock; water-intake areas.
- Parent material is sandstone and conglomerate.
- Plant available water content is between 21 - 40 mm, indicating very low potential soils.

AG174: Red-yellow apedal, freely drained soils

- Red, high base status <300 mm deep. The soils have favourable physical properties, but may have restricted soil depth, excessive drainage, high erodibility, low natural fertility.
- 2748 ha.

- Parent material is sandstone, shale, basalt and tuff or either sandstone mixed with conglomerate. Shale and coal of the Karoo Sequence are also present.
- Soils are generally less than 450 mm deep. Plant available water content is between 41 - 60 mm, indicating low potential soils.
- Freely drained, structure less soils.

IB312: Miscellaneous land classes

- Restricted land use options. May have water-intake from other areas. Non soil land classes (rocky area).
- 1937 ha.
- Parent material is quartzite, conglomerate, sandstone and shale as well as argillaceous sandstones.
- Soils are less than 450 mm deep.
- Plant available water content is between 21 - 40 mm, indicating very low potential soils.

AE303: Red-yellow apedal, freely drained soils

- Red, high base status < 300 mm deep (no dunes). May have restricted soil depth, excessive drainage, high erodibility, low natural fertility. Freely drained, structure less soils.
- 1646 ha.
- Parent material is alluvium, sand and calcrete and basalt, shale, mudstone and sandstone are also present.
- Soil depth is generally less than 450 mm.
- Plant available water content is between 41 - 60 mm, indicating low potential soils.

IA152: Miscellaneous land classes

- Undifferentiated deep deposits. Freely drained, structure less soils. Favourable physical properties, but some areas may have restricted soil depth, excessive drainage, high erodibility, low natural fertility. Irrigation is possible in restricted areas within the land type.
- 1387 ha.
- Parent material is shale, mudstone and sandstone or basalt, leucogneiss, amphibolite and metapelite.
- Water holding capacity 61 - 80 mm.

IB394: Miscellaneous land classes

- Rock areas with miscellaneous soils. Restricted land use options. May have water-intake from other areas. Non soil land classes (rocky area)
- 780 ha.
- Parent material is sandstone and conglomerate.
- Plant available water content is between 21 - 40 mm, indicating very low potential soils.

IB362: Miscellaneous land classes

- Rock areas with miscellaneous soils. Non soil land classes (rocky area). Restricted land use options. May have water-intake from other areas.

- 110 ha.
- Parent material is sandstone and conglomerate.
- Shallow soils.
- Plant available water content is between 21 - 40 mm, indicating very low potential soils.

AE269: Red-yellow apedal, freely drained soils

- Red, high base status > 300 mm deep. Favourable physical properties. May have restricted soil depth, excessive drainage, high erodibility, low natural fertility.
- 16 ha.
- Parent material is shale, sandstone, siltstone, mudstone and conglomerate.
- Soil depth is generally between 450 mm – 750 mm.
- Plant available water content is between 61 - 80 mm.

AE310: Red-yellow apedal, freely drained soils

- Red, high base status > 300 mm deep (no dunes). Freely drained, structure less soils. Favourable physical properties, but may have restricted soil depth, excessive drainage, high erodibility, low natural fertility.
- 14 ha.
- Parent material is sandstone and conglomerate or shale, basalt and tuff.
- Soils are generally between 450 mm – 750 mm deep.
- Plant available water content is between 41 - 60 mm, indicating low potential soils.

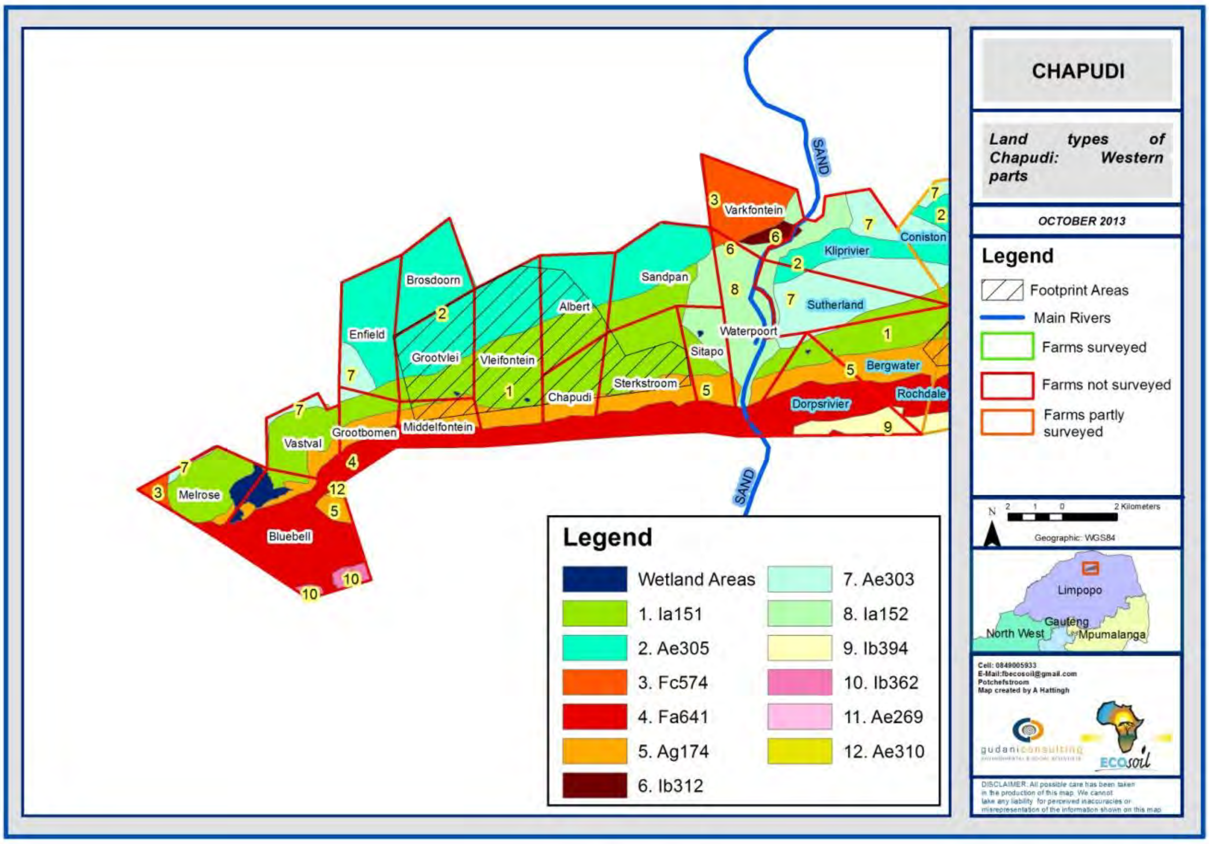


Figure 17: Land types of the western parts (Chapudi West Section) of the study area

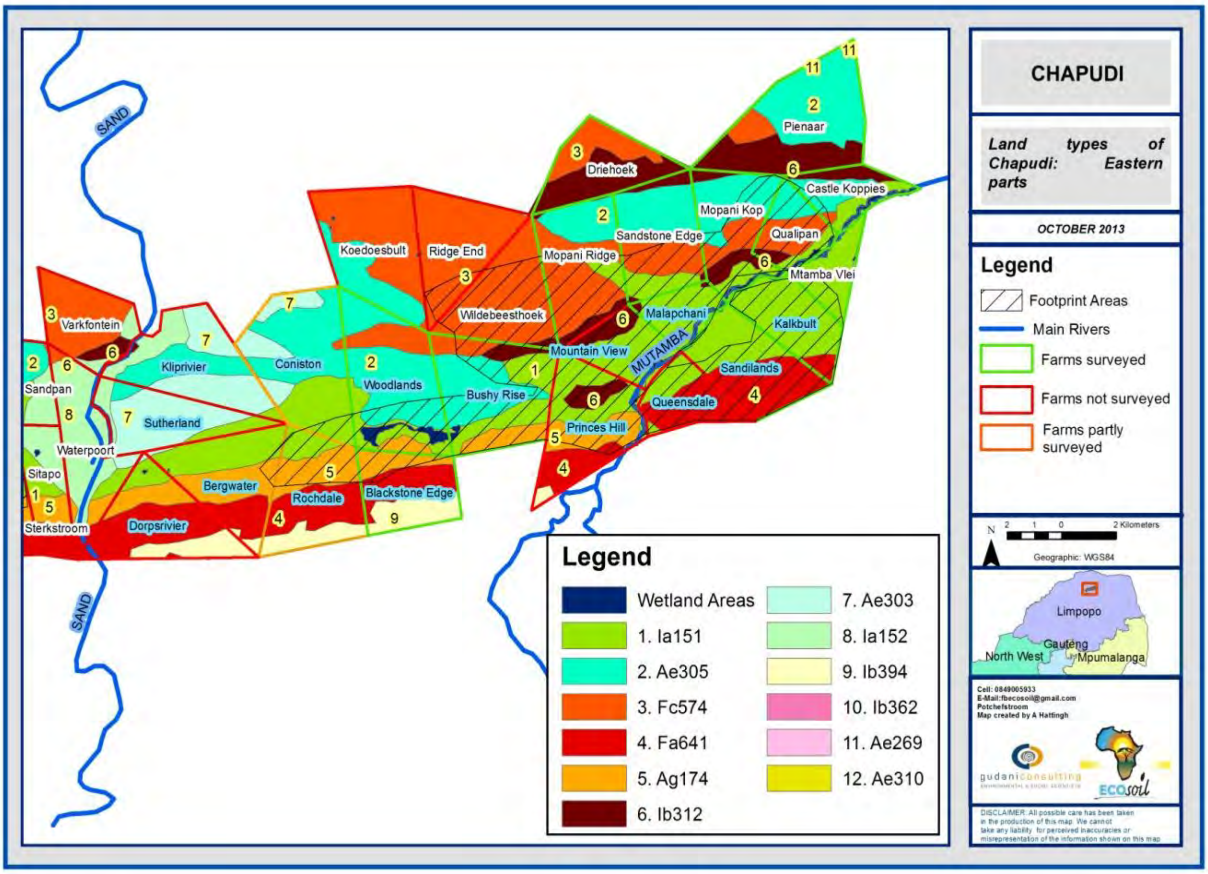


Figure 18: Land types of the eastern parts (Chapudi and Wildebeesthoek Sections) of the study area

1.2.2.3 Soil Forms

The soils vary significantly in physical and chemical composition over the different areas. They are strongly influenced by the underlying rocks (geology) from which they were derived, as well as by their position in the landscape and the origin of the parent material (in-situ versus colluvium/alluvium derived).

The major soil forms that generally have similar characteristics were grouped together in soil associations to simplify the data for interpretation purposes. Associations occurring on the proposed development and the number of soil form occurrences (in brackets), are as follow:

1.2.2.3.1 __Red apedal soils__

- Hutton (Hu) [429]: Has an Orthic A-Horizon over a Red Apedal A-Horizon over unspecified materials, like hard or weathered rock, stone or gravel.
- Plooysburg (Py) [21]: Has an Orthic A-Horizon over a Red Apedal A-Horizon over a hardpan horizon.
- Griffin (Gf) [4]: Has an Orthic A-Horizon over a Yellow Brown apedal A-Horizon on a Red Apedal Horizon.

The depth of the apedal red soils in this study area ranges between 40cm to deeper than 150cm (average 110cm). Clay content of the top soil ranges between 3 and 20% (average 6.7%), at 50cm the clay content ranges between 3 and 32% (average 8.7%), at 100cm the clay content ranges between 3 and 48% (mean 11.2%), at 150cm the clay content ranges between 3 and 43% (average 13.5%).

1.2.2.3.2 Yellow-brown apedal soils

- Clovelly (Cv) [88]: Has an Orthic A-Horizon over a Yellow Brown Apedal A-Horizon over unspecified materials, like hard or weathered rock, or gravel.
- Askham (Ak) [3]: Has an Orthic A-Horizon over a Yellow Brown Apedal A-Horizon over hardpan carbonate.

The average depth of the apedal yellow soils in this study area range from 40-150cm with an average of 108cm. Clay content of the top soil ranges between 2 and 25% (average 6.7%), at 50cm the clay content ranges between 3 and 33% (average 9.7%), at 100cm the clay content ranges between 3 and 25% (average 9.7%), at 150cm the clay content ranges between 8 and 25% (average 11.5%).

1.2.2.3.3 Neocutanic soils

- Oakleaf (Oa) [94]: Has an Orthic A-Horizon over a Neocutanic B-Horizon over unspecified materials, without signs of wetness in the subsoil.
- Gamoep (Gm) [8] and Etosha (Et) [4]: Have an Orthic A-Horizon over a Neocutanic B-Horizon over a hardpan- or soft carbonate horizon respectively.
- Molopo (Mp) [3]: Has an Orthic A-Horizon over a Yellow Brown Apedal A-Horizon on Soft Carbonate.
- Villafontes (Vf) [1]: Has an Orthic A-Horizon over an E horizon over a neocutanic A-Horizon.

In this study area the average depth of the neocutanic soils range from 40-150cm (average 106cm). Clay content in the top soil ranges between 3 and 27% (mean 10.2%), at 50cm the clay content ranges between 6 and 35% (average 18.2%), at 100cm the clay content ranges between 6 and 40% (mean 21.5%), at 150cm the clay content ranges between 15 and 25% (average 22.5%).

1.2.2.3.4 Carbonate soils

- Coega (Cg) [64] and Brandvlei Br [2]: Have an Orthic A-Horizon over a hardpan- or soft carbonate horizon respectively.
- Immerpan (Im) [1]: Has a Melanic A-Horizon over a hardpan carbonate horizon.

The depth ranges from 10-60cm (mean 21cm). The clay content in the top soil ranges between 3 and 35% (mean 15%)

1.2.2.3.5 Neocarbonate soils

- Augrabies (Ag) [20]: Has an Orthic A-Horizon over a Neocarbonate B on unspecified materials.
- Prieska (Pr) [13] and Addo (Ad) [2]: Have an Orthic A-Horizon over a Neocutanic B on a hardpan- or soft carbonate horizon respectively.

In this study area the average depth of the neocarbonate soils range from 40-150cm with an average of 87cm. Clay content in the top soil range between 9 and 45% (average 22.1%), at 50cm the clay content ranges between 8 and 35% (average 26.9%), at 100cm the clay content ranges between 10 and 40% (average 25.6%), at 150cm the clay content ranges between 22 and 28% (average 24.3%).

1.2.2.3.6 __Structured soils__

- Bonheim (Bo) [2]: It has a Melanic B-Horizon over a Pedocutanic B-Horizon without signs of wetness in the sub-soil.
- Sepane (Se) [5]: Has an Orthic A-Horizon over a Pedocutanic B-Horizon with signs of wetness.
- Shortlands (Sd) [1]: Has an Orthic A-Horizon over a Red Structured B- Horizon. Although this soil form does not have Pedocutanic properties it has soil structure in the sub soil and only occurs once in the entire area. It is therefore grouped in this class
- Swartland (Sw) [4]: Has an Orthic A-Horizon over a Pedocutanic B- horizon on Weathered rock (saprolite).
- Valsrivier (Va) [5]: Has an Orthic A-Horizon over a Pedocutanic B-Horizon without signs of wetness in the sub-soil.

In this study area the average depth of the structured soils range from 40-80cm with an average of 63cm. Clay content in the top soil ranges between 15 and 45% (average 28.4%), at 50cm the clay content varies between 24 and 60% (average 40%).

1.2.2.3.7 __Shallow rocky soils__

- Mispah (Ms) [283]: Has an Orthic A-Horizon over hard rock.
- Glenrosa (Gs) [28]: Has an Orthic A-Horizon on a Lithocutanic B-Horizon.
- Outcrop (OC) [1]: No soil present, only bare rock.

The average depth of these soils varies from 0 to 50cm (average 16.7cm). The clay content in the top soil varies between 3 and 31% (average 10%).

1.2.2.3.8 __No specific group soils__

- Fernwood (Fw) [1]: Has an Orthic A-Horizon over an E-Horizon on unspecified material.
- Namib (Nb) [1]: Has an Orthic A-Horizon over regic sand.
- Longlands (Lo) [1]: Has an Orthic A-Horizon over an E-Horizon on soft plinthite.

Although soil forms can give a slight indication of soil capability, it cannot give an indication of agricultural potential. Soil forms give an indication of expected soil colour, properties and soil forming processes.

- Large areas of the farms Coniston, Woodlands, Bushy Rise, Mopani Ridge, Sandstone Edge, Pienaar, Mopani Kop, Malapchani and even Sandilands and Caastle Koppies are covered with Hutton and Clovelly soil forms. These deep soils can be considered as medium to high potential, where climatic conditions are favourable. However this is not the case in the project area and the potential of these soils are degraded to Class III to IV due to climatic constraints.

- Shallow rocky soils are dominant in the farms Rochdale, Sandstone Edge and Sandilands, and also occur on large areas on the farms Mopani Ridge, Driehoek and the southern parts of Kalkbult.
- Neocutanic soils are mainly found in significant areas around the Matumba River on the farms Castle Koppies, Kalkbult, Malapchani and Sandilands, as well as on old riverbeds of the farms Coniston, Bushy Rise and Mopani Kop.
- Carbonate soils are found in some areas on the farms Mtamba Vlei, Kalkbult, Mopani Kop, Sandilands and Qualipan.

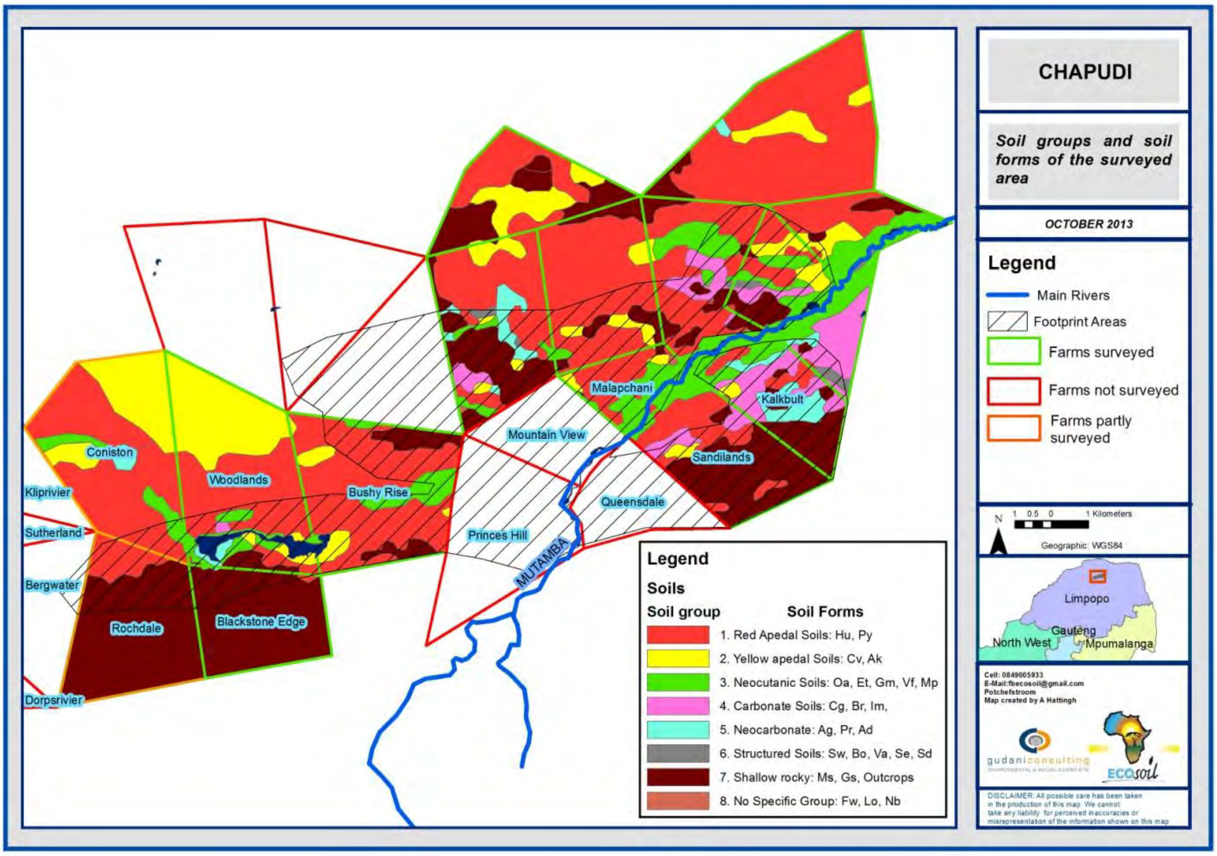


Figure 19: Soil groups (associations) and forms of the surveyed area (accessible farms)

Table 13: Summary of different soil physical properties of the soil groups

Properties	Soil Group 1	Soil Group 2	Soil Group 3	Soil Group 4	Soil Group 5	Soil Group 6	Soil Group 7
Soil association	Red Apedal	Yellow - brown Apedal	Neo-cutanic	Carbonate	Neo-carbonate	Structured Soils	Shallow, rocky
Soil forms	Hu, Py, Ky,	Cv, Ak	Oa, Gm, Et	Cg, Br	Ag, Pr, Ad	Bo, Sd Se, Sw, Va,	Ms, Gs
Dominant soil	Hutton	Clovelly	Oakleaf	Coega	Augrabies	Swartland	Mispah
Soil family	1200	1200	1120	1000	1120	1122	1100
Soil Depth cm	40-150	40-150	40-150	10-60	40-150	40-80	0-50
Average rooting depth cm	110	108	106	21	87	63	16.7
Infiltration rate	Fast 15-25mm/h	Fast 15-25mm/h	Moderate 10-15mm/h	Very Slow <5mm/h	Slow 5-10mm/h	Very Slow <5mm/h	Slow 5-10mm/h
Consistency	Loose	Loose	Friable	Soft	Soft	Hard	Loose
Structure	Apedal	Apedal	Weak blocky	Apedal	Weak blocky	Strong blocky	Apedal
Clay % A (aver)	3-20(6.7)	2-25(6.7)	3-27(10.2)	3-35(15)	9-45(22.1)	15-45(28.4)	5-55(53)
Clay % 50cm	3-32(8.7)	3-33(9.7)	6-35(18.2)	Soil not 50cm	8-35(26.9)	24-60(40)	Soil not 50cm
Clay% 100cm	3-48(11.2)	3-25(9.7)	6-40(21.5)	-	10-40(25.6)	-	
Clay% 150cm	3-43(13.5)	8-25(11.5)	15-25(22.5)	-	22-28(24.3)	-	
PAW mm/profile	13-185 (94.4)	30-183 (91.2)	18-198 (116.5)	6-74 (22.1)	50-188 (109.8)	57-136 (91.6)	0-54 (14.8)
Field capacity mm	49-340 (153)	45-334 (146)	31-378 (206.6)	9-137 (38.8)	90-383 (207)	120-396 (187.5)	0-105 (24.5)
Wilting point mm	12-156 (58.6)	16-152 (55.3)	14-180 (90.1)	3-66 (16.6)	41-165 (96.5)	63-224 (95.8)	0-51 (9.8)
Drainage	Fast	Fast	Moderate	Poor	Moderate	Poor	Moderate
Gravel/Rocks A-Horizon	-	-	-	R1	G3	-	R5
Gravel/rocks B1 Horizon	G1	G1	G3	R6	G3	-	R
Gravel/rocks B2 Horizon	G1	G1	G3	-	G3	G3	-
Wetness	0	0	0	0	0	W1	0
Compactability	High	High	High	Moderate	High	Moderate	Low
Erodibility	Very High	Very High	High	Very High	Very High	Very High	Very High
Potential Nematode Infestation	High	High	Moderate	Low	Low	Low	High
Irrigation classification	2	2	3	5	3	4	5

1.2.3 PRE-MINING LAND CAPABILITY

The land capability of the study area was classified into four classes (wetland, arable land, grazing land and wilderness) according to the Chamber of Mines Guidelines (COM), 1991.

Table 14: Criteria for Pre-Development Land Capability

Criteria for Wetland

- Land with organic soils or supporting hygrophilous vegetation where soil and vegetation processes are water determined.

Criteria for Arable land

- Land, which does not qualify as a wetland.
- The soil is readily permeable to a depth of 750 mm.
- The soil has a pH value of between 4.0 and 8.4.
- The soil has a low salinity and SAR
- The soil has less than 10% (by volume) rocks or pedocrete fragments larger than 100 mm in the upper 750 mm.
- Has a slope (in %) and erodibility factor (K) such that their product is <2.0
- Occurs under a climate of crop yields that are at least equal to the current national average for these crops.

Criteria for Grazing land

- Land, which does not qualify as wetland or arable land.
- Has soil, or soil-like material, permeable to roots of native plants, that is more than 250 mm thick and contains less than 50 % by volume of rocks or pedocrete fragments larger than 100 mm.
- Supports, or is capable of supporting, a stand of native or introduced grass species, or other forage plants utilisable by domesticated livestock or game animals on a commercial basis.

Criteria for Wilderness land

- Land, which does not qualify as wetland, arable land or grazing land.

The land capability of the surveyed area is presented in Figure 20 and is summarised per farm in Table 15.

Wetlands are defined as: "Land with organic soils or supporting hygrophilous vegetation where soil and vegetation processes are water determined". In this study area the following criteria was used:

- Riparian zones were not delineated, and only wetland soil parameters per definition were used.
- Small farm dams and pans that fell between two observation points (based on the grid size) were not mapped.

A large area of wetlands is found on the farm Woodlands 701 MS. This wetland is situated on the proposed infrastructure footprint area.

Footprints on the surveyed areas are generally covered by soils classified with a mixture of arable, wilderness and grazing capability. The farms Woodlands, Bushy Rise and Malapchani have significant areas of arable soils on the proposed footprints and are well suited for irrigation purposes. Smaller areas of arable soils on the footprints, well suited for irrigation and if good quality water sources is available, are also found on the farms Mopani Ridge, Sandstone Edge, Kalkbult, Qualipan and Mopani Kop.

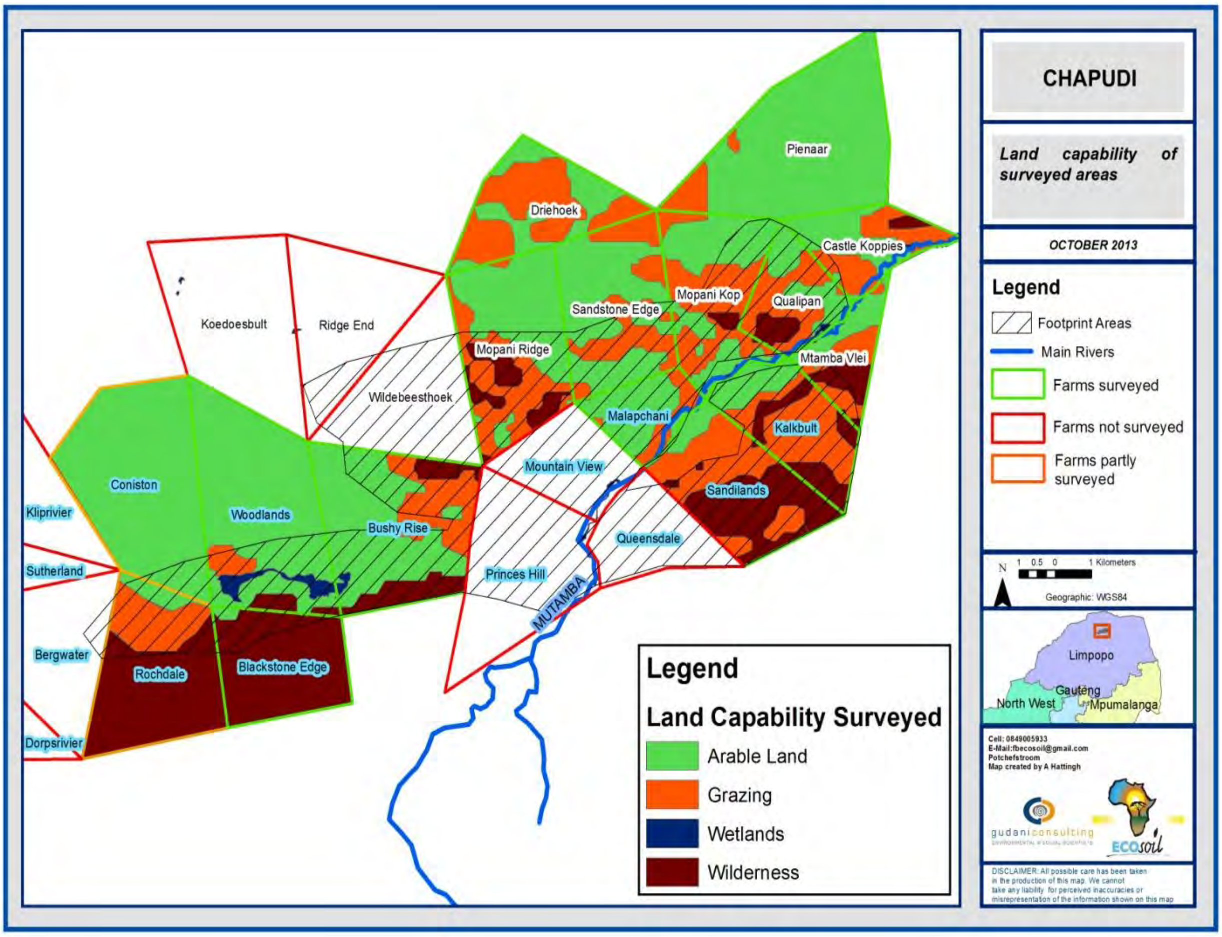


Figure 20: Land capability of the surveyed areas

Table 15: Land capability classes and total hectares of each farm respectively for the surveyed area

Farm Name	Total Area (ha)	Arable	Grazing	Wetland	Wilderness
Blackstone Edge	858.7	20.9			837.8
Bushy Rise	1439.9	882.7	312.2	12.4	232.6
Castle Koppies	574.6	268.0	232.5	30.9	43.3
Coniston	1505.7	1505.7			
Driehoek	872.6	317.6	555.0		
Kalkbult	757.6	160.4	393.1	1.0	203.1
Malapchani	427.8	310.2	107.5	10.1	
Mopani Kop	980.5	487.5	442.9	20.4	29.7
Mopani Ridge	1202.7	633.3	402.3		167.1
Mtamba Vlei	421.8	146.7	150.7	10.5	113.9
Pienaar	1618.0	1512.2	105.8		
Qualipan	655.4	328.7	232.4	20.0	74.4
Rochdale	1187.5	82.1	266.5		838.8
Sandilands	1016.0	422.6	86.5	0.6	506.4
Sandstone Edge	1096.7	702.3	394.4		
Woodlands	1555.8	1339.1	69.5	80.0	67.2
Total	16171.4	9120.0	3751.3	185.8	3114.3
% of surveyed Area	100.0	56.4	23.2	1.1	19.3

External factors like climate, topography, erosion factors, and surface rock and water quality parameters are brought in consideration to determine the present agricultural potential. Climatic conditions and availability of good quality irrigation water are general restraints within the region and has a direct impact on the agricultural potential of the different soil groups.

- The soils of Group 1-3 are classified as a class III potential. The biggest restraint being texture, percolation and soil fertility. These soils can be irrigated. Soil fertility problems can be overcome with chemical and biological fertilizers and management practices.
- The soils of Group 4 are classified as a class V-VI potential. The biggest restraint being shallow soils, erosion and surface rock.
- The soils of Group 5 are classified as a class IV potential. The biggest restraint being slow infiltration rates, erosion and surface rock.
- The soils of Group 6 are classified as a class V potential. The biggest restraint being slow infiltration rates, soil structure and poor drainage.
- The soils of Group 7 are classified as a class VII potential. The biggest restraint being surface rock, shallow soils.
- The soils of Group 8 are wetland areas and classified as a class VIII potential.

Table 16: Agricultural Potential Classification of land capability classes according to agricultural classification system

Soil Management Unit	Soil Group 1	Soil Group 2	Soil Group 3	Soil Group 4	Soil Group 5	Soil Group 6	Soil Group 7	Soil Group 8
Soil Types	Red Apedal	Yellow Apedal	Neo Cutanic	Carbonate	Neo Carbonate	Pedo cutanic	Shallow rocky	Wetland
Soil depths cm	40-150	40-150	40-150	10-60	40-150	40-80	0-50	-
Average soil depth cm	110	108	106	21	87	63	16.7	-
Limiting Factors	Texture, Percolation	Texture, Percolation	Erosion, Depth, Surface rock	Soil depth, Surface Rock, Erosion	Surface Rock, Erosion, Infiltration rate	Structure, Erosion, Wetness	Surface Rock, Depth	Water-logging
External Factors	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality	Climate, Water Quality
Land capability	Arable, crop production	Arable crop production	Grazing	Grazing / Wilderness	Wilderness / Grazing	Grazing	Wilderness	Wetland
Agricultural potential	Low to medium	Low to medium	Low to medium	Marginal	Low	Low	Marginal	Marginal
Agricultural Classification	III	III	III	V-VI	IV	V	VII	VIII

In conclusion:

- Approximately 2594 ha of the footprint area east of the Sand River (Chapudi and Wildebeesthoek Sections) are deeper than 75cm and can be regarded as good for crop production under irrigation where high quality water for irrigation is available.
- Footprint areas west of the Sand River were not surveyed, but from available data it can be concluded that large areas of the proposed footprint have arable soils.
- At present 2 236 ha in the project area are under cultivation (1699 ha dry land and 537 ha irrigated). These areas generally have deep soils and are suitable for crop production especially under irrigation when sufficient amount of good quality irrigation water is available.
- As a result of low rainfall, high temperatures (high evapotranspiration), susceptibility to compaction, present erosion and potential erosion susceptibility of the soils in the area, the soils are not always optimal for rain fed crop production.
- Water quality for irrigation purposes varies across the project area. The boreholes situated near the hills in the southern parts of the project area are highly suited for irrigation purposes, with absolutely no restrictions to irrigation.
- Some of the water samples only have minor suitability constraints and can be used for irrigation if it is well managed. The quality of water of some of the boreholes further north in the study area, is less suitable for irrigation purposes with restrictions specifically to sensitive crops.
- Shallow soils and surface rock are dominant in large areas. Areas classified for grazing have presently low basal grass cover and are dominated by Mopane shrub field.

- Present land use is cattle and game farming, but carrying capacity is questionable due to poor soil fertility (potential erosion susceptibility, shallow soils, and surface rock) and poor climatic conditions.
- Soils classified as arable land fall into classes III to IV according to the agricultural classification system.
- Generally the soils are sandy and susceptible to erosion (water and wind) and should be permanently covered with vegetation to prevent erosion and top soil loss. Uncovered areas are also susceptible to water erosion in times of high intensity storms.

1.2.4 PRESENT LAND USE

Approximately 2 236 ha of the total project area are cleared for crop production and 537 ha are irrigated.

1.2.4.1 Chapudi West Section

Crop production (predominantly vegetables) is taking place on 938 ha on the farms Waterpoort, Varkfontein, Sitapo and Sterkstroom (the floodplains of the Sandriver), as well as on Albert, Vleifontein and Enfield in the Chapudi west project area, as is indicated in yellow in Figure 21. All these farms, except Sterkstroom, also have some fields under irrigation (274 ha).

The majority of area is presently covered with low density woody species and used for grazing purposes for either cattle or game farming.

The southern higher lying areas are largely covered with high density woody species, especially on the farms Bluebell, Grootbomen, Chapudi, Sterkstroom, Middelfontein, Waterpoort and Sitapo. The northern parts of the farms Varkfontein and Albert also have considerable areas of high density woody species. However, these high density woody species are present in smaller areas on almost all farms.

Significant degraded areas with no or very scarce basal cover are present on the farms Sterkstroom, Sandpan and Grootvlei. Smaller areas of degraded land are also present on Vleifontein and Chapudi, Melrose, Albert, Enfield and Vastval. Due to the very low clay contents of the area degraded areas are highly susceptible to wind erosion. Water erosion may also occur.

1.2.4.2 Chapudi and Wildebeesthoek Sections

Crop production activities are present on 1298ha on the farms Mountain View, Princes Hill, Queensdale, Bergwater, Brosdoorn, Koedoesbult, Coniston, Grootvlei, Kliprivier, Rochdale, Sutherland, Wildebeesthoek and Bushy Rise as is indicated in Figure 22. Approximately 264 ha of these soils are under irrigation.

The majority of area is presently covered with low density woody species and used for grazing purposes for either cattle or game farming.

Almost the entire Rochdale and Blackstone Edge, as well as the southern higher lying areas of the farms Dorpsrivier, Bergwater are covered with high density woody species, The northern parts of the farms Varkfontein and Albert also have considerable areas of high density woody species. However, these high density woody species are present in smaller areas on almost all farms.

According to previous studies, combined with the present study the following land use areas were found:

- Commercial (or cleared) land: 2 236 ha (537 ha irrigated and 1699 ha dry land)
- Degraded: Forest and woodland: 2 816 ha
- Thicket and Bushland: 13 921 ha
- Woodlands: 21 158 ha
- Bare Rock (natural): 26 ha
- Wetlands: 403 ha

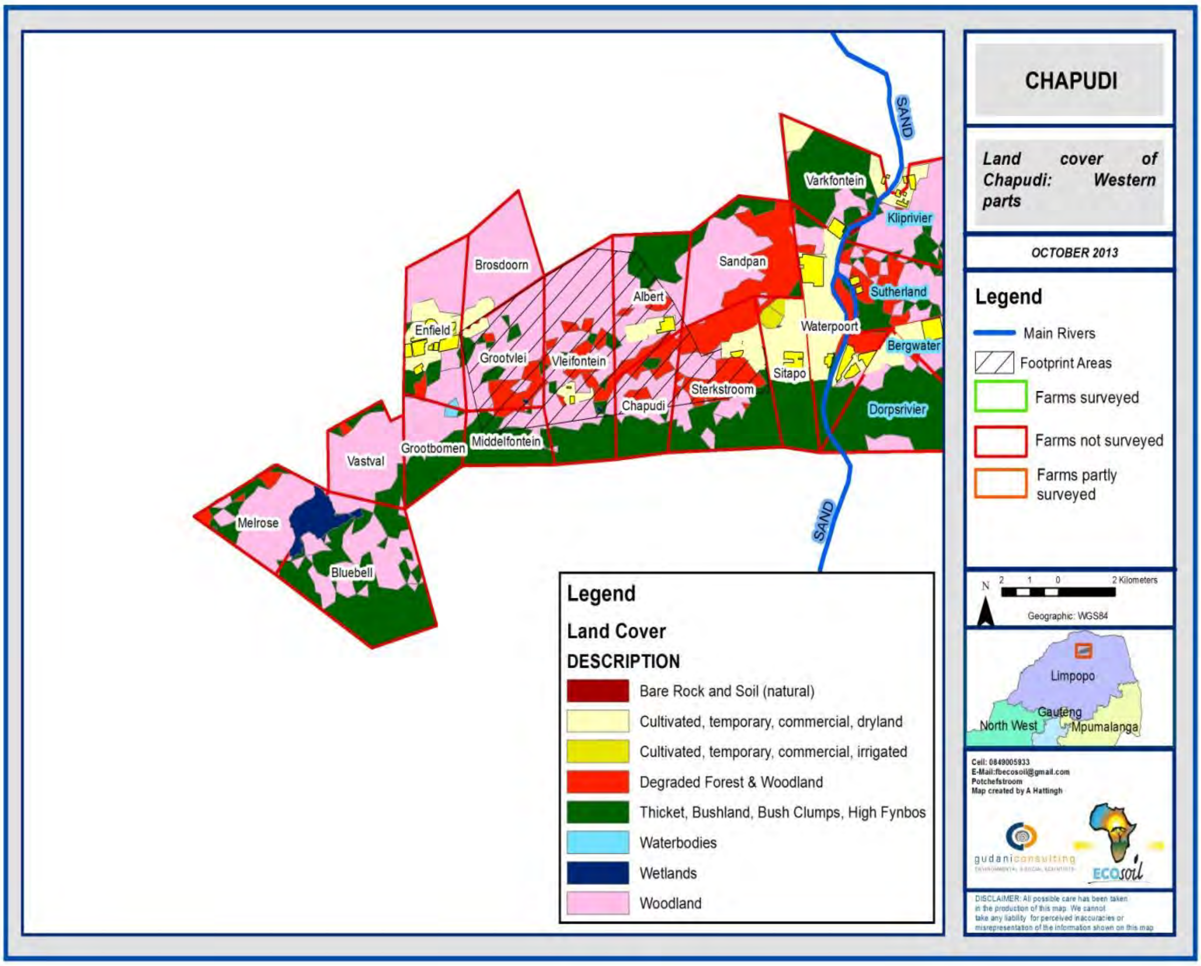


Figure 21: Present land cover of the western parts (Chapudi West Section) of the study area

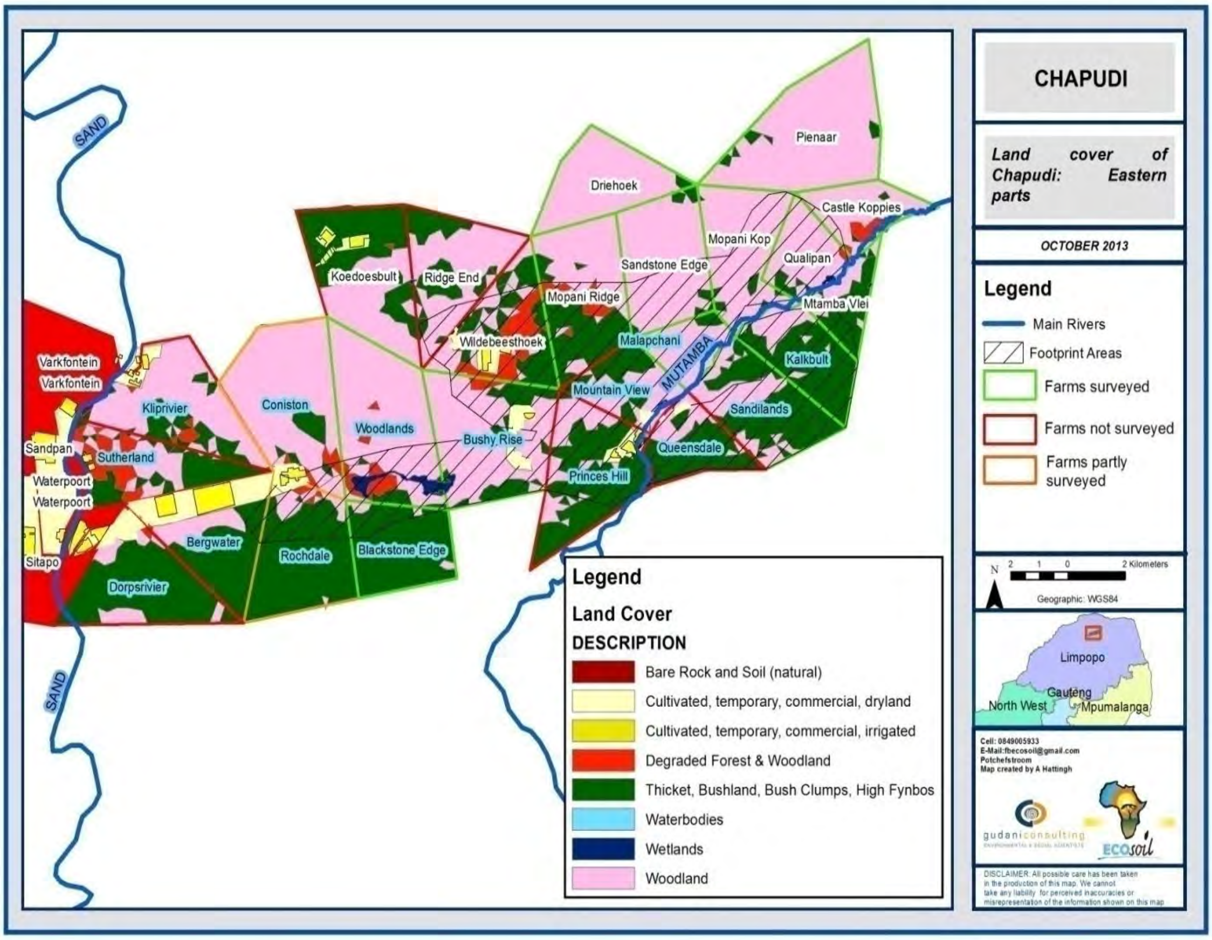


Figure 22: Present land cover of the eastern parts (Chapudi and Wildebeesthoek Sections) of the study area

1.2.5 BIODIVERSITY (FAUNA AND FLORA)

1.2.5.1 Flora

The vegetation of the study area belongs to the broad vegetation group the Savannah Biome (Low and Rebelo, 1996). The Savannah Biome is the largest Biome in Southern Africa, occupying 46% of its area, and over one-third the area of South Africa. It is well developed over the Lowveld and Kalahari region of South Africa and is also the dominant vegetation in Botswana, Namibia and Zimbabwe. A grassy ground layer and a distinct upper layer of woody plants (trees and shrubs) are characteristic of the Savannah Biome. Where this upper layer is near the ground (low growing) the vegetation may be referred to as Shrubveld, where it is tall and dense, as Woodland, and the intermediate stages are locally known as Bushveld.

The environmental factors delimiting the biome are complex and include (Low and Rebelo, 1996):

- Altitude ranges from sea level to 2 000 m;
- Rainfall varies from 235 to 1 000 mm per year;
- Frost may occur from 0 to 120 days per year; and
- Almost every major geological and soil type occurs within the biome.

A major factor delimiting the biome is the lack of sufficient rainfall, which prevents the upper (tree and shrub) layer from dominating, coupled with fires and grazing, which keep the grass layer dominant. Summer rainfall is essential for the grass dominance, which, with its fine material, fuels near-annual fires. In fact, almost all species are adapted to survive fires, usually with less than 10% of plants, both in the grass and tree layer, killed by fire. Even with severe burning, most species can resprout from the stem bases (Low and Rebelo, 1996).

The shrub-tree layer may vary from 1 to 20m in height, but in Bushveld typically varies from 3 to 7m. Soil depth is one of the critical factors that determine tree height in the biome. The shrub-tree element may come to dominate the vegetation through bush encroachment in areas that are being overgrazed (Low and Rebelo, 1996).

Most of the savannah vegetation types are used for grazing, mainly by cattle or game. In the southernmost savannah types, goats are the major stock.

Representation of the savannah biome in conservation areas in South Africa is good in principle, mainly due to the presence of the Kruger- and Kalahari Gemsbok National Parks within the biome. However, the large areas conserved in South Africa, belies the fact that half of savannah vegetation types are inadequately conserved, in having less than 5% of their area in reserves. However, much of the area is used for game farming and can thus be considered effectively preserved, provided that sustainable stocking rates and sound environmental practices are maintained. Tourism and hunting has become important utilisation options in the savannah biome.

Several studies in the Soutpansberg Mountain area indicated its importance with regard to biodiversity, endemic plant species and also some red data species (Hahn, 1994, 2002, 2003, 2006; Mostert, 2006; Mostert et al. 2008). Vegetation surveys in the area indicated that the area has an outstanding diversity of plant species, with 2 500 - 3 000 plant species recorded from the area. This resulted in the recognition of the Soutpansberg Centre of Endemism (Van Wyk & Smith 2001). The conservation value of the Centre lies in its unique ability to house a wide variety of floristic elements from the surrounding floristic regions (Hahn, 2002). Not only is the diversity of plant species in this area high, but the diversity in ecosystems is equally high, as indicated by Mostert (2006). The Kruger National Park which covers 2 million hectares contains about 380 tree species. The Soutpansberg which covers about 2 000 hectares has 321 tree species (Hahn, 2002).

1.2.5.1.1 Veld types

According to Mucina & Rutherford (2006), three veld types occur in the project area (Figure 23):

- Musina Mopane Bushveld on the plains (Least Threatened)
- Limpopo Ridge Bushveld on scattered hills and rocky outcrops (Least Threatened)
- Soutpansberg Mountain Bushveld on the Soutpansberg Mountain ridges to the south (Vulnerable)

Vulnerable vegetation types have lost more than 20% of their original extent, which could result in some ecosystem functions being altered.

Least Threatened applies to vegetation and is used when no significant disruption of ecosystem functioning is assumed and the vegetation types still have more than 80% of their original extent untransformed.

No Endangered or Critically Endangered Ecosystems (2011) as defined in terms of the NBA are affected by the proposed development as the classification of the vegetation units do not trigger the NBA.

Musina Mopane Bushveld

The Musina Mopane Veld is characterized by undulating to very irregular plains with some hills, at an altitude of around 600m. On areas with deep sandy soils, the *Kirkia acuminata* (white seringa) is one of the dominant tree species along with *C. mopane* (Mopane), *C. apiculatum* (Red Bushwillow) and *Grewia spp*. (Raisin bushes). The herbaceous layer is poorly developed, especially where mopane occurs in dense stands. This vegetation type is classified as poorly protected and "Least threatened" with 2% statutorily conserved in the Mapungubwe National Park, as well as the Nzhelele, Nwanedi, Musina and Honnet Nature Reserves. About 3% is transformed, mainly by cultivation, and soil erosion is moderate to high. The conservation target is 19%.

The geology consists mainly of gneisses and meta-sediments of the Beit Bridge Complex, with variable soils from deep red/brown clays to deep, freely drained sandy soils, to shallower types including skeletal Glenrosa and Mispah soil forms. The mean annual precipitation varies between 300 – 400 mm and the area is generally frost-free.

Important taxa include trees such as *C. mopane* (Mopane), *A. digitata* (Baobab), *A. nigrescens* (Knobthorn), *C. apiculatum* (Red Bushwillow), *A. senegal var. leiorhachis* (Slender Three-hook Thorn) and *Commiphora mollis* (Velvet Corkwood). Conspicuous small trees and shrubs include *G. bicolor* (White Raisin), *G. flava* (Velvet Raisin), *B. foetida subsp. rehmanniana* (Stink Shepherd's tree) and *T. prunioides* (Lowveld Cluster-leaf). The grass layer is characterized by *Aristida spp.* (Three-awn grasses), *S. uniplumis* (Silky Bushman grass), *S. pappophoroides* (Sand Quick), B. deflexa (False Signal grass), *E. cenchroides* (Nine-awned grass) and *U. mosambicensis* (Bushveld Signal grass).

Limpopo Ridge Bushveld

This vegetation type covers the irregular hills and ridges of much of the area in the vicinity of the Limpopo River. The altitude varies from 300 m to 700 m in the east, with some hills reaching 1 000 m in the west. The vegetation structure is moderately open savannah with a poorly developed ground layer. *K. acuminata* (White Seringa) is prominent on many of the ridges along with *A. digitata* (Baobab). On shallow calcareous gravel and calc-silicate soils, the shrub *Catophractes alexandri* is dominant. Areas of sandstone of the Clarens Formation are prominent in places such as Mapungubwe National Park. Although not as prominent as at Mapungubwe National Park, sandstone ridges also occur in the study area.

The mean annual precipitation varies from 300-400 mm and the area is generally frost-free.

Important plant species include the *A. digitata* (Baobab), *S. birrea* (Marula), *C. mopane* (Mopane), *C. glandulosa* (Tall Common Corkwood), *T. prunioides* (Lowveld Cluster-leaf), *B. albitrunca* (Shepherd's tree) and various figs, e.g. *F. tettensis*.

This vegetation type is classified as moderately protected and "Least Threatened", with some 18% statutorily conserved in the Kruger and Mapungubwe National Parks. Only about 1% is transformed, mainly by cultivation and mining. The conservation target is 19%.

Soutpansberg Mountain Bushveld

This vegetation unit is characterised by a dense tree layer and poorly developed grassy layer covering the mountain ridges of the Soutpansberg. The topography of the east-west orientated ridges of the mountain changes drastically over short distances, resulting in orographic rain on the southern ridges and a rainshadow effect on the northern ridges. Because of this topographic diversity, the Soutpansberg Mountain Bushveld comprises a complex mosaic of sharply contrasting kinds of vegetation within limited areas. The main vegetation variations are subtropical moist thickets (mainly along the lower-lying southern slopes, on clayey soils of volcanic origin), mistbelt bushclumps (within the mistbelt of the southern and central ridges; on rugged quartzitic outcrops with shallow sandy soils), relatively open savanna sandveld (on both deep and shallow quartzitic sands along the relatively dry middle and northern slopes of the mountain), and an arid mountain bushveld (along the very arid northern ridges of the mountain).

The geology consists mainly of reddish or brown sandstone and quartzite, conglomerate, basalt, tuff, shale and siltstone of the Soutpansberg group. The unit experiences summer rainfall with dry winters. Mean annual precipitation id between 450 and 900 mm.

Important plant species include *Burkea africana, Ochna pulchra, Enneapogon cenchroides, Catha edulis, Flueggea virosa, Mimusops zeyheri, Syzygium legatii* and *Parinari capensis*.

This vegetation type is classified as moderately protected and "Vulnerable", with some 2% statutorily conserved in the Blouberg, Happy Rest and Nwanedi Nature Reserves. About 21% is transformed, mainly by cultivation and plantations. The conservation target is 24%.

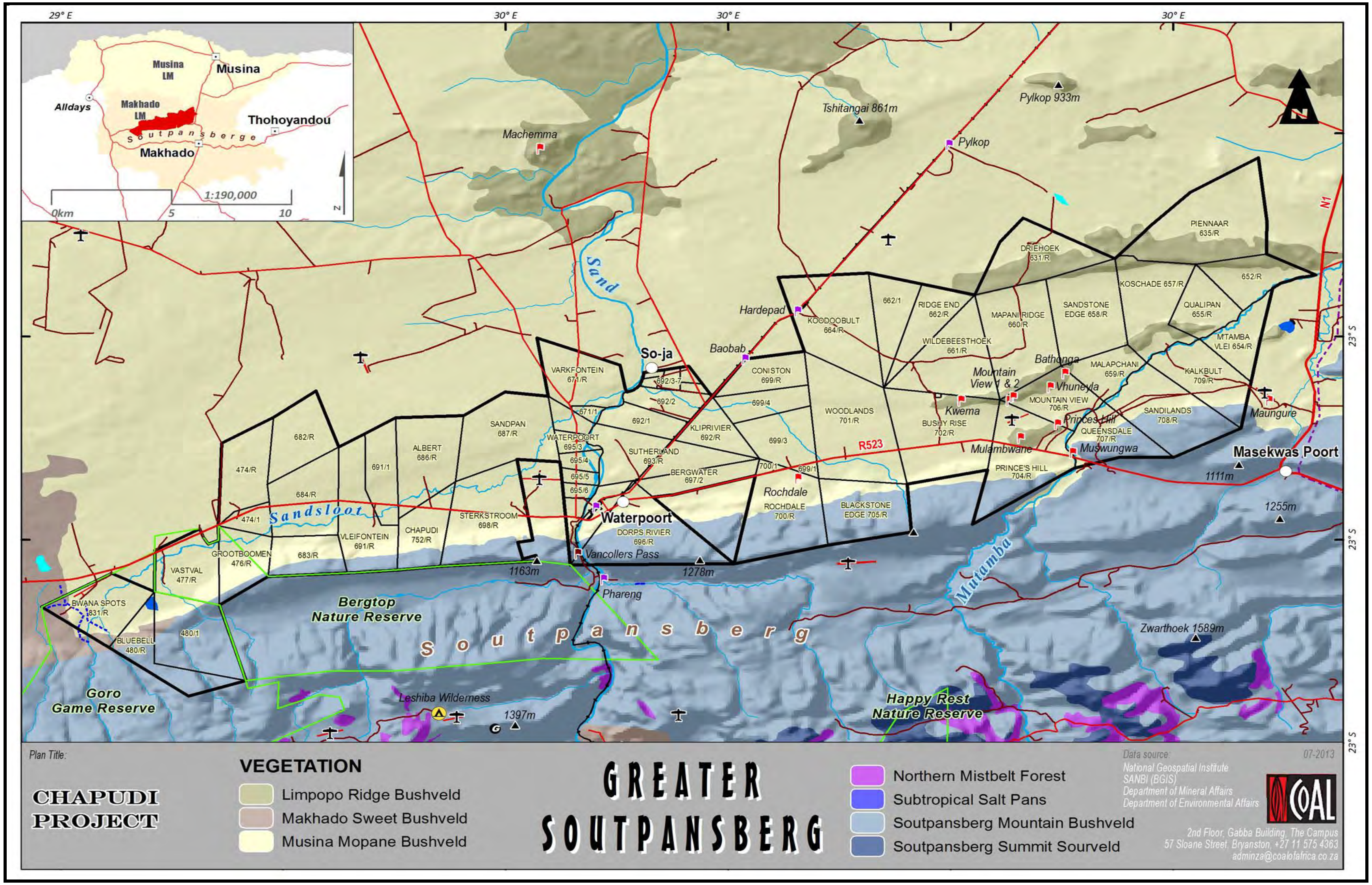


Figure 23: Vegetation of the site and surrounding area (Mucina and Rutherford, 2006)

1.2.5.1.2 Vegetation communities and sensitivity mapping

The study area is dominated by tree and shrub forms of *Colophospermum mopane*, *Terminalia prunoides, Commiphora spp., Grewia spp. and Boscia albitrunca.* The herbaceous layer is not well developed, probably due to low rainfall and overgrazing, and consists mostly of grasses such as *Aristida congesta subsp. congesta, Aristida adscensionis, Tragus berteronianus, Bothriochloa insculpta and Microchloa caffra.*

The plant species diversity is regarded as fairly low and has been supplemented with data collected from previous surveys in the area, due to the seasonal sampling limitations. A plant species list is provided in Appendix 1 of the Biodiversity Specialist Report (ANNEX-4).

Different plant communities develop as a result of differences in climate, geology, topography, rockiness, drainage, soil texture, soil depth, slope, and historic management. Each plant community usually represents a different habitat, has its own inherent grazing and browsing capacity, and represents specific habitats for certain types of faunal species.

The vegetation survey was conducted during the middle of the dry season and the possibility of encounteringherbaceous annuals and flowering plants was very low. The herbaceous layer, especially the grass layer, is heavily utilised and often influences diversity of the herbaceous species. Herbaceous plants are an important food source for game, especially in dry seasons and drought periods when the grass layer is depleted. Many of these plants are annuals and also do not appear every season. Geophytic species (plants with underground storage organs) are dormant during dry periods. The importance of long-term monitoring actions / surveys is imperative to assess the true diversity of a specific area, especially arid areas. The study was thus largely a field verification of previous studies and thus limited to those areas that were actually assessed.

The entire study area has not been mapped fully, as not all farms within the Chapudi Project area were accessible. The following distinct vegetation communities were identified (Figure 24:

Soutpansberg Mountain Bushveld – The entire Soutpansberg mountain area is considered to be ecologically, and from a biodiversity perspective, highly sensitive. Only the north-facing slopes of the mountain are included in the study site, but this does however not make it less important. The northern mountain slopes of the Soutpansberg are considered to be rich in plant species and ecologically sensitive. Although game does occur, this is habitat for mountain species and not plains species. This is an excellent area for conservation and ecotourism. A total of 94 plant species, mostly trees and shrubs, including three protected tree species, were recorded within the sampling area.

The Wetlands Ecosystem – Within the Shallow Valley (Plant Community 2) with the unconfined drainage line extending across the centre of the site in an east-west direction, is a small, localised seasonal wetland. The wetland is fed from several north-flowing drainage lines from the mountain as well as a shallow, small south-east flowing drainage line from the plains to the north. The water that accumilated in the valley during rainy seasons resulted in the formation of this wetland area. The wetland becomes dry, without any water, during the dry season. This is the only wetland in the entire study area. The main central wetland unit was classified as an unchanneled valley bottom hydro geomorphic wetland type. This wetland system forms part of a temporary sandy drainage line running down to the Sand River to the west of the study site. The Sand River is a tributary of the

LimpopoRiver, a river basin shared with Botswana, Mozambique and Zimbabwe. The drainage lines coming off the northern slopes of the Soutpansberg are small and probably seasonal or ephemeral in nature, with extremely limited and poorly defined riparian zones. The wetland is very small and localised. It is considered to be ecologically sensitive, although some sand mining is taking place. This system does not have high species richness, but some of the species are restricted to this area. Bullfrogs were recorded to be breeding in the pools of the wetland (Bredenkamp, 2009). In general, due to their formal protection status afforded by the National Water Act, all wetland areas should be designated as highly sensitive.

The River Ecosystems – Within the study area there are basically two river systems, the permanent Sand Rivier, with a number of tributaries and the Mutamba River. The riparian tree zone occurs on the river banks on both sides of the two river systems. This zone is approximately 10-20 m, or sometimes even up to 50 m wide, and indigenous trees and shrubs make up the canopy cover in this zone. In the case of the Sand River, a number of areas along its banks have been affected by agriculture. Stands of *Phragmites australis* (Common reed) occur along the river edges and drier river beds. The Mutamba River is considered to be in a pristine state. As the rivers in the area are considered as an ecological unit, the river banks, terraces and river bed are not separated for the description of the vegetation, but treated as a unit. Typical species include: *Acacia nigrescens, Acacia robusta, Combretummossambicensis, Ficus sycomorus, ZanthocercisZambesiaca*and *Phragmites australis.* River systems are always considered to be ecologically sensitive, and are thus given a very high (No-Go) sensitivity. This is due to the unique habitats they provide and support for several flora and fauna species. The river systems provide migration corridors for many species. River systems are particularly important due to the water transport and associated biological, economic, health and cultural values. The provision of clean and healthy water to people, agriculture and natural biological systems is of utmost importance in this arid region.

The Ridges Ecosystem – These hills and ridges form part of theSoutpansberg foothills, but as they are somewhat separated from the main mountain, not so high and not so diverse in plant species composition, although there are a number of species of special concern present. They also tend to form 'islands' within the typical Mopaneveld matrix and are thus considered to have a High sensitivity. The vegetation is typical mountain bushveld, with many woody species present. Typical species include: *Kirkia acuminata, Terminalia prunoides, Grewia flavescen* and*Commiphora mollis.* The ridges north of the Soutpansberg are generally considered to be rich in plant species and ecologically medium sensitive. This is an excellent area for conservation and ecotourism, and most of this ecosystem is situated on a privately owned up-market game farm and conservation area. These ridges tend to be dotted around the landscape and form refuge islands within the typical Mopaneveld matrix for certain fauna and flora species.

The Plateaus Ecosystem – The ridges discussed above form a flat to slightly undulating plateau on the crest of the ridges. The plateaus often have deeper soils and tend to be vegetated with grassland or sparse woodland. The plateaux areas form part of the Ridges Ecosystem and therefore also have a High sensitivity. Most ridge areas mapped have a central plateaux area. Typical species include: *Kirkia acuminata* and*Combretum apiculatum.* The ridges north of the Soutpansberg are generally considered to be rich in plant species and ecologically have at least a medium sensitivity. The plateaus are part of the ridges. Most of this ecosystem is situated on a privately owned up-market game farm and conservation area.

Mopane (Plains) Bushveld – A number of bushveld communities occurring on the level plains with distinct species assemblages can be differentiated within the study area. These communities are often highly fragmented and are often associated with slight variations in the underlying soils. Whilst it is possible to differentiate the communities using ordination techniques, they are difficult to distinctly map as the boundaries are not usually distinct and vary along a continuum. Sampling time limitations further exacerbated this. They are thus grouped together for the purposes of this report and generally have a Medium sensitivity. In general this vegetation is not rare and not threatened, except that it is often prone to droughts and then often overgrazed. There is concern on the presence of large number of the protected tree species, *Sclerocarya birrea* (Marula), *Adansonia digitata* (Baobab) and large numbers of various species of *Commiphora.*

- Combretum apiculatum-Commiphora Arid Bushveld
- Acacia tortilis, Zanthocercis zambesiaca Bushveld
- *Terminalia prunoides* Bushveld
- *Terminalia sericea* Bushveld
- Mopane Bushveld
- *Acacia tortilis-Cataphractus*Veld on limestone
- *Kirkia-Acacia senegal* Bushveld
- South-western Degraded Shrubveld
- North-western Degraded Bushveld

Old Fields, Current Agriculture and Secondary re-growth – Various old fields occur within the study area, some irrigated with water from the SandRiver. Smaller patches of old fields, some lying fallow for many years, occur on numerous farms as well. The vegetation of the old fields (not currently cultivated) is either open secondary grassland, or an open thornveld, dominated by *Acacia tortilis* and *Dichrostachys cinerea.*Typical species include*: Acacia tortilis* and *Urochloa mosambisence.* The agricultural fields and old fields have low conservation value and low sensitivity, and are, from an ecological point of view, ideal for the development of mining infrastructure.

For further description of the vegetation communities, refer to Section 5 of the Biodiversity Specialist Report (ANNEX-4).

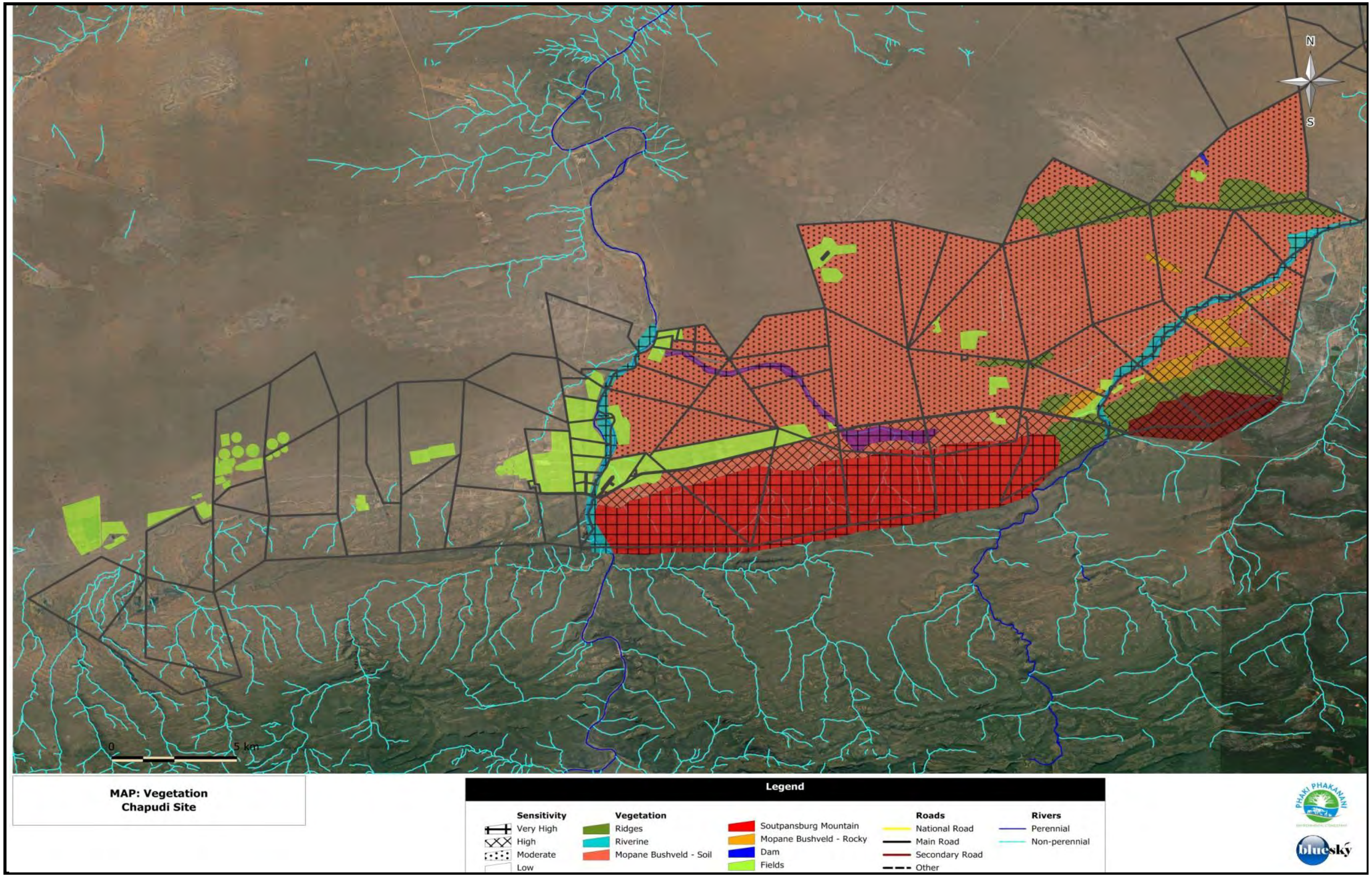


Figure 24: Vegetation communities and sensitivity mapping

1.2.5.1.3 Protected and endemic flora

Table 17 lists the protected flora that could potentially occur within the site, having distributions within Limpopo and the Soutpansberg, although many may not be present at lower altitudes such as is the case regarding the Mopane site. These were investigated during the site visit; however, due to seasonal (winter) constraints during the site visit, the presence/absence of these species could not be confirmed.

Table 17: List of applicable conservation status (status indicated in table below)

****Status**	**Conservation Status**
LEMA12	Limpopo Environmental Management Act, No. 7 of 2003. Schedule 12: Protected plants
NFA	National Forest Act, No. 84 of 1998.
RED-E	J. Golding (ed), 2002. *Southern African Plant Red Data lists* (Southern African Botanical Diversity Network Report 1). Pretoria, South Africa: National Botanical Institute – Endemic species
HAHN	Hahn, 2003. Soutpansberg Endemic Flora
RED-RDL	J. Golding (ed), 2002. *Southern African Plant Red Data lists* (Southern African Botanical Diversity Network Report 1). Pretoria, South Africa: National Botanical Institute – Red data listed
TOPS-E	Threatened or Protected Species Regulations, Govt Notice No. R152 of 23 February 2007 – Endangered species
TOPS-P	Threatened or Protected Species Regulations, Govt Notice No. R152 of 23 February 2007 – Protected species
TOPS-V	Threatened or Protected Species Regulations, Govt Notice No. R152 of 23 February 2007 – Vulnerable specie

Botanical Name	**Afrikaans Name**	**English Name**	****Status**	**Presence***
Acacia erioloba		Camel Thorn	RED-RDL (DE)	C
Adansonia digitata	Kremetartboom	Baobab	NFA, LEMA12	C
Adenia gummifera var. *gummifera*		Monkey Rope	RED-RDL (DE)	N
Adenium multiflorum	Impalalelie	Impala lily	LEMA12	C
Adromischus umbraticola subsp. *ramosus*			RED-RDL (DD)	N
Alepidea peduncularis			RED-RDL (DD)	N
Aloe angelica		Williespoort Aloe	HAHN	N
Aloe littoralis	Mopanie-aalwyn/Bergaalwyn	Mopane Aloe littoralis	LEMA12	N
Aloe swynnertonii		Vumba Aloe	RED-RDL (DD)	N
Aloe vossii			RED-RDL (DD)	U
Aristida scabrivalvis subsp. *contracta*	Pers-steekgras	Purple three-awn grass	RED-E	N
Balanites maughamii	Fakkelhout	Torchwood	NFA	C
Barleria holubii	Kleinblaar-barleria	Small-leaved Barleria	RED-RDL	N
Blepharis spinipes			HAHN	N
Boscia albitrunca	Witgat	Shepherd's tree	NFA	C
Bowiea volubilis subsp. *volubilis*		Climbing Onion	RED-RDL (VU)	N
Ceratotheca saxicola			HAHN	N
Ceropegia cimiciodora			RED-RDL (VU)	N
Cineraria alchemilloides subsp. *alchemilloides*			RED-RDL (Rare)	N
Combretum imberbe	Hardekool	Leadwood	NFA	C
Combretum vendae		Venda Bushwillow	HAHN	C
Cryptocarya transvaalensis			RED-RDL (DE)	N
Curtisia dentata		Assegai	RED-RDL (NT)	N

Botanical Name	Afrikaans Name	English Name	**Status	Presence*
Cyamopsis dentata			RED-E	N
Delosperma zoutpansbergense		Ice Plant	HAHN	N
Dicoma montana			HAHN RED-RDL (Rare)	N
Duvalia procumbens			HAHN	N
Elaeodendron transvaalense		Bushveld Saffron	RED-RDL (NT)	N
Encephalartos hirsutus		Venda Cycad	HAHN	N
Euphorbia aeruginosa			HAHN	N
Gunnera perpensa		River Pumpkin	RED-RDL (DE)	N
Harpagophytum procumbens	Duiwelsklou	Devil's Claw /Grapple plant	TOPS-P	N
Hibiscus waterbergensis			RED-RDL	N
Hoodia corrorii subsp. lugardii	Ghaap	Ghaap	LEMA12,TOPS-P	N
Huernia spp *Huernia nouhuysii*		Huernia (all species) – Zebraflower, Toad plant, Owl-eye, etc.	LEMA12 RED-RDL (VU)	N
Ilex mitis var. *mitis*		African Holly	RED-RDL (DE)	N
Ipomoea bisavium			HAHN RED-RDL (Rare)	N
Justicia montis-salinarum			RED-RDL (Rare)	N
Kalanchoe crundallii			HAHN	N
Khadia borealis			RED-RDL (Rare)	N
Myrothamnus flabellifolius			RED-RDL (DD)	N
Mystacidium brayboniae			HAHN RED-RDL (NT)	N
Ochna glauca	Bloublaarrooihout	Bird's eye/blue-leaved ochna	RED-RDL	N
Ocotea kenyensis		Transvaal stinkwood	RED-RDL (VU)	U
Orbea hardyi			RED-RDL (Rare)	N
Orbea maculata subsp. *maculate*			RED-RDL	N
Orbea spp		Orbea (all species)	LEMA12	N
Otholobium polyphyllum			RED-RDL	N
Panicum dewinteri			HAHN RED-RDL (NT)	N
Pavetta tshikondeni			HAHN	N
Peristrophe cliffordii		Peristrophe	LEMA12, RED-RDL, RED-E	N
Peristrophe gillilandiorum		Peristrophe	LEMA12, RED-RDL, RED-E	N
Philenoptera violacea	Appelblaar	Apple-leaf /Raintree	NFA	C
Plinthus rehmannii			RED-RDL	N
Prunus africana		Red Stinkwood	RED-RDL (VU)	U
Psoralea repens			RED-RDL	N
Rapanea melanophloeos			RED-RDL (DE)	N
Rhus magalismontana subsp. coddii	Bergtaaibos		HAHN	N
Rhynchosia vendae			HAHN	N
Sartidia jucunda			RED-RDL (VU)	N
Sclerocarya birrea subsp. *caffra*	Maroela	Marula	NFA	C
Sesbania leptocarpa/mossambicensis			RED-E	N
Spirostachys Africana	Tambotie	Tamboti	LC	C

Botanical Name	Afrikaans Name	English Name	**Status	Presence*
Stapelia spp	Aasblom	Carrion Flower/Stapelia (all spp)	LEMA12	N
Streptocarpus caeruleus			HAHN	N
Tavaresia/Decabelone spp		Ghaap (all species)	LEMA12	N
Tylophora coddii			RED-RDL (Rare)	N
Warburgia salutaris	Peperbasboom	Pepper-bark tree	RED-RDL (EN)	N
Zoutpansbergia caerulea			HAHN	N

*** Presence: C-Confirmed; N-Not confirmed, but possibly present; U-Unlikely.**

The core of the Soutpansberg Centre of Endemism is associated with the rocky areas within the Soutpansberg Mountains, with approximately 3 000 vascular plant species andone endemic genus. Approximately 1.5% of the species recorded within the Soutpansberg Centre of Endemism are considered endemic/near-endemic species/infraspecific taxa. Of the 45 endemic or near endemic species, almost 47% of the species are succulents.

Many species are dormant or a positive identification is not possible during the winter months, and their presence/absence could not be confirmed.

Tree species present that are protected in terms of the National Forests Act (NFA) include:

- *Acacia erioloba* (Camel Thorn)
- *Adandonia digitata* (Boabab)
- *Balanites maughamii* (Torchwood)
- *Boscia albitrunca* (Shepherd's tree)
- *Combretum imberbe* (Leadwood)
- *Philenoptera violacea* (Apple leaf)
- *Sclerocarea birrea* (Marula)

Special interest was noted on the farm Blackstone Edge with the identification of a Baobab species which seemed to comprise unique characteristics (*pers communication with landowner*). A single Baobab tree was identified and lacked leaves due to the seasonal influence, as such no discriptions could be ascertained on site. However some unusual traits have been identified causing suspicions that this could be a new species of Baobab. The study could not stipulate potential distributions, however indications are thatmore trees could be identified associated with wetland systems. Further studies will be required to confirm this suggestion at appropriate season, possibily looking at the pollen and at a genetic level.

A uniqe cluster of Tamboti Species (*Spirostachys Africana*) has been identified in the vicinity of wetland GSPC W1 (wetland on the farm Blackstone Edge. This is a unique discovery given the sporadic Tamboties identified in the area. However, it is a common morphology that Tamboti are associated with dry water corses or wetland ecosystems.

1.2.5.1.4 Introduced or exotic/alien plants

Due to the low rainfall, the project area is generally free of unwanted species and is likely to remain so. Introduced and exotic plants are limited to developed, disturbed and riparian areas.

Table 18: Exotic and weed plant species found within the site

Botanical Name	Common Name	CARA Status*	Presence/Comment
Argemone subfusiformis	Mexican poppy	1	Scattered, often in disturbed areas, can become problematic if left uncontrolled.
Caesalpinia gilliesii	Bird of paradise	1	Scattered, often in disturbed areas, can become problematic if left uncontrolled.
Melia azedarach	Syringa	3	Scattered, uncommon outside of riparian area and along watercourses.
Ricinus communis	Castor Oil Bush	2	Scattered, often in disturbed areas, can become problematic if left uncontrolled.
Sesbania punicea	Dorset pea	1	Scattered, often in disturbed areas, can become problematic if left uncontrolled.
Cereus jamacaru	Queen of the Night	2	Scattered, often in disturbed areas or old human habitations, can become problematic if left uncontrolled.
Causuarina	Beefwood		Scattered, often in disturbed areas, can become problematic if left uncontrolled.

*CARA Status: Refer to relevant legislation section for clearing requirements.

The Mexican Poppy, Castor Oil Bush and Dorset Pea can become invasive as weedy pioneers in disturbed areas and would require control during post mining rehabilitation.

1.2.5.2 Fauna

1.2.5.2.1 Mammals

The Soutpansberg has a remarkable diversity of mammals that make up 60% of the total number of species that occur in South Africa. More mammal species have been recorded in the Soutpansberg than in the Cape Floristic Kingdom, which was previously recorded at 127. The Kruger National Park only contains two more species of mammals than the Soutpansberg, which is particularly rich in bats, carnivores and larger hoofed animals.

Of the 104 mammal species (listed in Appendix 2 of ANNEX-4) known to occur within the Mopane bushveld area, there are 2 species which are critically endangered:

- Black Rhinoceros (*Diceros bicornis michaeli*)
- Short eared Trident Bat (*Cloeotis percivali*)

There are 2 endangered species:

- Tsessebe (*Damaliscus lunatus lunatus*)
- African wild dog (*Lycaonpictus*)

11 Near threatened species:

- South African Hedge-hog (*Atelerix frontalis*)
- Serval (*Leptailurus serval*)
- Spotted Hyaena (*Crocuta crocuta*)
- Brown Hyaena (*Hyaena brunnea*)
- Honey Badger (*Mellivora capensis*)
- Leopard (*Panthera pardus*)
- Goeffroy's Horseshoe Bat (*Rhinolophusclivosus*)
- Darling's Horseshoe Bat (*Rhinolophus darlingi*)
- Hildebrandt's Horseshoe Bat *(RhinolophusHildebrandtii*)
- Schreiber's Long-fingered Bat (*Mimiopterus schriebersii)*
- White Rhinoceros *(Ceratotherium simum)*

And 6 vulnerable species include:

- Roan antelope (*Hippotragus equinus*)
- Sable antelope (*Hippotragus nigerniger*)
- Cheetah (*Acinonyx jubatus*)
- Lion (*Panthera leo*)
- Ground pangolin(*Manis temminckii*)
- Giant rat (*Cricetomys gambianus*)

*1.2.5.2.2 **Avifauna***

According to the Soutpansberg Birding Route Organization, the Soutpansberg Mountains and Limpopo River Valley hosts over 540 bird species. This is 56% of the South African avifauna and 76% of the South African terrestrial and fresh water avifauna, excluding vagrants and oceanic avifauna. The Soutpansberg Mountain Range itself hosts between 380 and 400 species. The western Soutpansberg covers an area of 900 km^2 and has 298 species of avifauna (Stuart, Stuart, Gaigher & Gaigher, 2001). The quarter degree Grid Square 2230AA (an area of about 700km^2) has 338 native species and the quarter degree Grid square which includes The Greater Kuduland Conservancy 2130DA (700 km^2 with 412 species) and the Greater Kuduland Conservancy itself (150 km^2 with 304 species). A complete list of potential bird species is provided in Appendix 2 of ANNEX-4.

The Chapudi Project area is located outside but directly adjacent to SLBR Birding Areas (Figure 25).

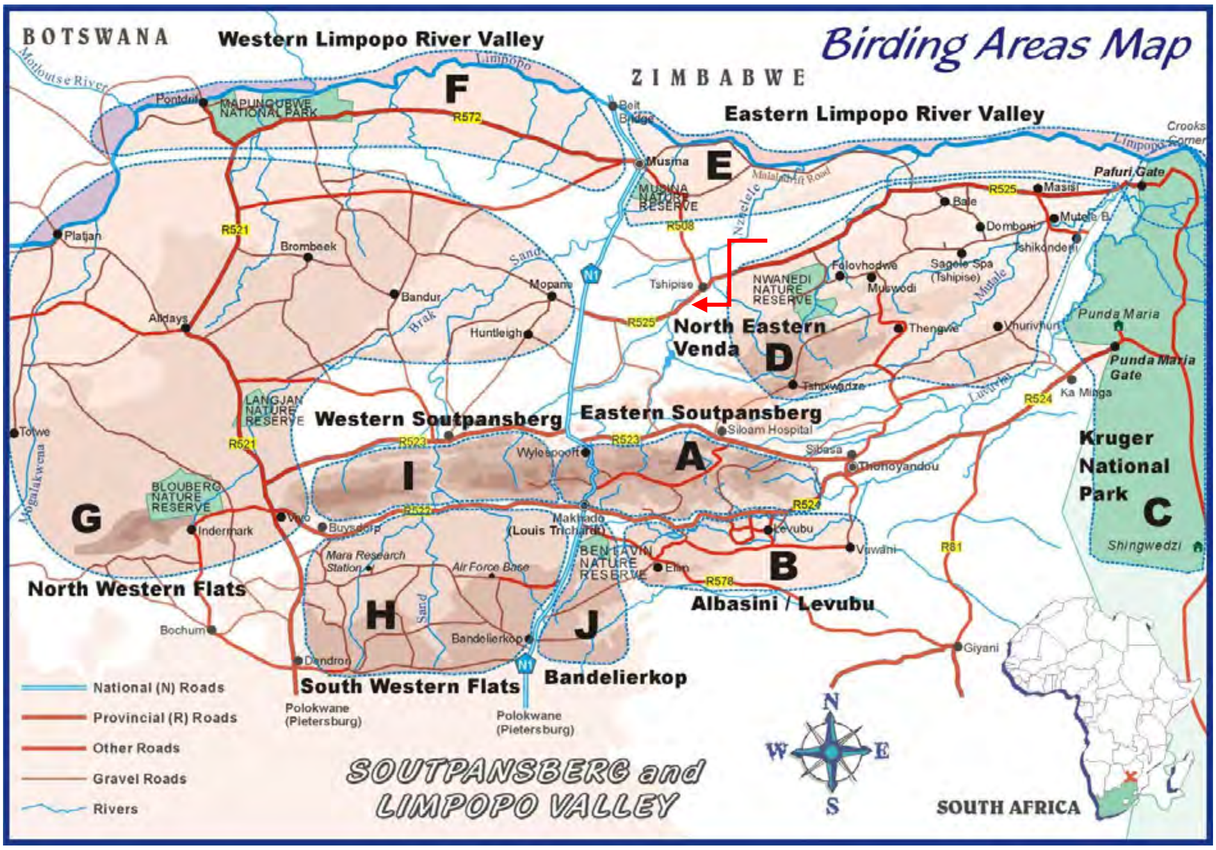


Figure 25: SLBR Birding areas

There are 38 birds of prey species which includes Species of Special Concern (SSC) of the Soutpansberg:

- Cape vulture(*Gyps coprotheres*)
- Crowned eagle (*Stephanoaetus coronatus*)
- Forest Buzzard (*Buteotrizonatus*)
- Bat Hawk (*Macheiramphus alcinus*)
- Crested Guineafowl (*Guttera pucherani*)
- Blue spotted wood dove (*Turtur afer*)
- Knysna Turaco (Tauraco corythais)
- Pel's fishing Owl (*Scotopeliapeli*)
- Mottled spinetail *(Telecanthura ussheri*)
- Narina Trogon (*Apaloderma narina*)
- African Broadbill (*Smithornis capensis*)
- Grey Cuckoo-shrike (*Coracina caesia*)
- African golden Oriole (*Oriolus auratus*)
- Eastern bearded Robin (*Erythropygia quadrivirgata*)
- Gorgeous Bush Shrike (*Telephorusquadricolor*)
- Black Fronted bush-shrike (*T. Nigrifrons*)
- Golden Backed Pytilia (*Pytilia afra*)
- Green Twinspot (*Mandingoa nitidula*)
- Pink Throated-Twinspot (*Hypargos margaritatus*)

The Blouberg Nature Reserve is situated approximately 60 kilometres from the study area to the west. The mountain in this reserve houses the largest breeding colony of Cape Vulture (endangered) in the world. An additional colony is located about 10 km to the South, on the farm Buffelspoort 222 IS. These birds have extensive home ranges (300 km or greater) and the entire study area falls well within the birds feeding ground. Furthermore, the game farms and wilderness areas are likely to provide important foraging habitat for the vultures (especially the Buffelspoort population).

At least 5 Red Data species that are listed as vulnerable occur in the area:

- White-Backed Night heron (*Gorsachius leuconotus*)
- Cape Vulture, Martial Eagle (*Polemaetus bellicosus*)
- African fin-foot (*Podica senegalensis*)
- Grass Owl (*Tyto capensis*)
- Pel's Fishing Owl

11 near threatened species:

- The Black Stork (*Ciconia nigra*),
- Bat Hawk (*Macheiramphus alcinus*)
- Ayres' Eagle (*Hieraetus ayresii*)
- Crowned Eagle
- Peregrine Falcon (*Falco peregrines minor*)
- Lanner Falcon (*Falco biarmicus*)
- Half collared King-fisher (*Alcedo semitorquata*)
- African Broadbill
- Orabge Thrush (*Zoothera gurneyi*)
- Wattled-eyed Flycatcher (*Platysteira peltata)*
- Pink -Throated Twinspot

Birds are attracted to the Mopane veld for food and nesting grounds. Weavers make use of many trees for nest building and breeding, with some species making use of only one species of tree, and others a variety tree species. Weavers are attracted to Mopane veld as many tree species therein have thin branch tips to bind nests to and thorns, to provide protection against predatory nest raiders. The buffalo weaver (*Dinemellia dinemelli)* limits its breeding to the Baobab (*Adansonia digitata*).

Bee-eaters (*Merops* spp) use steep river banks to dig tunnel nests which offer an advantage. Rollers, such as the Lilac breasted Roller (*Coraciascaudatus),* make use of cavities in trees for nesting, many Mopane trees naturally develop cavities in their trunks when they become old.

Birds of Prey (Raptors) are site specific in terms of breeding. The Mopane veld offers a wide variety of habitats that is utilized as nesting habitats for Raptors. For example, African Fish Eagles (*Haliaeetus vocifer*) build large nests in forked branches of large trees near water courses, while Crowned Eagles make use of similar trees situated in heavily forested areas. Martial Eagles and Black Eagles (*Ictinaetus malayensis*) nest on large cliff faces, while Spotted Eagle Owls (*Bubo africana*) use small cliff edges or edges on river banks to breed. Raptors are attracted to the Mopane veld due to habitat and an abundance of prey, which includes; rodents and birds for the small Raptors and small mammals for larger Raptors. The number of large Raptors that were surveyed for the purpose of the proposed mine was limited, due to the fact that they have large home ranges. For example the Martial Eagle has a home range of up to 100 km², and therefore the resident pair of Martial Eagles will keep out any of its own species within the radius of 100 km.

1.2.5.2.3 __Reptiles__

There are over 400 reptile species in southern Africa, with a possible occurrence of 120 species in the Mopane bushveld. Reptiles are important as they aid in the control of rodents and provide food for many animals (secretary birds, raptors and carnivorous mammals). They occupy every habitat within the Mopane veld, and certain species occupy restricted habitats (niches). Any form of destruction/development will have extremely negative effects on these reptiles. A complete list of reptiles is provided in Appendix 2 of ANNEX-4.

There are 4 species that could occur in the Mopane bushveld with a near threatened status:

- Distant's ground agama (*Agama aculeate distant)*
- Southern African Python (*Python natalensis*)
- Soutpansberg Flat Lizard (*Platysaurus relictus*)
- Soutpansberg Rock Lizard (*Australolacerta rupicola*)

There are 4 species that hold a vulnerable status and could occur within the Mopane bushveld:

- South African Python(*Python natalensis*)
- Muller's velvet gecko (*Homopholis mulleri*)
- Cryptic Dwarf Gecko (*Lygodactylus nigropunctatus incognitus)*
- Soutpansberg Dwarf Gecko (*Lygodactylus ocellatus soutpansbergensis*)

There is one exotic species, the Tropical house gecko (*Hemidactylus mabouia),* along with the presence of the Nile crocodile which was recorded in the SandRiver. The presence of the crocodile is a result of recent flooding of the Limpopo River where the crocodiles escaped from a crocodile farm.

Table 19: Reptile Species of Special Concern (SSC) that have been identified

SCIENTIFIC NAME	COMMON NAME	HABITAT	POTENTIAL IMPACT
Homopholos mulleri	Muller's Velvet Gecko	Likely to occur within the mature trees of the Mopane Bushveld.	Destruction of trees during bush clearing will result in a loss of habitat
Lygodactylus nigropunctatus incognitus	Cryptic dwarf gecko	Restricted to outcrops of the Soutpansberg, with isolated populations within the Musina plain.	Direct destruction of outcrops during mining operations.
Lygodactylus Occendentalis soutpansbergensis	Soutpansberg Dwarf Gecko,	Restricted to the mountain outcrops of the Soutpansberg, with isolated outcrops within the Musina Plain.	Destruction of outcrops during mining operations.
Typhlosaurus lineatus subtaeneatus	Striped-bellied Blind legless skink	Restricted to sandy soils within the Musina Plain.	Habitat destruction during mining operations.
Australolacerta rupicola	Soutpansberg rock lizard	Restricted to the Soutpansberg mountain tops.One record, however, confirmed that it can occur within outcrops north of the Soutpansberg.	Destruction of outcrops leading to the destruction of habitat.
Python natalensis	Southern Rock Python	Found throughout the habitat.	Destruction of habitat resulting in conflict with humans.
Amblyodipsas microphthalma nigra	Soutpansberg Purple glossed snake	Restricted to Aeolian soils within the Musina Plain.	Destruction of habitat during mining operations
Xenocalamus tranvaalensis	Speckled Quill-snouted snake	Restricted to Aeolian soils of the Musina Plain.	Destruction of the habitat during mining operations.
Platysaurus relictus	Soutpansberg Flat Lizard	Restricted to the Soutpansberg	Destruction of outcrops leading to habitat destruction.

1.2.5.2.4 __Amphibians__

Amphibians are difficult to survey as many of them are nocturnal and many are restricted to permanent water bodies. The correct time to survey frogs is during times of high rainfall or whilst it is raining. One can identify frogs by the calls (vocalization) of the males during breeding season.

As the surveys were conducted in July (which is out of frog season), there is a lack of species recorded. There is a possibility of 26 amphibian species that could occur within the Mopane veld, of which 1 species is considered endangered, the Northern Forest Rain Frog (*Breviceps silvestris*). There are 2 species which are protected under the NEMBA under the Threatened and Protected Species Rating; the Giant African Bull Frog (*Pyxicephalus adspersus*) and the African Bull Frog (*Pyxicephalus edulis*). A complete species list is provided in Appendix 2 of ANNEX-4.

1.2.5.2.5 __Invertebrates__

An elimination process was undertaken when investigating invertebrate (insects). Firstly, insects were categorized and analysed according to the insects' occurrence within the Limpopo Province and its distribution in terms of the study area (the northern area of the Limpopo Province). They were then cross referenced for specific occurrence in the Mopane bushveld through important factors, such as; dietary requirements, flora and micro habitat. Other important factors include; cultural, pest, ecological factors and conservation status.

For example, the *Pontia helice* (Meadow White Butterfly) occurs within the Limpopo Province as well as throughout South Africa. It was therefore excluded from this report as it will not be affected by the mining activities. However, the *Sagra bicolor* (Swollen-legged Leaf beetle) only occurs in the Limpopo Province, the northern parts of the North West Province and Mpumalanga, it has limited distributed throughout South Africa and has therefore been included.

Invertebrate communities consist of decomposers, herbivores, parasites and predators (carnivores), and all occur within the Mopane veld. However, even though a particular species is dependent on the Mopane veld, they have been documented to survive on other vegetation habitats.

Termites

There are seven species of termites that occur in the northern region of the Limpopo Province (Picker, Griffiths & Weaving, 2004), with three important species occurring within the study area: *Amitermes hastats* (Black Mound Termite), *Odontotermes badius* (Common Fungus-growing Termite) and *Macrotermes natalensis* (Large Fungus-growing Termite).

Termites play a major role in the Mopane veld ecology:

- They aid in moribund tree decomposition (collapsed old dead trees) thus bringing them to the soil surface to decay.
- They provide a means of burying plant matter underground, which in turn increasing the nutrient value of the soil.
- An abandoned moribund termite mounds serve as a refuge for reptiles, such as snakes and geckos.
- They also act as a food source for animals such as birds, small mammals and larger mammals, such as the aardvark.

Thus said, Termites are a major contributor to the ecological functioning of the Mopane veld. The ecological balance between termites and the woodland will be disrupted as a result of unsound human development practices. For example, termites might consume too many trees and affect development by devouring fence poles, wooden structures and buildings. Termites have more mobility as they spread to new areas via flying ants. Therefore, Termites are highly important as they build their nests around and against trees, and then convert the tree into soil (when the tree dies) to provide nutrients for new plants and trees to grow.

Butterflies and moths

Many butterfly species are habitat specific and can be regarded as bio-indicator of rare ecosystems (Terblanche, 2012). According to Woodhall (2005) it is preferable to survey butterflies at specific times of the year, mainly springtime and early summer, or late summer to autumn. Since the rainy season had no yet commenced during the site-visit, many plant species were still dormant and thus, a full butterfly survey was unable to be completed.

There are 9 Red Data Butterfly species which could occur within the study area. According to Henning, Terblanche & Ball (2009) threatened butterfly species of the Limpopo Province are:

- *Alaena margaritace* (Wolkberg Zulu): critically endangered
- *Aloeides stevensoni* (Steven's POrt): Vulnerable
- *Anthene crawshayi juanitae* (Juanita's Ciliated Blue/Hairtail): Vulnerable
- *Dingana jerinae* (Jerine's Widow): vulnerable
- *Erikssonia edgei* (Edge's Acraea Copper) :critically endangered
- *Lepidochry sops lotana* (Lotana Blue critically): endangered
- *Pseudonympha swanepoeli* (Swanepoel's Brown): critically endangered
- *Telchinia induna salmontana* (Soutpansberg Acraea): vulnerable.
- *Anthene liodes* (Liodes Ciliated Blue/Hairtail) is not threatened but is of special conservation concern due to its very restricted range in South Africa

The greater Soutpansberg area can support over 250 butterfly species (Woodhall, 2005). The *Acraea machequena* and *Acraea lygus* are both rare species with limited distributions in South Africa and could occur within the Mopane veld.

Over 50 species of butterflies occur within the Mopane bushveld. Out of the habitats investigated, it was found that the butterfly species were most abundant within the riparian zones. The most important species identified are as follows and are listed in terms of their distribution and association to the Mopane Veld:

- White-cloaked Skipper (*Leucochitonea levubu*)
- Friar (*Amauris niavius*)
- African Monarch (*Danaus chrysippus*)
- Guinea Fowl (*Hamanumida daedalus*)
- Green-veined Charaxes (*Charaxes candiope*)
- Foxy Charaxes (*Charaxes jasius*)
- Club-tailed Charaxes (*Charaxes zoolina*)
- Straight-line Sapphire (*Lolaussilas*)
- Swanepoel's Copper (*Aloeides swanepoeli*)

Ant Lions

There are 14 species of Ant lion that occur within the Mopane bushveld area (Picker, Griffiths & Weaving, 2004). Ant lions control the ant population in South Africa, and they are all predators.

The larval stage of the Ant lions life-span is terrestrial, later they become flying insects that resemble dragonflies. Ant lions burrow funnel traps into loose sand whilst submerging themselves in the centre of the burrow to wait for prey to fall into the trap. They are not sand specific and can be found in many different types of soil; the main factor for their occurrence is loose dry soils.

Although certain species occur throughout South Africa, some species are limited to the Mopane veld. The most important species are:

- Gregarious antlion (*Hagenomyia tristis)* whose larvae live off soft vegetation under trees.
- Large grassland antlion (*Creoleon Diana*) which lives in the Acacia grassland.
- Grassland Ant lions (*Distoleon pulverulentus*) whose larvae live in shallow loose sand.

- *Neuroleon* whose larvae live in fine sand under over hanging rock.
- Dotted veld ant lion (*Palpares sobrinus*), the larvae travels freely in loose sand and lie just below the surface to ambush and drag prey under.
- Mottled veld ant lion (*Palpares caffer*) whose larvae travel freely in loose soil just beneath the surface to ambush prey and drag them under the sand.
- Hook tailed ant lion (*Palparidius concinnus*), the larvae live and feed in deep sand.
- Blotched long-horned antlion (*Tmesibasis lacerate*), with this species, the larvae live under stones.

Lady Birds (Family: Coccinellidae)

Lady birds are important invertebrates as they are a form of biological pest control for citrus farming. The larvae are commonly black with conspicuous yellow or white markings. Adults and larvae are usually carnivorous (feeding on various homopteran bugs, small insects and mites), except for the subfamily *Epilachninae* which are herbivorous. 5 carnivorous species occur within the Mopane veld, (Picker, Griffiths & Weaving, 2004) namely:

- Black Two-spot Ladybird (*Chilocorus distigma*) which feeds on Aloe white scale.
- Humbug Ladybird (*Micraspis striata*), which feeds on small insects (such as thrips).
- Spotted Amber Ladybird (*Hippodamia variegate*), a specialized feeder of aphids.
- Lunate Ladybird (*Cheilomenes lunata*), specialist feeder of aphids (including wheat aphids).
- Black Mealy Bug Predator (*Exochomus flavipes*), which feeds on aphids, mealy bugs, soft scales and cochineal insects.

There are two species of lady birds which are herbivorous and are known pests, namely:

- Nightshade Ladybug (*Epilachna paykulli*) which is a pest for feeding on the leaves of potato leaves, solenaceous plants, and tomatoes.
- Potato Ladybird (*Epilachna dregei*); which feeds on leaves of potatoes and tomatoes.

Mygalomorph Spiders (with reference to Baboon Spiders)

Mygalomorph spiders are a primitive group of spiders and mainly consist of tarantulas, baboon spiders and trap door spiders. It is important to note that all baboon spiders are protected by the NEMBA Threatened or Protected Species (TOPS). Baboon spiders (*Arachnida Theraphosidae*) with a high conservation status in the Limpopo Province are:

- *Ceratogyrys bechuanicus,* they are not threatened but all *Ceratogyrus* species are protected by TOPS.
- *Ceratogyrys brachycephalus*, all *Ceratogyrus* species are protected by TOPS.
- *Pterinochilus*, all *Pterinochilus* species are protected by TOPS.

Baboon spiders belonging to the *Ceratogyrus* family (Horned baboon spiders) are mainly found in the Limpopo Province. It is of importance to the pet trade and is on the TOPS list with other baboon spider genera *Harpactira* and *Pterinochilus*.

Ceratogyrus bechuanicus and *Ceratogyrus brachycephalus* are usually only found in small colonies, whereas Baboon spiders, such as *Pterinochilus* are usually in much larger colonies. The distribution of *Ceratogyrus bechuanicus* ranges from Botswana, Central Namibia, Zimbabwe and Mozambique to the northern parts of South Africa (Dippenaar-Schoeman, 2002). *Ceratogyrus bechuanicus* has also been recorded in the western Soutpansberg (Foord, Dippenaar-Schoeman & Van der Merwer, 2002).

In contrast to *Ceratogyrus bechuanicus*, *Ceratogyrus brachycephalus* has a more restricted distribution. They are confined to localities in central Botswana, southern Zimbabwe and the extreme north of Limpopo (De wet & Dippenaar-Schoeman, 1991: Dippenaar-Schoeman, 2002). *Ceratogyrus* bechuanicus is well represented in the Kruger National Park (De wet & Schoonbee, 1991). *Ceratogyrusbrachycephalus* has only been found in the Messina Provincial Nature Reserve, while its historical distribution includes the Langjan Nature Reserve (De wet & Schoonbee 1991). *Ceratogyrusbrachycephalus* with a much smaller distribution has a higher conservation priority than *Ceratogyrus bechuanicus*.

There appears to be no threatened baboon spider species on the site, although care must be taken to provide for natural no-go areas to provide habitat if there should be on the site. The diversity of micro habitats supports the statement that baboon spiders are present on the site.

There is an abundance of orb web spiders within the Mopane Veld which encourages the female wasp of *Batozonellus fuliginosus* into the bushveld as it specializes in preying on orb web spiders.

Scorpions

Hadogenes troglodytes, a non-threatened rock scorpion, is habitat sensitive and therefore protected by TOPS. *Hadogenes troglodytes* is sensitive to habitat destruction owing to its small brood size and slow rate of reproduction (Leeming, 2003). *Hadogenes troglodytes* is restricted to rocky outcrops and mountain ranges in the northern parts of South Africa (Leeming, 2003) and is the longest scorpion in the world. *Opistophthalmus wahlbergi* is known from the area and is protected by TOPS.

Wasps

Wasps are known as insect predators. Wasps either occur throughout the entire South Africa or have widespread distributions within South Africa; none of which are exclusively dependant on or are have exclusive distribution within the Mopane veld. The cricket hunter wasp (*Chlorion maxillosum*) preys on the giant burrowing cricket (*Brachytrupes membranaceus*), which is restricted to the Mopane veld.

Dung Beetles

Dung beetles perform an important ecological function in the bushveld. Dung beetles convert animal dung into humus and deliver manure under the ground, thus aiding in nutrient delivery to plant roots.There are over 700 dung beetle species throughout South Africa. The conservation important dung beetles within the area are:

- *Scarabaeus schulzeae*
- *Metacatharsius sp*
- *Proagoderus lanista*
- *Onitis obenbergeri*

Other important dung beetles which do not have a listed conservation status are:

- Green dung beetle (*Garreta nitens*)
- Grooved dung beetle (*Heteronitis castelnaui*)
- Trident dung beetle (*Heliocopris neptunus)*
- Plum dung beetle (*Anachalcos convexus)*
- Bi-coloured dung beetle (*Proagoderus tersidorsis*)
- Large Copper dung beetle (*Kheper nigroaeneus)*
- Fork nosed dung beetle (*Coptorhina klugi*)

These dung beetle species were identified as important due to their exclusive distribution within the Mopane veld and limited distribution throughout South Africa etc.

Mopane Moth (Imbrasia Belina)

The larvae of the Mopane Moth feed on a large variety of plants including Mopane (*Colophospermum Mopane*), *Ficus, Terminalia, Trema* and *Rhus*. They form an important constituent (after evisceration and drying) of the local diet. Outbreaks of this species defoliate shrubs which deprives game of available food. After the moths appear, the Mopane trees recover. This species is in competition with the Speckled Emperor moth (*Gynanisa maja*) and can compete for Mopane trees during the larvae stage, especially when outbreaks occur by both species simultaneously. The Mopane moth is opportunistic and their larvae may feed on citrus trees therefore they may become a pest for the citrus farmers in the surrounding areas.

Other invertebrates of importance are listed in Table 20.

Table 20: Table of Invertebrate Species having Ecological Importance

INSECT SPECIES	ECOLOGICAL IMPORTANCE/COMMENT
Dung beetles	Converts dung into humus which provides nutrients to the soil. 17 difference species occur within the Mopane bushveld.
Armoured darkling beetle	The beetle larvae live in the soil and feeds on roots and plant detritus, converting the matter into soil nutrients. Its presence was confirmed in the Sand River, 4 were found in the pit traps on one occasion.
Corn cricket	This insect feeds on acacia leaves and forms a major food source for bat eared foxes, birds and jackals. There are citrus farms in proximity to the proposed mining area, where the insect has been known to become pests.
Giant burrowing cricket (*Brachytrupes membranaceus*)	Occur mainly within Mopane Veld, and is hunted by the cricket hunter wasp (*Chlorion maxillosum*). The Giant burrowing cricket is the largest and loudest cricket in the world.
Bush hoppers (family *Euschmidtiidae*)	Mainly occurs within the Limpopo Province.
Brachytypus rotundifrons (no common name)	Distribution is restricted to the Limpopo Province.
Pantoleistes princeps	Occurs within the Mopane Veld and is associated with termite mounds.
Homoeocerus auriculatus	Occurs within Mopane veld, and feeds on both indigenous and alien acacia species (*Acacia mearnsii*).
Leptoglossus membranaceus	This insect is a pest to citrus farmers, as the fruit which they feed on will drop from the tree. There are many Citrus farms in the area.
Dieuches	A ground dwelling insect that feeds on dassie (*Hyrax*) dung.
Edible stinkbug (*Encosternum delegorguei*)	A diurnal insect that feeds on Acacia and other shrubs and trees. The bug (harugwa), a local delicacy, is killed in hot water and squeezed to remove the almost nauseating secretion then roasted or dried. Also

INSECT SPECIES	ECOLOGICAL IMPORTANCE/COMMENT
	eaten in South Africa raw or cooked.
Red Scale (*Aonidiella aurantii*)	This is a pest of citrus trees as its toxic saliva cause yellow spots. Most citrus trees in the area are infested with thus bug.
Aloe white scale (*Duplachionaspis exalbida*)	This is a pest to aloes and sever infestations can cause leaf tips to wither. Populations are generally kept under control by wasps and ladybird beetles.
Marsh ground beetle (*Bradybaenus opulentus*)	Predator of small insects and occurs mainly within Mopane veld
Butterflies	50 species occur within the Mopane bushveld. The most important species are: White-cloaked Skipper (*Leucochitonealevubu*), Friar (*Amaurisniavius*), African Monarch (*Danauschrysippus*), Guinea Fowl (*Hamanumidadaedalus*), Green-veined Charaxes (*Charaxescandiope*), Foxy Charaxes (*Charaxesjasius*), Club-tailed Charaxes (*Charaxeszoolina*), Straight-line Sapphire (*Lolaussilas*) and Swanepoel's Copper (*Aloeidesswanepoeli*).
Bees	Bees form a major role in pollination of the plants and trees in Mopane Veld. There are several species of bees throughout the Limpopo Province, the most important being the Honey bee (*Apis mellifera*). The CapeHoney bee invades and supplants colonies of the less aggressive African Honey bee. Although they are very important as crop pollinators, honey bees may deprive more specialized and efficient indigenous bees of pollen and nectar, effectively reducing pollination of wild flowers. Honey bees are also important for honey production for humans. Bee populations are on the decline due to a disease called American Foul Disease (AFD).) This disease affects the immune system of the bee, thus allowing pathogens to enter and destroy the bee, and subsequently the entire colony.
Mopane bee (*Meliponula* sp.)	This small bee is stingless and is known for trying to collect moisture from eyes and mouths of humans, although not dangerous, it is an irritant in the Mopane bushveld.

1.2.5.2.6 Faunal sensitive areas

Areas sensitive from a faunal perspective are related to the habitat present. Sensitive areas include the river systems and drainage lines as well as areas having exposed rocky outcrops usually having notable populations of reptiles.

1.2.5.3 Biodiversity and Ecosystem Processes

1.2.5.3.1 National Biodiversity Assessment (NBA, 2011)

No NBA 2011 Endangered or Critically Endangered Ecosystems are affected by the proposed development.

1.2.5.3.2 Biodiversity Proxy

The Biodiversity Proxy was created by combining a layer created through the interpolation of species grid information compiled by the Vhembe Biosphere Reserve (VBR) scientific group with the Conservation Status of the SANBI vegetation. Values were then subtracted using the land cover to reflect transformation and impacts.

In general the Biodiversity Proxy for the affected area is moderate to high (Figure 26), becoming very high along the Soutpansberg in the south around Muswungwa.

1.2.5.3.3 <u>Ecosystem Services</u>

Using the Ecosystem Services (ESS) Classification developed for the Department of Environmental Affairs (DEA) by Transboundary Consulting Africa (2012), the ESS Index for the Chapudi Project and surrounding areas was compiled by combining the values of the Provisioning (Food, Fresh Water and Mineral Value), Regulating (Carbon Sequestration, Groundwater Regulation and Water Purification), Supporting (Biomass Production, Threatened Ecosystems and Conservation Status) and Cultural (Scenic Value, Preservation Value, Heritage Value and Human Impacts) Service.

Ecosystem Services are moderate for most of the affected area, becoming high and very high along the Soutpansberg in the south (Figure 27).

Broad ecosystem delineation is limited to the terrestrial Mopane and mixed veld areas, sandstone ridges and plateaus, rocky ridges and outcrops and the Sand and Mutamba Rivers with associated riverine forest, floodplains and large drainage lines.

The riverine forest and floodplains are important dry season refuge areas for many faunal species in their natural state. It is also a centre of floral diversity. Some of these areas, however, are degraded and overgrazed. The SandRiver does provide a source of water, while the deeper alluvial soils may provide better forage than areas inland of the riparian zone. Any impacts on the sensitive aquatic ecosystems, regardless of the source, need to be avoided.

Impacts on this system include erosion, deforestation through flooding, habitat loss and degradation and the associated impacts on faunal and floral diversity, dewatering, water abstraction as well as increased sedimentation. Continued impacts on the riverine ecosystems may also ultimately reduce the capacity of this system to absorb dramatic flooding events.

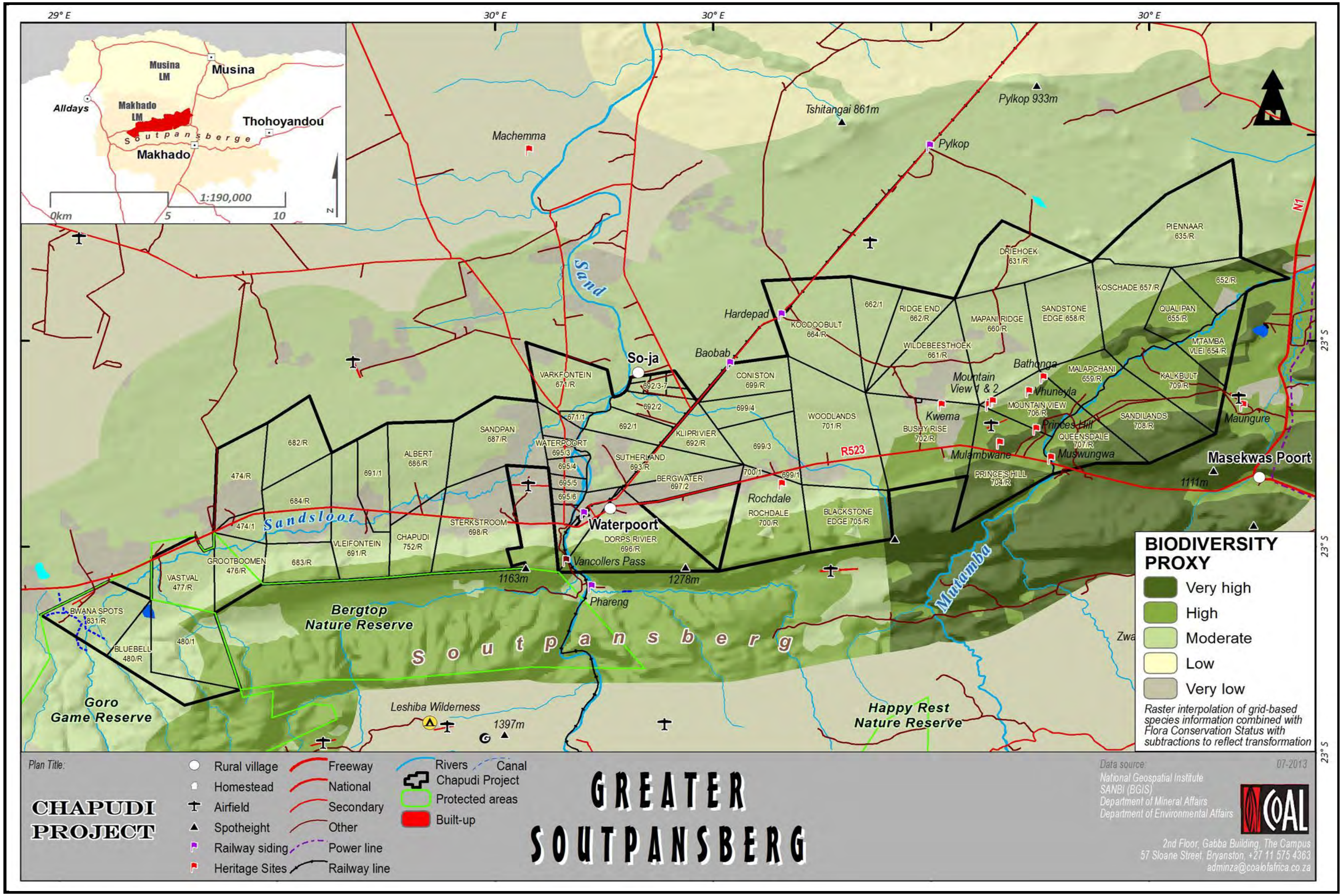


Figure 26: Biodiversity Proxy of the Chapudi Project area and surrounds

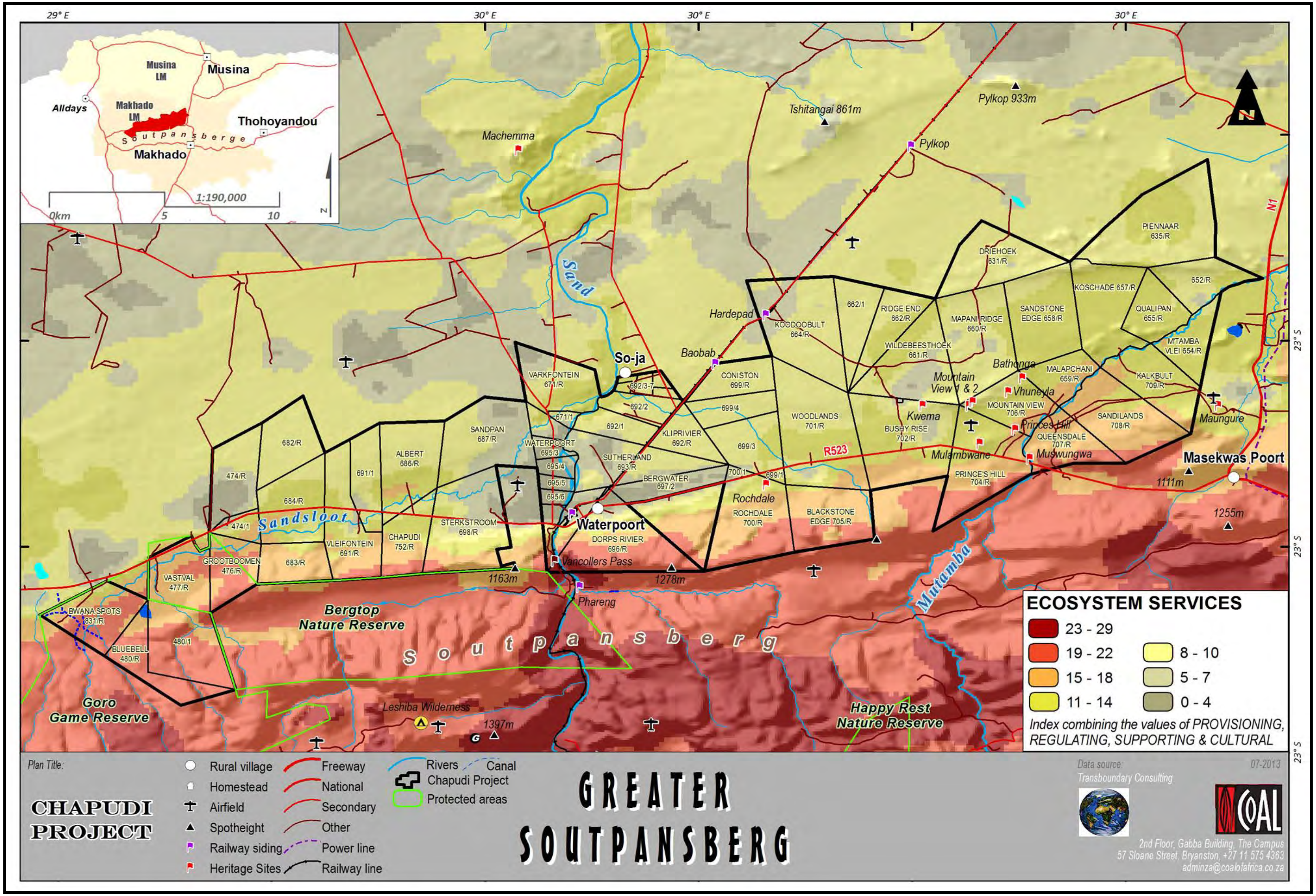


Figure 27: Ecosystem Services of the Chapudi Project area and surrounds

1.2.6 AQUATIC ENVIRONMENT

1.2.6.1 Ecoregions

When assessing the ecology of any area (aquatic or terrestrial), it is important to know which ecoregion the area is located within. This knowledge allows for improved interpretation of data to be made, since reference information and representative species lists are often available on this level of assessment, which aids in guiding the assessment.

The Chapudi Project area falls within the Limpopo Plain Ecoregion and is located within the A71J, A71H and A80F quaternary catchments. Figure 28 below indicates the aquatic ecoregions and quaternary catchment of the Chapudi Project area.

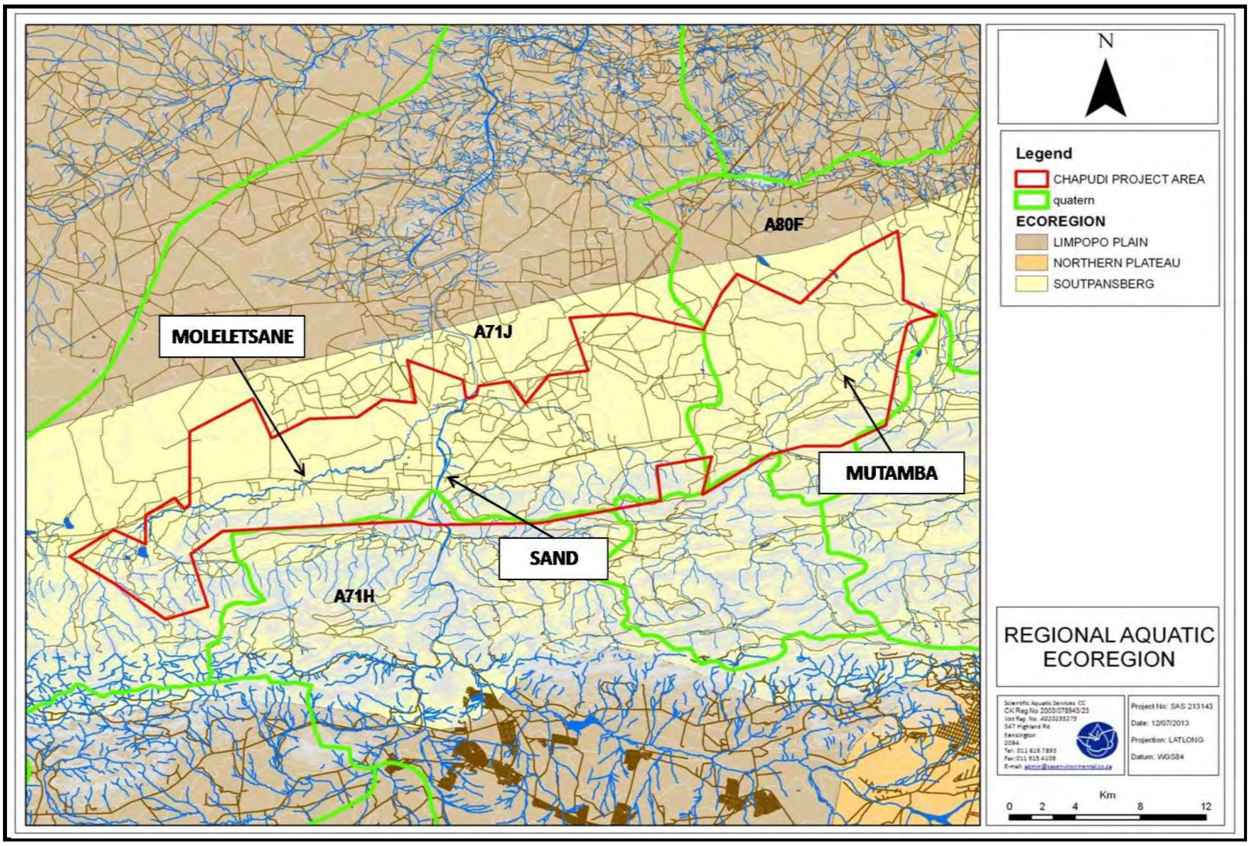


Figure 28: Ecoregions associated with the Chapudi Project area (Mucina and Rutherford, 2006)

1.2.6.2 Ecostatus

Water resources are generally classified according to the degree of modification or level of impairment. The classes, used by the South African River Health Program (RHP), are presented in the table below and will be used as the basis of classification of the systems in future field studies.

Table 21: Classification of river health assessment classes in line with the RHP

Class	Description
A	Unmodified, natural.
B	Largely natural, with few modifications.
C	Moderately modified.
D	Largely modified.
E	Extensively modified.
F	Critically modified.

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.

Table 22: Summary of the ecological status of quaternary catchments A71J, A71H and A80F based on Kleynhans (1999)

Catchment	Resource	EIS	PESC	DEMC
A71J	Sand River	Low/Marginal	Class B	D: Resilient system
A71H	Sand River	Moderate	Class B	D: Resilient system
A80F	Nzehele River	High	Class D	B: Sensitive system

A71J

According to the ecological importance classification for the quaternary catchment, the system can be classified as a ***Resilient*** system which, in its present state, can be considered a Class B (largely natural) stream.

The points below summarise the impacts on the aquatic resources in the A71J quaternary catchment (Kleynhans 1999):

- The aquatic resources within this quaternary catchment have been moderately affected by bed modification as a result of erosion, grazing and sedimentation within the catchment.
- Flow modification within the catchment is considered very low.
- Marginal impacts from inundation of the system occur as a result of weirs within the catchment.
- Riparian zones and stream bank conditions are considered to be moderately impacted by erosion, grazing and sedimentation.

- A very low impact occurs as a result of the introduction of in-stream biota.
- Impacts on water quality in the system are considered very low.

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 marginal diversity of habitat types.
- The site has a very low importance in terms of conservation.
- The riverine resources in this system have no intolerance to flow and flow related water quality changes.
- The aquatic resources in the area have a marginal importance in terms of migration of species.
- The system is considered to be of no importance in terms of rare and endemic species conservation.
- The aquatic resources in this catchment are marginally important in terms of the provision of refuge areas.
- The riverine resources in this system have a low sensitivity to changes in water quality and flow.
- The aquatic resources in this area are of moderate importance in terms of Species/Taxon richness with up to 10 different species present.
- The system is of no importance with regards to unique or endemic species.

A71H

According to the ecological importance classification for the quaternary catchment, the system can be classified as a ***Resilient*** system which, in its present state, can be considered a Class B (largely natural) stream.

The points below summarise the impacts on the aquatic resources in the A71H quaternary catchment (Kleynhans 1999):

- The aquatic resources within this quaternary catchment have been moderately affected by bed modification as a result of sedimentation within the catchment.
- Impacts as a result of flow modification within the catchment due to agricultural activity are considered low.
- Marginal impacts from inundation of the system occur as a result of weirs within the catchment.
- Riparian zones and stream bank conditions are considered to be marginally impacted as a result of grazing and erosion.
- A very low impact occurs as a result of the introduction of in-stream biota.
- Impacts on water quality due to agricultural activities within the catchment are considered low.

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 moderate diversity of habitat types including pools, rapids and a kloof in the Soutpansberg.
- The site has a moderate importance in terms of conservation.
- The riverine resources in this system have a moderate intolerance to flow and flow related water quality changes with special mention of *Labeo* species.
- The aquatic resources in the area have a moderate importance in terms of migration of species.
- The system is considered to be of no importance in terms of rare and endemic species conservation.
- The aquatic resources in this catchment are moderate important in terms of the provision of refuge areas.
- The riverine resources in this system have a moderate sensitivity to changes in water quality and flow.
- The aquatic resources in this area are of moderate importance in terms of Species/Taxon richness with up to 14 different species present.
- The system is of no importance with regards to unique or endemic species.

A80F

According to the ecological importance classification for the quaternary catchment, the system can be classified as a ***Sensitive*** system which, in its present state, can be considered a Class D (largely modified) stream.

The points below summarise the impacts on the aquatic resources in the A80F quaternary catchment (Kleynhans 1999):

- The aquatic resources within this quaternary catchment have been marginally affected by scouring of the system.
- Flow modification within the catchment is considered very high due to the control of flow by a dam upstream.
- Marginal impacts from inundation of the system occur.
- Riparian zones and stream bank conditions are considered to be moderately impacted by erosion.
- A low impact occurs as a result of the introduction of in-stream biota with special mention of *Azzola sp*. (Water Fern) and *Cyprinus sp*. (Carp).
- Impacts on water quality in the system are considered high as water released by the dam has a modified temperature and quality.

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 high diversity of habitat types.
- The site has a moderate importance in terms of conservation with special mention of a gorge in the system.

- The riverine resources in this system have a moderate intolerance to flow and flow related water quality changes.
- The aquatic resources in the area have a high importance in terms of migration of species and form a transition zone between mountain and lowveld. Special mention is made of the migration of eels, fish and birds.
- The system is considered to be of high importance in terms of rare and endemic species conservation. Some species may occur upstream of Nzhelele Dam.
- The aquatic resources in this catchment are moderately important in terms of the provision of refuge areas.
- The riverine resources in this system have a moderate sensitivity to changes in water quality and flow. The gorge area is particularly sensitive to changes in flow.
- The aquatic resources in this area are of high importance in terms of Species/Taxon richness with up to 16 different species present.
- The system is of high importance with regards to unique or endemic species with special mention of *Barbus eutenea* (Orangefin Barb), *Barbus lineamaculatus* (Line-spotted Barb) and *Barbus maculatus*.

1.2.6.3 Ecological Importance

The RSA Wetland Types (2010) and National Freshwater Ecosystem Priority Areas (NFEPA) (2011) databases were consulted to define the ecology of the wetland or river systems within the Chapudi Project Area that may be of ecological importance. Aspects applicable to the Chapudi Project Area and surroundings are discussed below:

- 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 subWMA indicated for the Chapudi Project is the Sand subWMA.
- 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 Area (FEPA).
- The Sand River is a perennial system and the Moleletsane River is an ephemeral system. Both rivers are classified as Class B (largely natural) rivers and are not indicated as free flowing or flagship rivers. However, the portions of the rivers which flow through the Chapudi Project Area are indicated as Upstream Management Areas.
- Upstream Management Areas are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas.
- The Mutamba River is a perennial system classified as a Class D (largely modified) river however it is not indicated as a free flowing, flagship or FEPA river.
- Three wetland features within the Chapudi Project area (to the west of the project area) are indicated as wetland FEPAs. Wetland FEPAs currently in an A or B ecological condition

should be managed to maintain their good condition. Those currently in a condition lower than A or B should be rehabilitated to the best attainable ecological condition.

- Two wetland clusters are indicated within the Chapudi Project 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.
- Wetlands located within the Chapudi Project area are not shown to have sighting or breeding areas for cranes.
- No RAMSAR wetlands are located within or close to the Chapudi Project area.
- No wetlands are indicated to fall within 500m of an IUCN threatened frog point locality.

1.2.6.4 Wetland Assessment

Due to the extent of the study area as well as access restriction, with special mention of the western area of the project, sites considered to be representative of the characteristics of the features within the study area were selected. Selection of areas representative of the different feature groups, took place with the use of desktop methods (contours, flood lines, digital satellite imagery and topographical maps indicating depressions or drainage lines) after which selected points of interest were identified which are representative of the various systems. Each point of interest was assessed during the field survey to distinguish between true wetland and non-wetland, as well as true riparian and non-riparian features. For the purposes of this investigation, use was made of distinguishing factors as either defined by DWA (2005) for 'wetland habitat' or defined in the NWA (Act No 36 of 1998) for 'riparian habitat'.

Features within the study area were categorised with the use of the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis, 2013). After the field assessment it can be concluded that three main feature groups are present within the study area, namely depressions (GSPC W1, GSPC W2, GSPC W3 and smaller pans), rivers (Sand River, Mutamba River and Moleletsane River) and smaller drainage lines. Within the area several artificial earth dams were also observed, some of which are perennial with others that only seasonally or ephemerally hold surface water and support vegetation adapted to life in saturated soils.

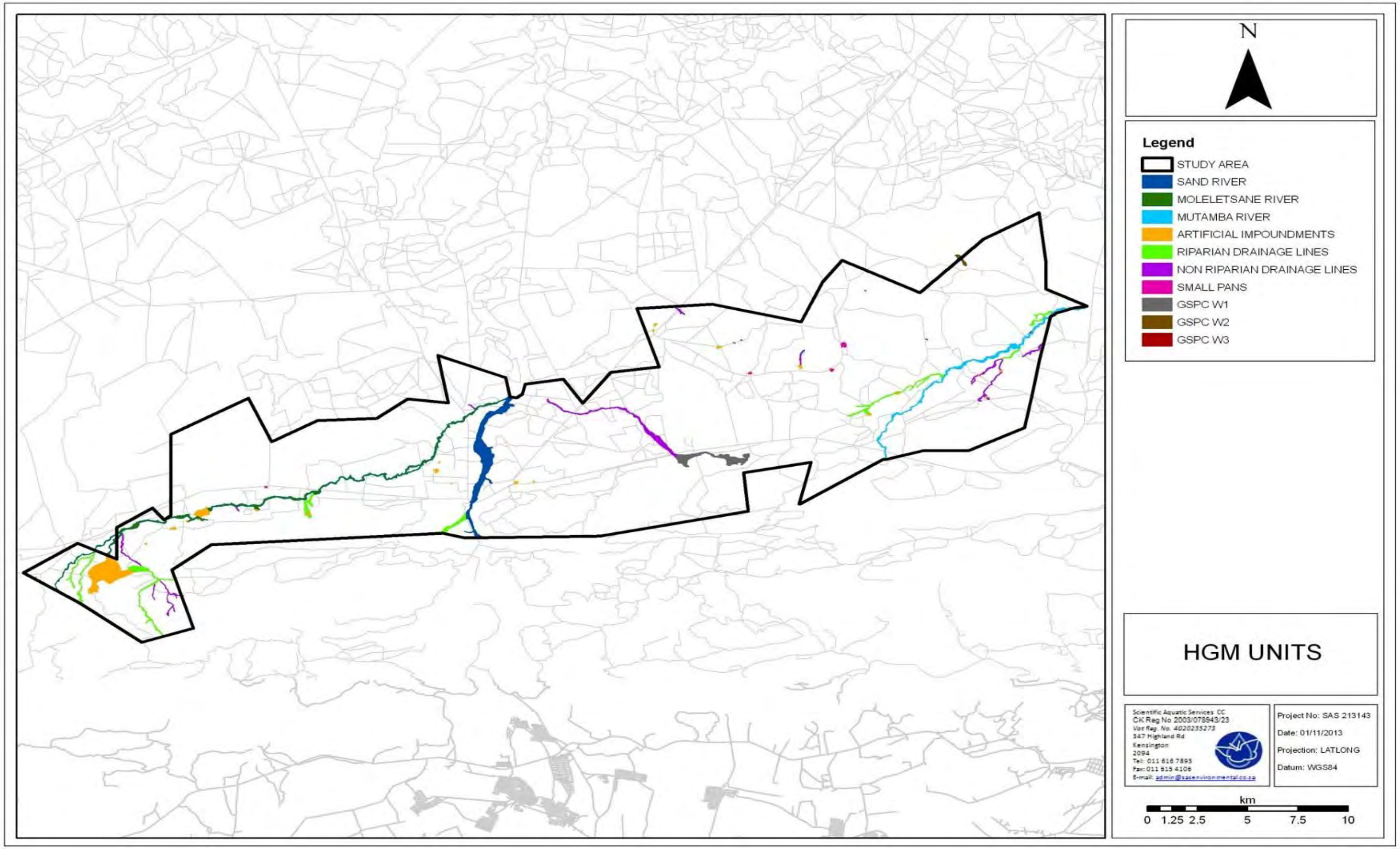


Figure 29: Wetland features within the Chapudi Project area

The following general conclusions were drawn upon completion of the wetland assessment – refer to ANNEX-5 (Aquatic Specialist Study, SAS 2013) for detail description:

- The riverine resources are of significant importance in terms of wetland function and service provision with special mention of biodiversity as well as water provision to farmers within a water stressed region. Game farming is also the present land use of the majority of the farms investigated with limited areas utilised for crop cultivation, consequently the river systems have remained largely undisturbed and are therefore important in terms of biodiversity value. The Sand River and the Nzhelele River, of which the Mutamba River is a major tributary, have significant downstream importance for socio-cultural purposes with special mention of water supply as well as biodiversity maintenance and other basic ecosystem services. Measures to ensure the ongoing functioning of the Sand and Mutamba Rivers in the area are therefore considered of high significance.
- Mining related activities and infrastructure as proposed by the present layout provided by the proponent would most likely significantly impact on the Moleletsane River, Sand River and Mutamba River. Should mining activity encroach onto the allocated 100m buffer zones, effective mitigation of impacts would be unlikely.
- It should be noted that the region in the vicinity of the study area is significantly water stressed and as a result farmers depend on water from the rivers for general water provision for agriculture as well as livestock and game farming with specific reference to the Sand River and Mutamba River. Furthermore, it would be difficult if not impossible to substitute the water supply from rivers with alternative water sources except for possible groundwater use. If the proposed mining activity results in a decrease in available water volumes in the aquifers associated with these water courses, or result in the formation of a cone dewatering, many farmers within the study area as well as downstream areas would be significantly affected in addition to adverse impacts on the ecology of the area.
- The Sand and Mutamba rivers are also considered to be of increased significance with regards to biodiversity maintenance due to the presence of fish that would be restricted to river corridors and refugia formed during the winter months. Therefore, reduced water volumes will directly impact on the survival as well as migratory corridors of aquatic species. Any reduction of stream flow, as a result of the project, that leads to the loss of refugia for aquatic species or the significant loss of downstream water supply, should be considered an extremely high risk on the Sand River and a moderate to high risk on the Mutamba River.
- Characteristics of smaller drainage lines with riparian zones are considered to be largely uniform throughout the study area. The majority of the features are located within more isolated areas further from agriculturally related activities and the lack of water for extensive periods of the year does not make it feasible for abstraction. All these aspects have resulted in drainage features with limited levels of present impact, which can be considered important in terms of biodiversity conservation.
- GSPC W2 and GSPC W3 as well as smaller pans showed characteristics of a wetland habitat in which soil is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soils. These depressions are considered to be of increased EIS for aquatic and terrestrial species which rely on these systems for parts of their life cycles as well as drinking water during winter months. It is for this reason that these systems should be conserved wherever possible and that as far as possible connectivity between

these areas and surrounding open areas should be maintained, in order to support the biodiversity maintenance services that these systems provide.

- The results obtained from the assessment of wetland ecoservices indicate that the Sand River can be considered the most important in terms of function and service provision, with the highest scores calculated for water supply, biodiversity and tourism and recreation. The next highest average scores calculated was for the Mutamba River and to a lesser degree the Moleletsane Stream. The GSPC W1 wetland on the Black Stone Edge Farm is considered to be a depression feature of high ecological significance while all other depression features in the area are considered to be of lower significance.
- Wet-Health was used to determine the PES of the wetland depressions and pans within the study area. The pans have been impacted by anthropogenic activities, but can still generally be considered to be in good condition and are considered to be important in terms of biodiversity support in the area.
- The VEGRAI ecostatus was used to assess the response of riparian vegetation to impacts within rivers as well as smaller drainage lines. The mean scores calculated for the Sand River, Mutamba River and the Moleletsane River. The Sand River can be defined as a Class C (moderately modified) system with the upper Mutamba river being less impacted in a Class A and B (natural to largely natural) range and the lower area slightly more modified in the Class C (moderately modified) and mean scores calculated for the smaller drainage lines, fall within Class B (largely natural) category. The Moleletsane river was classified as a Class C (moderately modified) system.
- Based on the findings of the study it is evident that from a wetland point of view, the EIS of the river systems are largely similar. All the systems can be defined as Class B systems indicating a high EIS. The Moleletsane River had the lowest EIS with a borderline (B/C) condition indicating a moderate to high EIS. When the aquatic ecology of the Sand River is considered, from where several assessment points are available it is evident that the aquatic ecology of the system is in a poorer condition than the wetland EIS assessment indicates. Based on the consideration of both the wetland EIS and the aquatic ecostatus indices, the most appropriate EIS for the upper reaches of the Sand River have been defined as a Class B system with the lower areas more likened to a Class D resource.
- The wetland features within the subject property showed a more significant variation in the EIS. The GSPC W1 (wetland on the farm Blackstone Edge) had the highest EIS being defined as a Class A system, indicating a very high EIS.
- The GSPC W2 and GSPC W3 wetlands had lower values (Class C) and can be defined as having a moderate EIS. The smaller natural depression wetlands were considered to have a high (Class B) EIS. The artificial wetlands formed through the construction of small earth dams were defined as having a borderline Class C/D EIS indicating a moderate to low EIS.
- Due to the ephemeral nature of the drainage lines, not all drainage lines could be considered riparian habitat as defined by NWA No 36 of 1998. Therefore, distinction was made between drainage lines with riparian zones and drainage lines without riparian zones. Smaller drainage lines with riparian zones are defined as watercourses.
- Smaller drainage lines without riparian zones are not considered wetlands but are still defined as watercourses.

- The bulk of the mining support structure such as the plant ROM facilities and the associated pollution control facilities are planned in this area on the Black Stone Edge Farm. These activities in the area are likely to severely impact on the GSPC W1 wetland leading to the permanent destruction of the wetland features. Since the infrastructure in this area is not resource dependent, the infrastructure could be moved to an alternative location without compromising on the mining resource. Due to the unique nature of this feature and the biodiversity it supports, with special mention of the known presence of protected species and the high probability of occurrence of other species of conservation concern, it is strongly recommended that the infrastructure be moved from this area to an area which where these activities will have a significantly lower impact on wetland resources.

The following general conclusions were drawn upon completion of the aquatic assessment – refer to ANNEX-5 (SAS, 2013) for a detail description of the assessment methodologies and results obtained during the site visit:

- Increased concentrations of dissolved salts were observed in a downstream direction , resulting from low flow conditions compounded by water abstraction from the system for both the Sand and Mutamba Rivers or agricultural purposes);
- pH values also increased in a downstream direction;
- The most significant impacts (instream habitat) are from water abstraction, flow modification and water quality modifications. Both sites obtained a "D" ("Largely modified") classification with regard to instream habitat integrity;
- In the riparian zone the system has been affected by vegetation removal, alien encroachment and bank erosion;
- With regard to riparian zone habitat integrity, site GSP3 was classified as "D" (largely modified), whilst site GSP1 was classified as "C" (moderately modified);
- Overall scores of 55.9 % (GSP3) and 56.5% (GSP1) were calculated, placing both sites GSP3 and GSP1 in class D (largely modified);
- Habitat diversity and structure was considered inadequate for supporting a diversity of aquatic macro-invertebrate communities at all three downstream sites (GSP1, GSP3 and GSP4);
- Habitat conditions seem to deteriorate in a downstream direction with impacts from farming and construction evident;
- Conditions (macro-invertebrate community) in the Sand River have deteriorated in a downstream direction according to both the Dallas (2007) and the Dickens & Graham (2001) classification systems;
- At site GSP6, the stream may be considered to be in a class C (moderately impaired) condition according to the Dickens & Graham (2001) classification system and in a class D (largely impaired) condition according to the Dallas (2007) classification system;
- In comparison the downstream sites vary between class C (moderately impaired) and class E (severely impaired) conditions according to the Dickens & Graham (2001) classification system. With the Dallas (2007) classification system conditions vary between class D and class and in a class E/F for the three downstream sites (GDP4, GSP3 and GSP1);

- The MIRAI results in terms of (ecological category classification) follow the same trends as that obtained using the SASS class classifications (C for GSP6, E for GSP4, D for GSP3 and F for GSP1);
- The (ecostatus) EC classification obtained are in congruence with previous studies performed in the same system;
- The automated EC calculated for the FRAI (C/D for GSP6, E for GSP4, E for GSP3, D for GSP1 and F for the system as a whole) largely corresponds to that obtained for the MIRAI.
- An overall IHIA score of 86.7% was obtained for the upstream site on the Mutamba River (GSP8) was calculated, defining the system class A (unmodified/natural). Some reductions in integrity are however evident in a downstream direction on the system;
- Habitat diversity and structure was considered highly suitable for supporting a diverse and sensitive aquatic macro-invertebrate community
- In terms of general ecological category classification, the values obtained are in congruence with previous studies performed in the same system. A faunal assessment for the Chapudi Project (compiled by Natural Scientific Services CC) previously reported on ecological categories between six sites. For five of these sites classifications varied between D and E with only one site achieving a C ecological classification. For site GSP8 (M1 historically) specifically, an ecological classification of D was achieved (compared to C obtained in the current assessment).
- From the fish community assessments it is clear that the EC calculated for the FRAI largely corresponds to that obtained for the MIRAI. Because the habitat (and hence potential drivers) was fairly homogenous between the sites, the refined EC was also similar.
- In terms of general ecological category classification, the FRAI EC's obtained are lower compared to previous studies performed in the same system. A faunal assessment for the Chapudi Project (compiled by Natural Scientific Services CC) previously reported ecological categories ranging between B and C. The variation in results may be attributed to the low flows at the time of assessment and potential migratory movement of fish in the system.
- The Sand River is seen to be a water stressed system with the degree of water stress increasing in a downstream direction. The Sand River can be considered to be a system of high aquatic Ecological Importance and Sensitivity due to the provision of refugia and in the local area and the support it provides to the aquatic ecology of the area. The system is also deemed important in terms of the provision of services to the terrestrial fauna, such as the provision of drinking water of the area as well as a high significance from a socio-cultural point of view, with special mention of water provision for agriculture. It is deemed essential that all effort is made to ensure that impacts on the Sand River as a result of the proposed Chapudi Project are minimised.
- Based on the findings of the aquatic study the Mutamba River is seen to be a water stressed system with the degree of water stress increasing in a downstream direction. Some recovery of the system does however occur in the lower reaches but impacts on the aquatic ecology of the lower reaches of the system are still considered to be likely. The Mutamba River can be considered to be a system of reduced Ecological Importance and Sensitivity in relation to the Sand River due to the limited provision of refugia and in the local area and the limited support it provides to the aquatic ecology of the area. The system is however deemed important in terms of riparian vegetation habitat and the provision of services to the

terrestrial fauna of the area as well as fair significance form a socio-cultural point of view. It is deemed essential that all effort is made to ensure that impacts on the Mutamba River as a result of the proposed Chapudi Project are minimised.

1.2.6.5 Present Ecological State and Recommended Ecological Class

According to the resource directed measures for protection of water resources a wetland or river may receive the same class for the Present Ecological State (PES), as the Recommended Ecological Class (REC), if the habitat is deemed in good condition, and therefore must stay 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 feature. The results obtained from the assessments indicate relatively low levels of transformation on all levels of ecology. It is therefore recommended that the features be assigned the same REC as the PES Class calculated.

The Ecological Importance and Sensitivity (EIS) and REC values are presented in the table below:

Table 23: Assigned REC classes

Feature	PES Class	EIS Class	REC Class
Sand River (upper)	B/C	C	C
Mutamba River	A/B	B	B
Moleletsane Stream	B	B/C	B/C
Smaller drainage lines	A	B	B
GSPC W1	C	A	A
GSPC W2	B	C	C
GSPC W3	C	C	C
Smaller pans	A	B	B

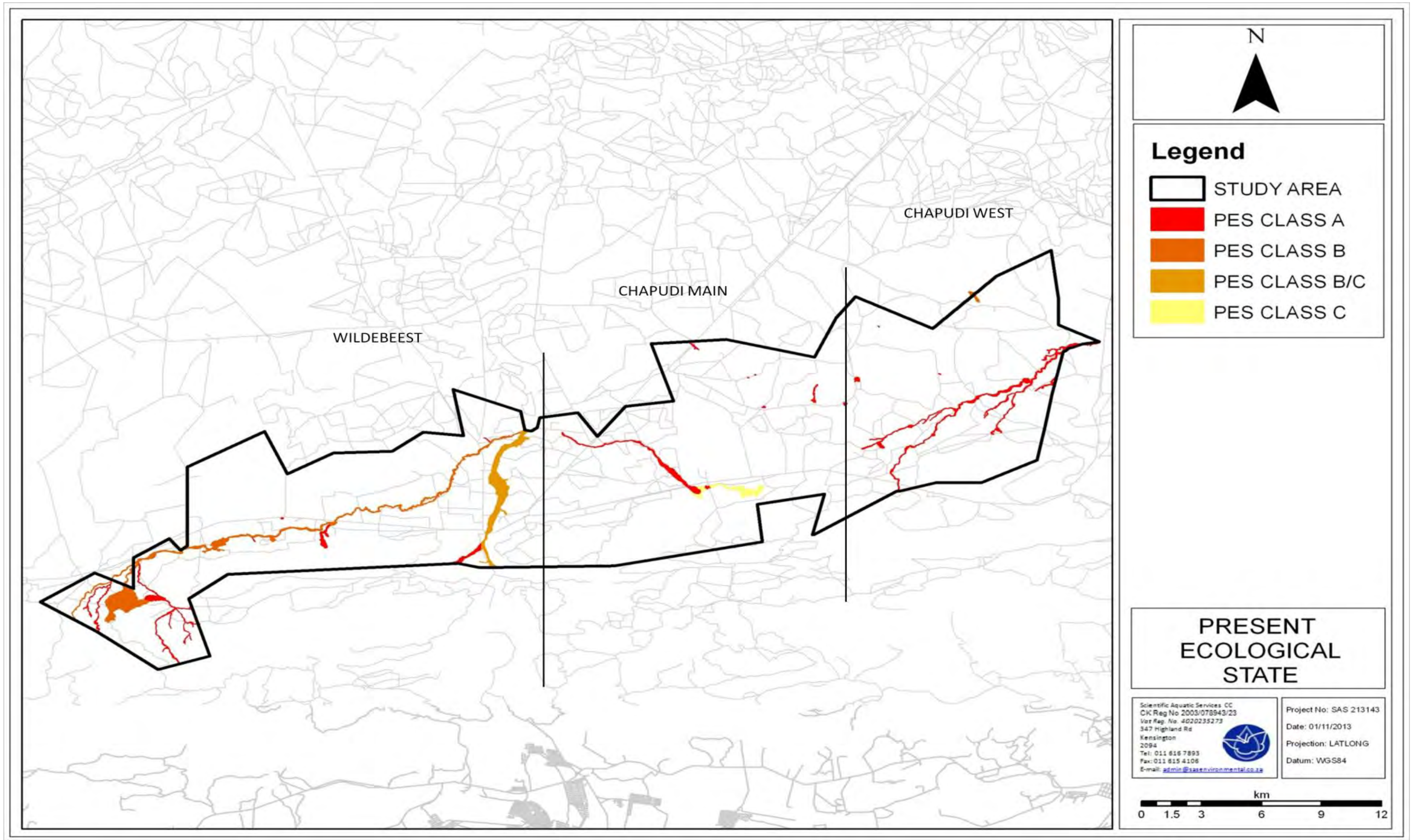


Figure 30: Present Ecological State (PES) of wetlands in the Chapudi Project area

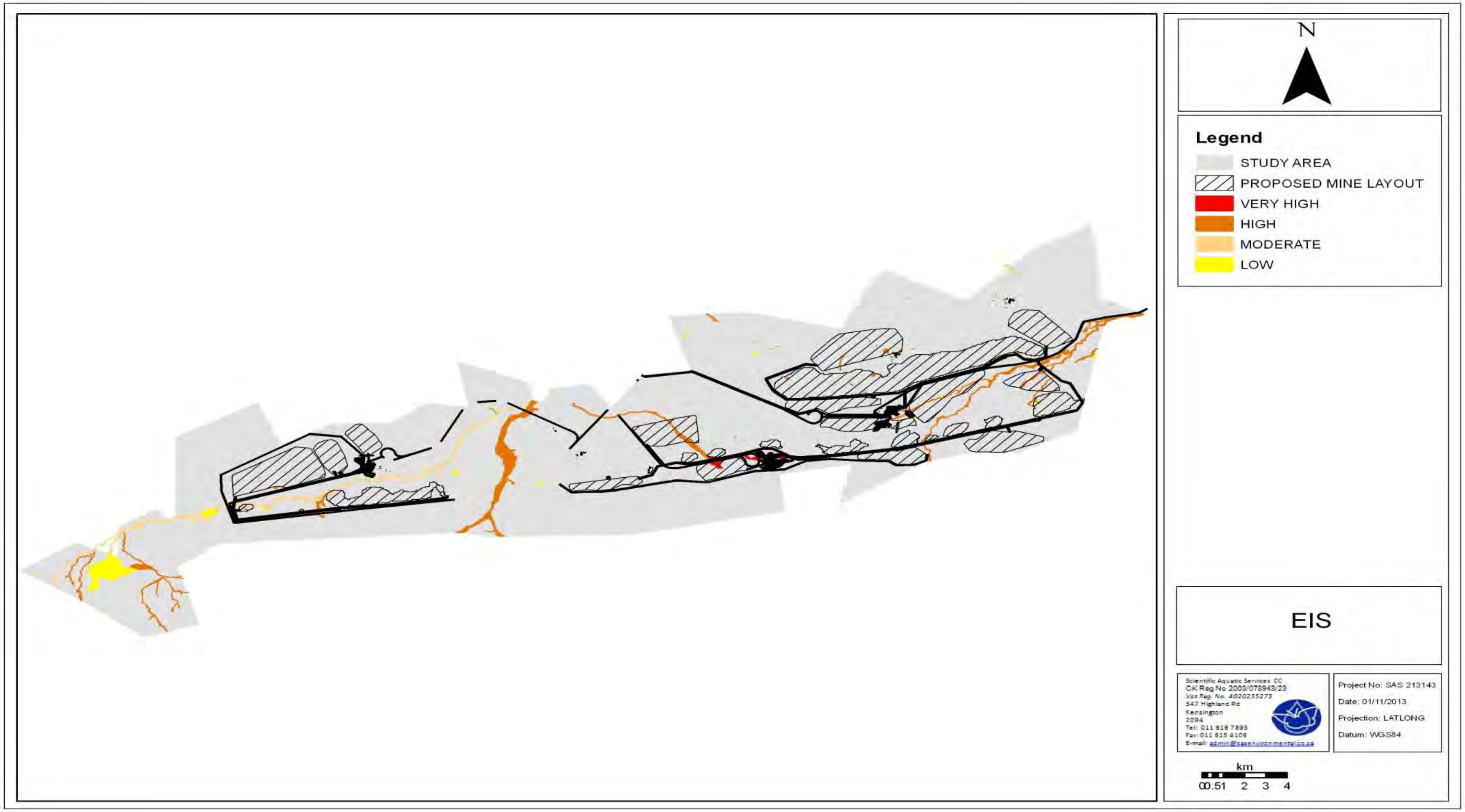


Figure 31: Ecological Importance and Sensitivity (EIS) of wetlands in the Chapudi Project area

1.2.7 SURFACE WATER

1.2.7.1 Locality and Background Information

Figure 32 below shows the Chapudi Project in relation to the quaternary catchments areas of the Sand and Mutamba Rivers. The Sand River Sub-Basin is regarded as by far the driest of the river basins in the Limpopo River Water Management Area (WMA) (ISP, Limpopo WMA, DWA 2004). The surface water resources are thus regarded as very limited and there is no scope for construction of dams.

The existing major dams in the Sand River catchment are located upstream namely:

- Seshego Dam in the Blood River (Polokwane Local Municipality)
- Hout River Dam (supply to rural villages)
- Turfloop Dam in the south-eastern part of the Basin
- Spies Dam in the Dorps River about 20 km west of Louis Trichardt

There are no major dams in the Mutamba River catchment.

There is no government developed irrigation scheme but extensive private and commercial irrigation schemes have been developed, mostly in the central reaches of the basin. The bulk of the water requirements are met almost exclusively by the ample groundwater resources (Limpopo WMA Water Resources Situation Assessment, DWA 2002).

In the upper region of the Basin, Polokwane and other larger towns rely on transfers of water from other Water Management Areas (WMA's).

The Chapudi Project is bisected by the watershed of quaternary catchment A71J (Sand River) and A80F (Mutamba River). The Chapudi West Section is inside Quaternary Catchment A71J, while the Chapudi and Wildebeesthoek Sections are almost wholly inside catchment A80F.

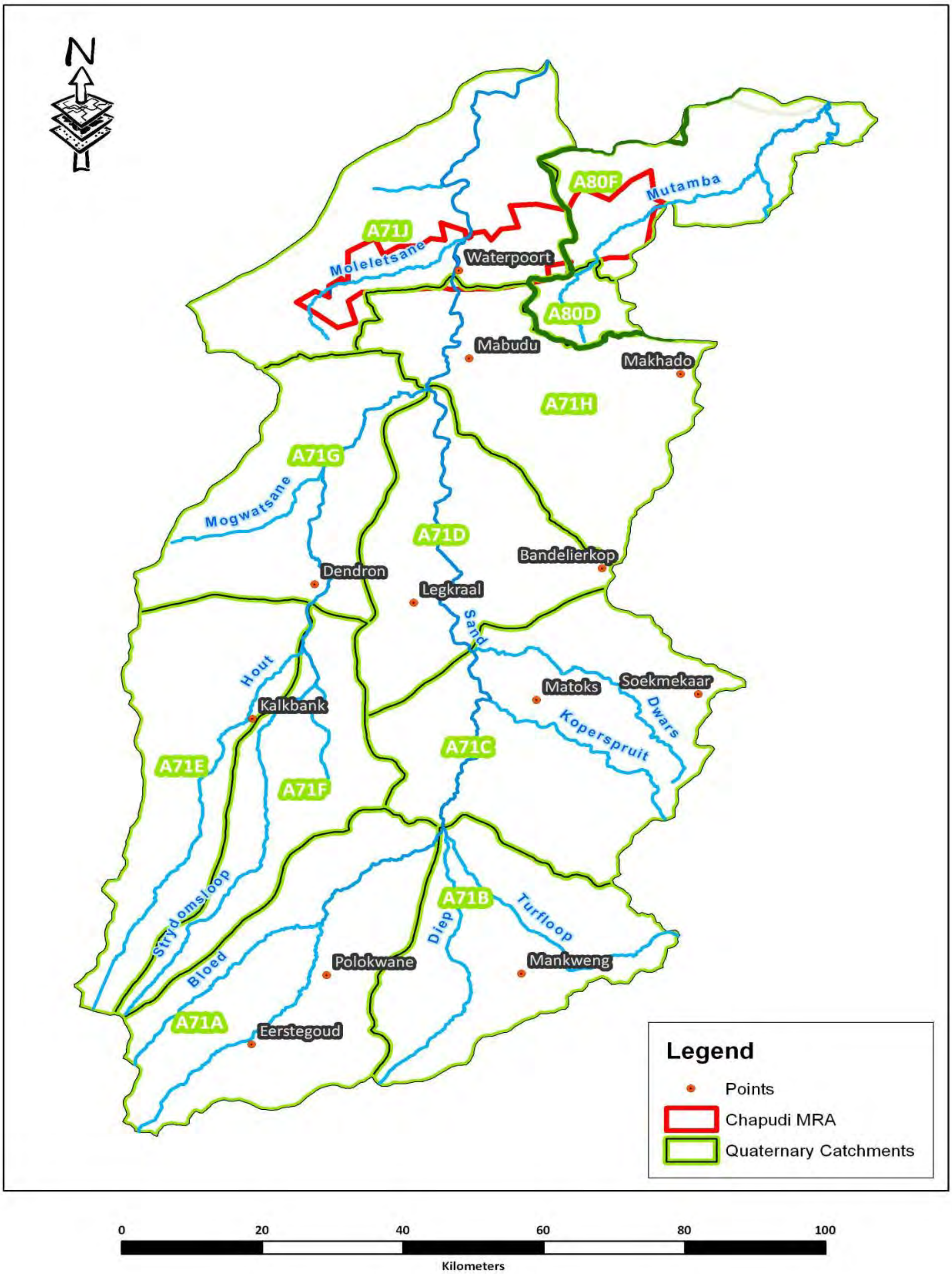


Figure 32: Chapudi Project in relation to the quaternary catchment areas of the Sand and Mutamba Rivers

1.2.7.2 Surface Water Quality

According to the Water Resource Situation Assessment, the upper and central Sand River receives "large quantities" of industrial and domestic effluent from large towns and high density rural towns along its banks. The mineralogical water quality of the whole of the catchment was thus classified as "marginal" (DWA, 2002).

In contrast to this assessment, the ISP study (DWA, 2004) states that apart from problems with groundwater quality in the Vivo and Dendron areas there are no major water quality problems in the Sand River Key Area (the key area includes the Sand River Basin and other smaller rivers draining to the Limpopo River).

A Baseline Study of the water chemistry of the Limpopo Basin (Univ. of Zimbabwe, 2009) found that in the Vhembe District, which includes the Sand River, nitrate levels increased with groundwater flow towards the Sand River and high levels of nitrate were recorded in both the river and alluvial groundwater during the raining season. It was suggested that the nitrate is from dry land cropping, overgrazed pastures and, in some areas, pit latrines. High fluoride was noted in the area north of the Soutpansberg and has been attributed to high evaporation.

DWA has a river water quality monitoring station at Waterpoort (22°54'37 S, 29°26'41 E), which is relevant to the Chapudi Project area. Figure 33 below shows the locality of the water quality monitoring stations.

Table 24: Water quality measured at Waterpoort (Station A7H001)

Macro-elements												
Element	Unit	DWA Gauge "Waterpoort" : STATION A7H001 in Quaternary Catchment A71J							Aquatic Ecosystem WQT	Drinking Water WQT	Agriculture WQT (irrigation)	Agriculture WQT (livestock)
DATE		4/2000	12/2001	10/2002	01/2003	04/2004	08/2005	02/2006				
pH		8.2	8.5	8.2	7.9	7.8	7.8	7.7		6.0 - 9.0	6.5-8.4	
E.C	mS/m	70	253	20	36	19	10	10		150	40	
TDS	mg/l									1000		1000
NO3	mg/l	0.8	0.02	0.07	0.12	0.06	0.04	0.04	0.5	6	5	100
F	mg/l	0.21	0.41	0.13	0.23	0.1	0.05	0.11	0.75	1	2	2
SO4	mg/l	34	207	6	16	7	2	5		400		1000
Cl	mg/l	105	565	12	41	13	8	6		200	100	1500
Ca	mg/l	34	77	14	23	14	8.5	5		150		1000
Mg	mg/l	22	92	8	8	7	3	3		100		500
Na	mg/l	64	287	7	28	10	4	6		200	70	2000
TAL	mg/l	34	207	6	16	7	2	5				
HCO3	mg/l											
CO3	mg/l											
P	mg/l											
NOTE: VALUES IN GREEN SHOW CONSTITUENTS WHERE RANGE TESTED NOT FINE ENOUGH TO COMPARE TO TARGET WATER QUALITY RANGE												

Table 24 shows water results for the most recent seven years. This station has a long record of monthly sampling but these values were selected to give an indication of more recent water quality, albeit upstream of the site and of irrigation areas. Elevated levels of pH, EC, chloride and sodium occurred after the extreme flood of 2000 and also in the following year. Instead of a dilution effect, this data may indicate the effect of higher wash-off from contaminated areas.

Table 25: Water Quality in Sand River downstream of Waterpoort on farm Bergwater 712 MS

Macro-elements													
Element	Unit	**Sand River downstream of Waterpoort in Quaternary Catchment A71J**							Aquatic Ecosystem WQT	Drinking Water WQT	Agriculture WQT (irrigation)	Agriculture WQT (livestock)
DATE		27/06/2013										
pH		7.47								6.0 - 9.0	6.5-8.4	
E.C	mS/m	13.7								150	40	
TDS	mg/l	67								1000		1000
NO_3	mg/l	<0.017							0.5	6	5	100
F	mg/l	0.105							0.75	1	2	2
SO_4	mg/l	<0.04								400		1000
Cl	mg/l	9.15								200	100	1500
Ca	mg/l	12								150		1000
Mg	mg/l	5.52								100		500
Na	mg/l	5.97								200	70	2000
TAL	mg/l	52.5										
HCO3	mg/l											
CO3	mg/l											
P	mg/l											

Table 25 shows the water quality results for the sample taken by WSM Leshika during a site visit in June 2013. Refer to Figure 33 below for the locality of the sampling points. Table 26 shows the water quality results for the samples taken by SRK Consulting (Pty) Ltd during the period of December 2008 to October 2009 and the results are as follows:

Mutamba River:

- Three upstream samples (MRU) were taken in May June and October 2009, and two downstream (MRD) samples in May and June 2009, the watercourse being dry in October.
- The TDS increased from 107 mg/ℓ in May to 152mg/ℓ in October fairly uniformly across all major ions, presumably as the upstream catchment concentrated through the dry season.
- The downstream samples (MRD) were very similar to their upstream counterparts (with TDS ranging from 100 to 120mg/ℓ), other than there being no equivalent sample in October 2009.
- All constituents tested in the Mutamba River remained below the WQT range.

Sand River:

- Four upstream samples (SRU) were taken from the Sand River in December, May, July and October, but only two downstream samples (MRD) were available, in May and July 2009.
- The TDS in SRU declined through the year from 95 to 64 to 55 to 52mg/ℓ while the downstream samples showed no chemical relationship with SDU, having TDS of 490mg/ℓ and 750mg/ℓ in May and July. Presumably this is explained by the strong influence of the saline tributary, the Moleletsane River joining the Sand River approximately 10km upstream of the SRD sampling point. There is no sampling point in the Moleletsane River.
- The pH, nitrate, chloride and sodium WQT ranges were exceeded.

Table 26: Flow in the Mutamba and Sand Rivers sampled by SRK

CHAPUDI PROJECT

Macro-elements

Element	Unit	**SRK Consulting results (December 2008 to October 2009)**							Aquatic Ecosystem WQT	Drinking Water WQT	Agriculture WQT (irrigation)	Agriculture WQT (livestock)
		MRU	MRD	SRU	SRD							
pH		7.0-7.5	7.2-7.5	6.7-8.6	8.3-8.5					6.0 - 9.0	6.5-8.4	
E.C	mS/m	15-25	15-17	7.6-19	71-109					150	40	
TDS	mg/l	98-152	100-120	52-95	460-750					1000		1000
NO_3	mg/l	0.2-0.3	0.2-0.3	0.1-2.4	0.1-0.4				0.5	6	5	100
F	mg/l	0.1	0.1	0.1	0.2-0.3				0.75	1	2	2
SO_4	mg/l	4.2-8.3	4.3-8.5	0.6-3.7	41-85					400		1000
Cl	mg/l	18-31	18-29	7.9-11	87-168					200	100	1500
Ca	mg/l	5.2-12	4.8-15	5.5-16	43-44					150		1000
Mg	mg/l	5.1-7.7	5-5.8	2.8-6.8	24-36					100		500
Na	mg/l	14-31	15-19	4.7-7.6	76-128					200	70	2000
TAL	mg/l	40-71	43-49	27-76	186-260							
HCO3	mg/l											
CO3	mg/l											
P	mg/l											

MRU - Mutamba River Upstream
MRD - Mutamba River Downstream
SRU - Sand River Upstream
SRD - Sand River Downstream

Table 27 shows the water quality results for the sample taken in the Mutamba River by WSM Leshika in May 2011 and again in January 2013. Refer to Figure 33 below for the locality of the sampling point. Except for a slight exceedance of nitrate, all constituents tested within the WQT range.

Table 27: Water quality in the Mutamba River sampled by WSM

MAKHADO COAL PROJECT - GROUNDWATER CHEMICAL ANALYSIS
Macro-elements

Element	Unit	SMON 1 May 2011	SMON-1 (2013/01/17)	Aquatic Ecosystem Water Quality Threshold	Drinking Water Quality Threshold	Agriculture Water Quality Threshold (irrigation)	Agriculture Water Quality Threshold (livestock)
pH		8.2	7.2		6.0 - 9.0	6.5 - 8.4	
E.C	mS/m	27.1	14		150	40	
TDS	mg/l	132	91		1000		1000
NO_3	mg/l	0.80	<1.4	0.5	6	5	100
F	mg/l	0.20	<0.10	0.75	1	2	2
SO_4	mg/l	7	11.68		400		1000
Cl	mg/l	38.00	20.90		200	100	1500
Ca	mg/l	7	3.78		150		1000
Mg	mg/l	10	4.05		100		500
Na	mg/l	38	15.98		200	70	2000
TAL	mg/l	68					
HCO3	mg/l	68					
CO3	mg/l	<5					
P	mg/l	<0.2	0.06				

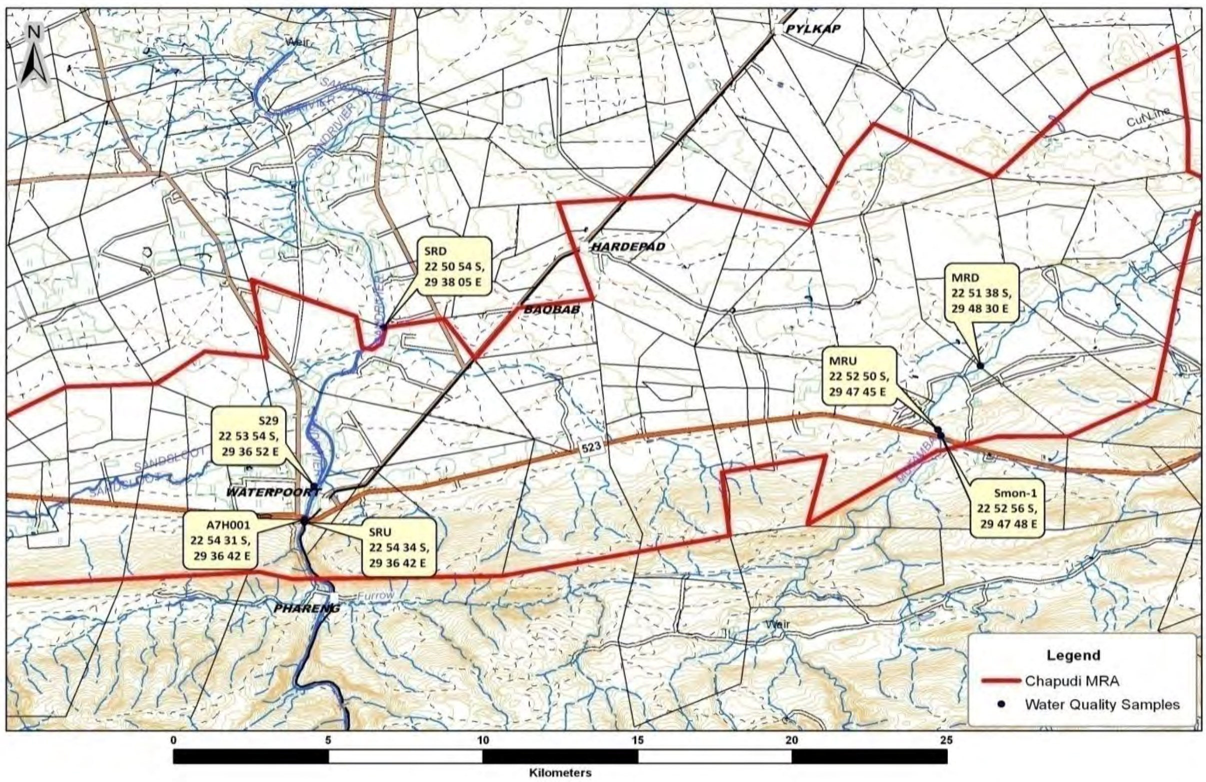


Figure 33: Water quality monitoring points for the Sand and Mutamba Rivers

1.2.7.3 Current Surface Water Use

The farm land is used for cattle and game farming, as well as irrigation from the Sand River alluvium and from groundwater.

The water used for domestic water supply and crop production in the study area is sourced from groundwater. Due to the ephemeral nature of river and stream flows, surface water is not used except where small earth dams catch some runoff for cattle and game watering in the wet season.

1.2.7.4 Current Drainainage System

Figure 34 shows the major rivers and the general flow directions of the drainage systems for the Sand River basin, the Mutamba River Basin as well as the local catchments within the project area. The 1:100- year flood-lines for the major rivers have been determined and are included in Figure 35 and Figure 36.

Figure 34 also gives a graphical representation of the drainage density of the catchments which indicates that even though the site is situated in a dry region and even the large rivers are ephemeral, surface water flows do occur, after rainfall events, in a defined network. The drainage density in the east in the Mutamba River appears to be somewhat less than in the western section of the site towards the Moleletsane River. This may reflect the different geology of the steeper mountain slopes in the east of the mountain range. Note that the broken blue lines, which are well defined in Figure 35 and Figure 36, denote ephemeral streams on this map scale.

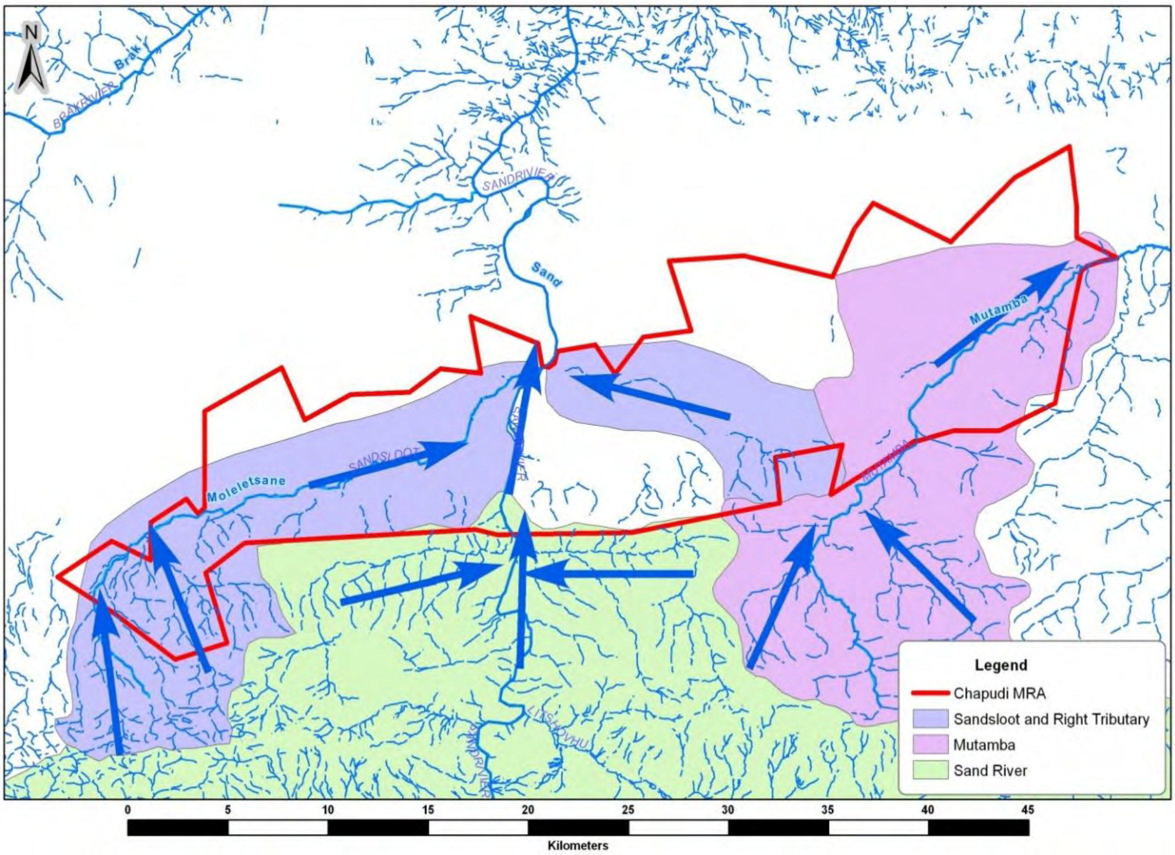


Figure 34: Major rivers and general drainage direction in Chapudi Project area

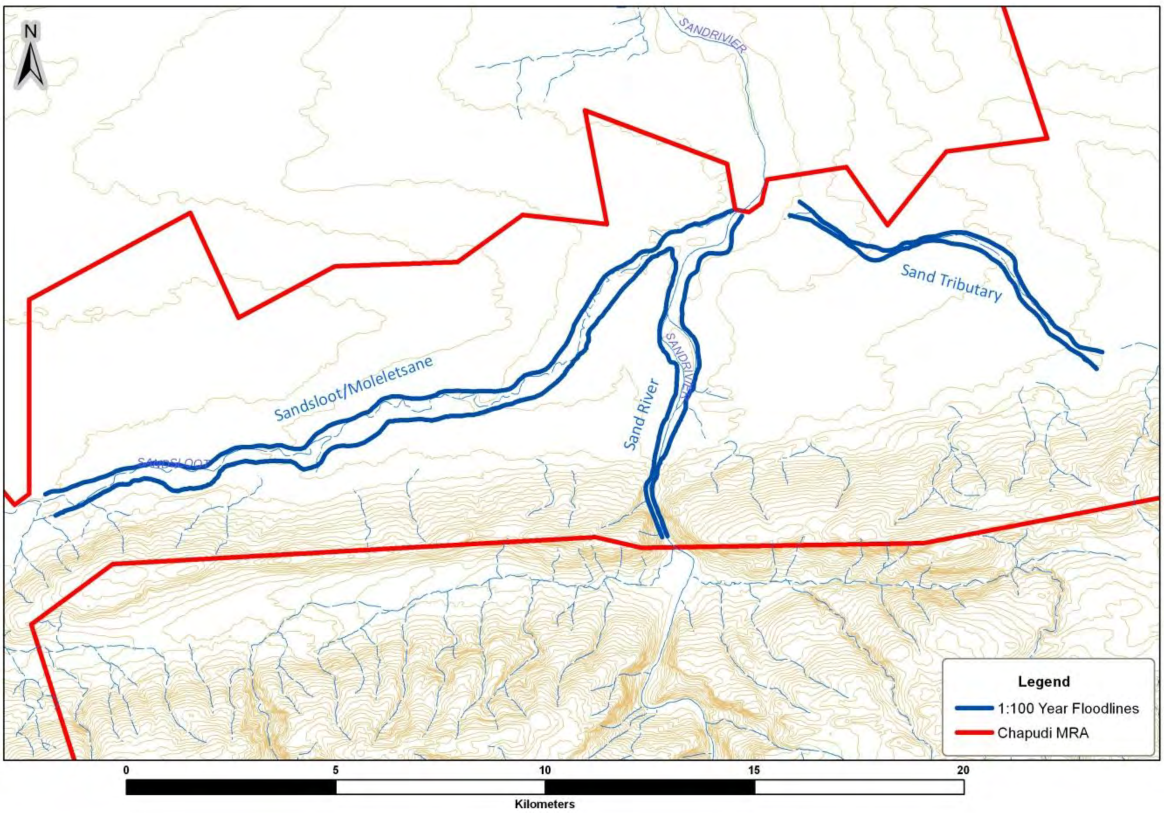


Figure 35: Western section drainage lines and major river flood-lines

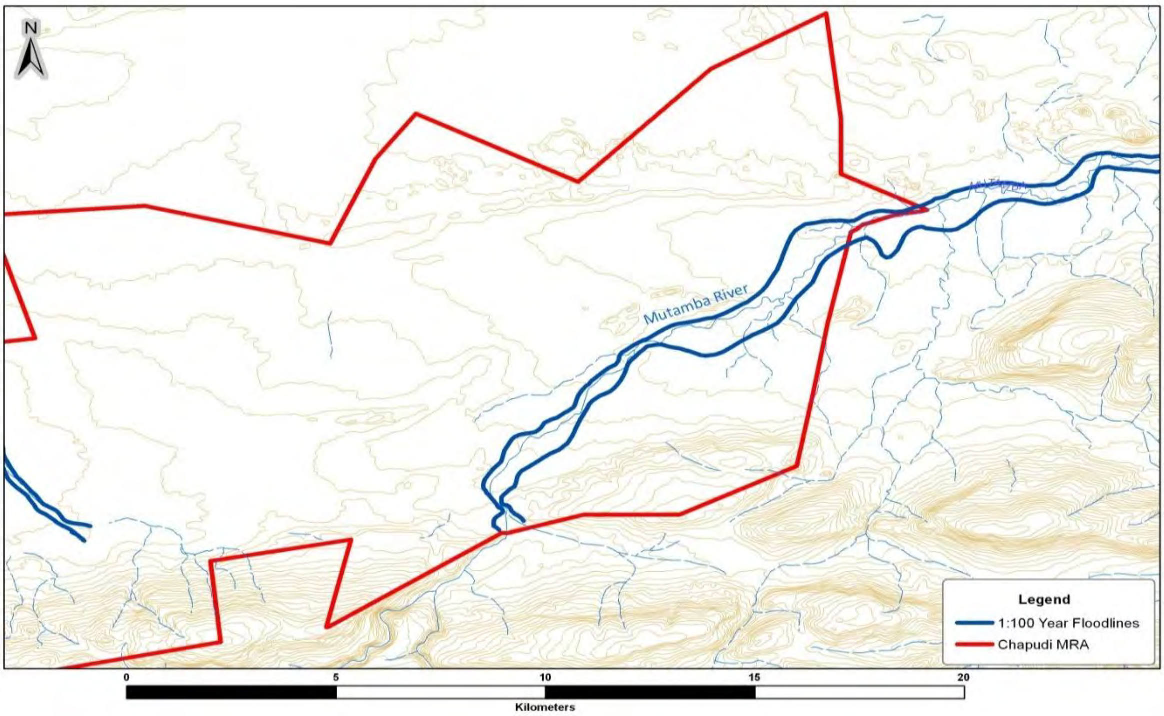


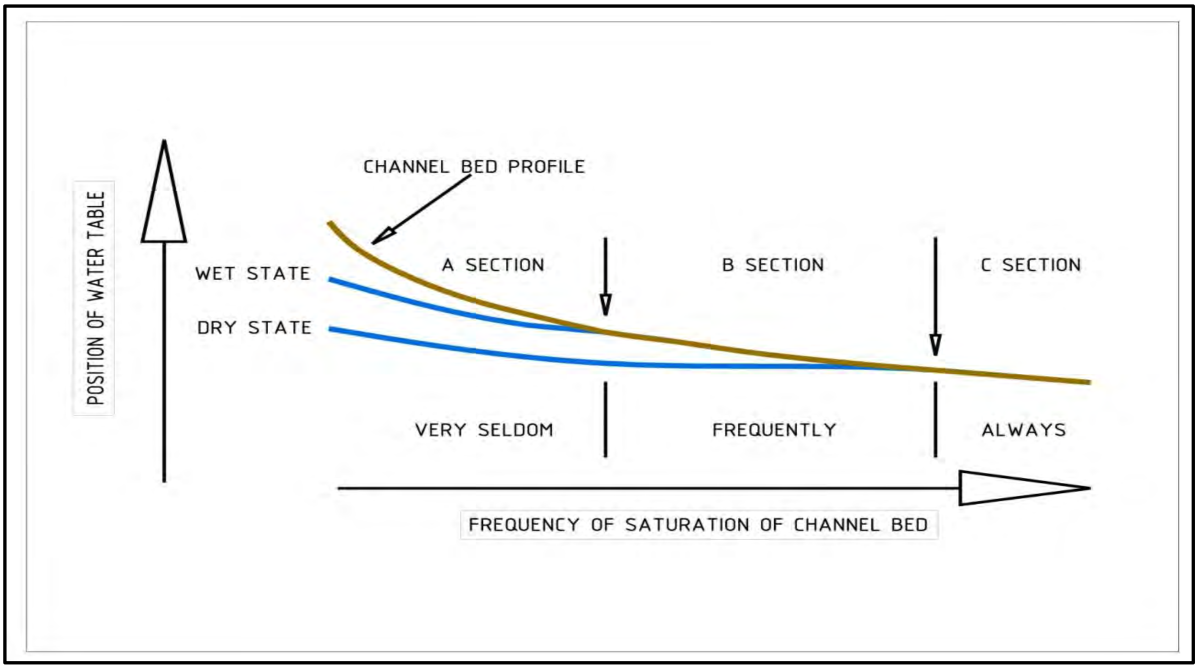
Figure 36: Eastern section drainage lines and major river flood-lines

1.2.7.4.1 __Stream Classification__

River channels may be classified according to guidelines by DWA in "*A practical field procedure for identification and delineation of wetlands and riparian areas*" as shown below (taken from DWA, 2005). Three sections along the length of a watercourse is defined, with the upper Section A defined as being above the zone of saturation and it therefore does not carry base flow. They are mostly too steep to be associated with alluvial deposits and are not flooded with sufficient frequency to support riparian habitat or wetlands. This type does however carry storm runoff during fairly extreme rainfall events but the flow is of short duration, in the absence of base flow. The 'A' watercourse sections are the least sensitive watercourses in terms of impacts on water yield from the catchment.

On the site, Section A channels occur on the mountain slopes and foothill slopes in this dry region, also along the smaller streams on the lower region.

Even the Mutamba and Sand Rivers are classified as only Section B streams. According to the DWA guidelines, the B Sections are those channels that are in the zone of the fluctuating water table and only have base flow at any point in the channel when the saturated zone is in contact with the channel bed. In these B Sections base flow is intermittent, with flow at any point in the channel depending on the current height of the water table. Because the channel bed is in contact with, or in close proximity to, the water table, residual pools are often observed when flow ceases. The gradient of the channel bed is flat enough in these Sections for deposition of material to take place and initial signs of flood plain development may be observed.



1.2.7.4.2 Springs

According to the groundwater study report (WSM Leshika Consulting, November 2013), springs occur where the water table intersects the surface, usually along some structure. The Moleletsane River appears to have its origin in a spring on the farm Bwana Spots to the west of the project. The Zoutpan Salt Mine was also historically fed by springs. A spring existed on the farm Sitapo at Luna Spa but has dried up probably after irrigation started.

From google images springs or “seeps” appear to exist all along the foot of the Soutpansberg Mountain. The local topography on the northern slope of the mountain leads to a particular surface flow pattern, as follows: the relatively high mountain peaks to the south create a very steep slope towards the main rivers, with a drop of some 335 m over about 1 645 m which equals a slope of 20%. The streams draining the mountain slope have thus carved out well-defined incised streambeds. When these streams enter the relatively flat terrain at the foot of the mountains, the flow velocity decreases and sediment is deposited which leads to the creation of sediment fans. In some instances riverflow ceases as water is transported as subsurface flows through the sediment fans and no discernible streambeds occur, hence the discontinuity of drainage lines shown on the topographical maps.

Further down the slope towards the major streams and rivers, surface flow is re-established as springs or seeps develop. Lush vegetation usually characterize these springs and due to high evapotranspiration, the contribution to surface water flows is often much reduced.

1.2.7.4.3 Flood Peak Calculations

Flood peak assessments of the Sand and Mutamba Rivers have done, and is described in detail in Section 4 of the Surface Water Impact Assessment report, 2013 (ANNEX-2). It is not repeated here.

1.2.8 GROUNDWATER

1.2.8.1 Borehole Census

A borehole census was conducted by GCS in 2005 and the data was used in the SRK 2009 report. SRK conducted their own hydro census in 2008 during which numerous water samples were taken but very little water level data was added due to limited access to equipped boreholes. The GCS borehole census farms include the following; Chapudi, Sterkstroom, Varkfontein, Sutherland, Kliprivier, Coniston, Rochdale, Woodlands, Blackstone Edge, Bushy Rise, Prince’s Hill, Mountain View and Malapchani. The water level data is therefore largely from the 2005 census.

Although outside the mine application area, data from Sitapo was included due the close proximity and intensive irrigation on the farm.

WSM conducted groundwater baseline studies in 2012 on the farms Coniston, Wildebeesthoek, Mountain View, Sandstone Edge and Mopani Ridge which were added and augmented to 2005 data.

Borehole data was also collected by AGES (Pty) Ltd during 2013 in areas not evaluated by previous studies or where the data is too old or access to farms were potentially contentious. The AGES borehole census covered the following farms: Northwich, Blackstone Edge, Bushy Rise, Kalkbult, Sandilands, M’tamba Vlei, Generaal, Sutherland East, Malapchani, Driehoek and Woodlands. The borehole census data is summarized in Appendix B of the Groundwater Impact Assessment (WSM, 2013 – ANNEX-3). The borehole localities are indicated on Figure 37.

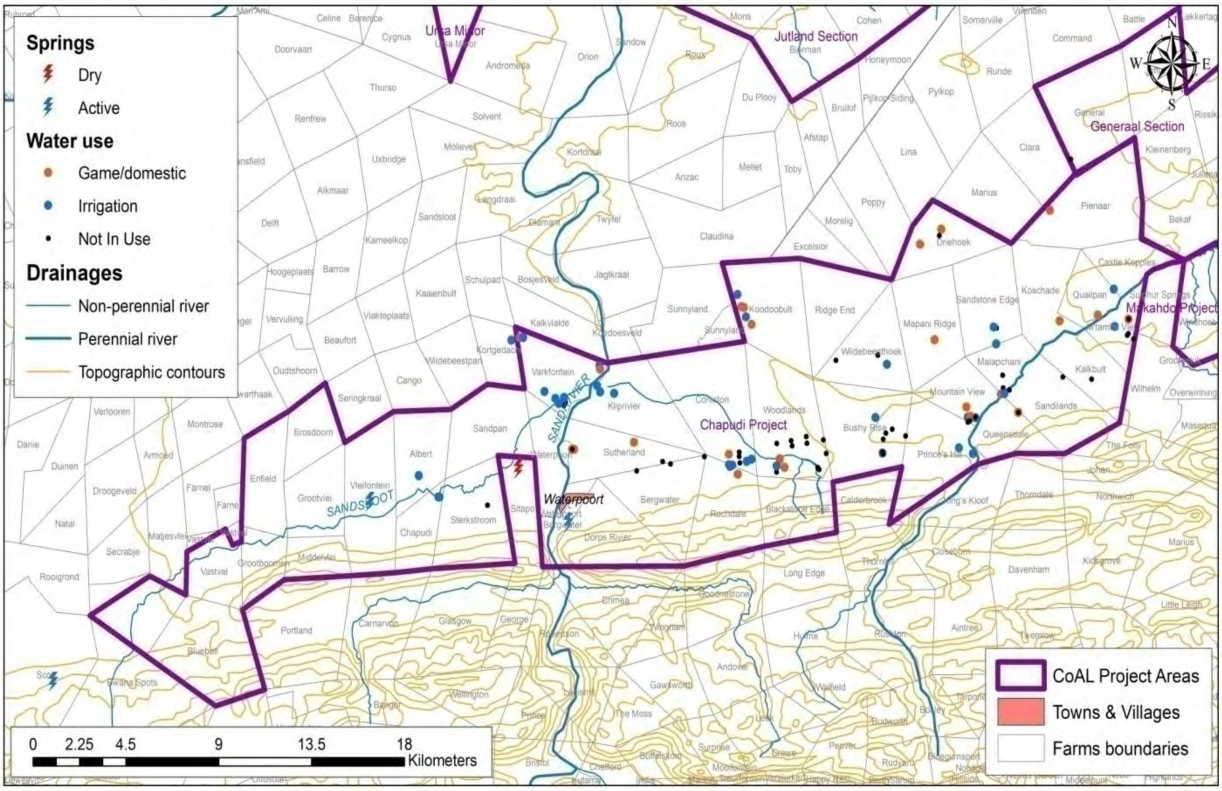


Figure 37: Borehole census localities

1.2.8.2 Piezometry and Groundwater Flow

If the water table is undisturbed, the groundwater surface tends to mimic a subdued form of the topography. Water levels measured during the hydrocensus revealed water levels ranging from 0 to in excess of 50 mbgl. The water level data was colour coded according to set of piezometric height ranges from which a piezometric contour map was drawn (Figure 38).

The map shows that the water table approximates the topographic surface. Cones of depression are visible on Secrabje, Sandilands, Wildebeesthoek, Coniston and Woodlands. Considerable groundwater development has occurred since 2005 and no doubt the piezometric surface has changed considerably since. The map shows numerous isolated highs (Varkfontein) and lows due to the 7 year difference in time between the different data sets, but also the confined character of the layered aquifers of the Karoo strata.

Springs occur where the water table intersects the surface, usually along some structure. The Moleletsane River appears to have its' origin in a spring on the farm Bwana Spots to the west of the project. The Zoutpan Salt Mine was also historically fed by springs. A spring at Luna Spa (see Figure 37) existed on the farm Sitapo but has dried up probably after irrigation started. From google images springs appear to exist all along the foot of the Soutpansberg Mountain.

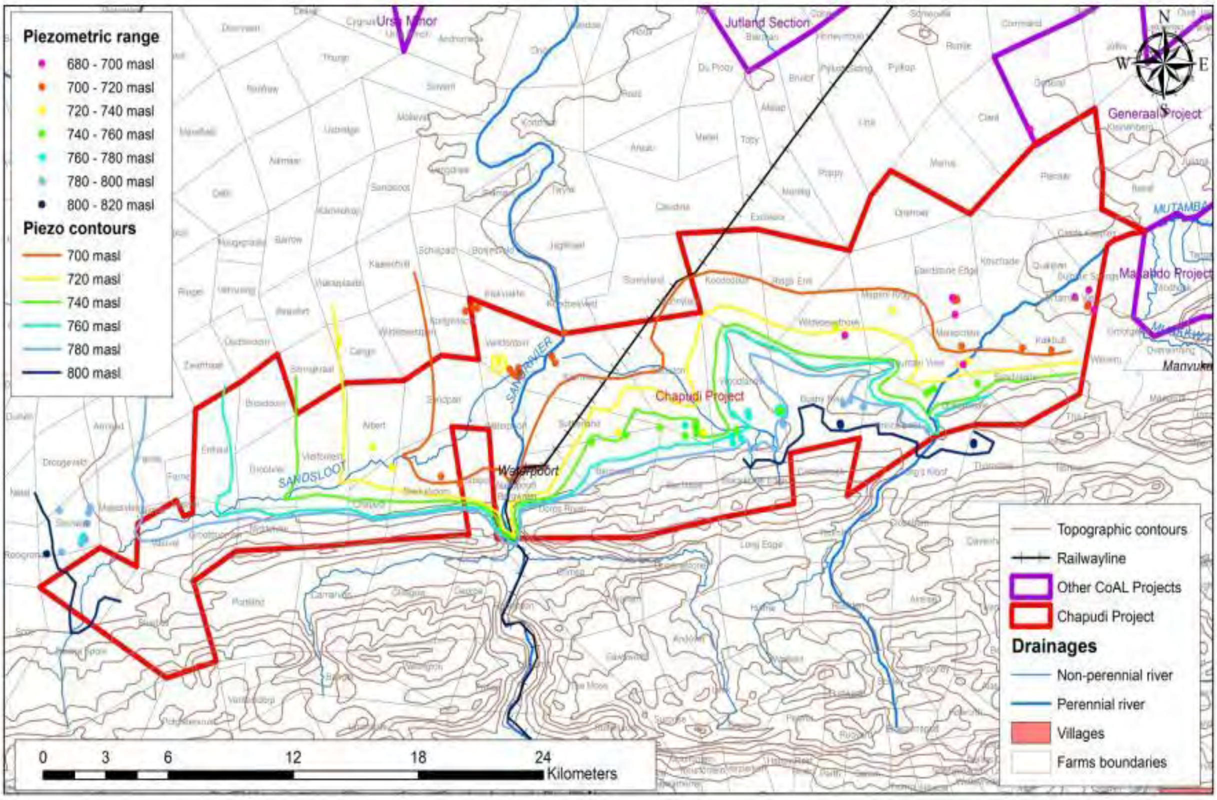


Figure 38: Piezometric contour map showing general groundwater flow direction

1.2.8.3 Impact of Regional Geology on the Hydrogeology of the Project Area

Refer to Section 2.1 that describes the regional geology in detail.

The Soutpansberg Group rocks form a mountain range with shallow soil resulting in higher recharge. This is the main recharge zone of the regional aquifer. Consequently, groundwater in this aquifer is relatively fresh. Zones of high transmissivity occur where the Karoo strata rocks are down faulted against the Soutpansberg quartzite's by East – West striking fault structures. These include the brittle coal horizon, sandstone formations such as the Fripp and Klopperfontein Formations, dolerite sills and the underlying Soutpansberg quartzites and volcanics. This water is exploited by irrigation farmers along the base of the mountain and along the Sand River.

Groundwater derived from direct recharge within the Karoo strata is generally more saline and as it flows northward, it becomes progressively more saline. The structural link between with the Karoo strata and the Soutpansberg result in differing water levels and chemistry in boreholes in close proximity with one another.

North of the Karoo strata, across the Tshipise fault, groundwater in the Limpopo Mobile Belt gneisses is also replenished by local recharge and is less saline. Groundwater in this regional aquifer conforms to the regional topographic gradient and is drained through the E-W regional faults of the Tshipise fault system.

Groundwater is also drained by evapotranspiration and numerous springs

1.2.8.4 Groundwater Quality

Groundwater quality is dependent on the concentrations of soluble salts and the residence time of water within the host rock. Water derived from secondary aquifers in the area can vary considerably. Good quality groundwater can be found in the quartzites and lavas of the Soutpansberg strata. Moderate to brackish water can be found in the Nzhelele shale and the lower Karoo strata. The Bosbokpoort formation marks a climatic change to increasing aridity which culminates in the aeolian sands of the Tshipise Member of the Clarens formation. The sediments of the Bosbokpoort Formation to Red Rocks Member reflect the changing climate with a concurrent increase in salinity up the sequence. The Moleletsane River flows eastwards and along strike over these salt rich rocks resulting in elevated salinities in the alluvial and shallow fractured aquifers along its banks.

The chemistry of 19 data points were available from the SRK 2009 report and augmented by 7 from WSM Leshika baseline studies. The samples were analysed for pH, major elements and trace metals. The chemistry data is presented with reference to the Water Quality Threshold (WQT) according to DWA-SA Water Quality Guidelines for Rivers and Streams for the following water uses:

- Drinking water
- Agriculture-irrigation
- Agriculture-livestock

1.2.8.4.1 Macro chemistry

Table 28: DWA Water Quality Threshold Classification – Macro chemistry

Species	pH	E.C	TDS	NO_3	F	SO4	Cl	Ca	Mg	Na
Unit		mS/m	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Drinking	6.0 - 9.0	150	1000	6	1	400	200	150	100	200
Agriculture (irrigation)	6.5 - 8.4	40		5	2		100			70
Agriculture (livestock)			1000	100	2	1000	1500	1000	500	2000

A total of 26 hydro-census samples were analysed for pH and major and micro elements. The chemistry results are listed in the table below. Concentrations exceeding the WQT for any of the above uses are marked in red.

Table 29: Macro-chemistry from historical data

Species		pH	E.C	TDS	NO_3	F	SO_4	Cl	Ca	Mg	Na
Unit	date		mS/m	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Bushy Rise BH5	22/12/08	6.3-9.0	8.5-33	205	0.1-2.6	0.1-0.5	2.4-8.5	13-46	2.9-5.8	3.4-6.5	5.2-37
BH4	22/12/08	6.6-7.2	256-281	2030	2.3-12	0.2	52-91	672-915	144-248	98-109	134-160
Chapudi, BH21	2/02/09	6.1-6.6	11.-13	88	0.1-0.4	0.1-0.2	5.3-12	14-21	4.5-4.8	5.8-7.8	8.8-12
Chapudi, BH25	2/02/09	6.0-6.7	9.3-9.7	75	0.5-0.9	0.1-0.2	3.2-7.0	12.-16	3.9-16	4.1-5.9	6.3-8.3
Chapudi, BH26	2/02/09	7.2-8.1	300-1820	11600	7.0-124	0.1-0.5	140-590	820-6220	137-223	86-461	360-3540
CON-4	15/02/13	7.0	38.7	251.6	<1.4	0.14	7.46	15.4	38.32	19.23	13.03
Coniston, BH9	22/12/08	7.1-8.3	37-43	270	0.2-4.5	0.1-0.2	4.8-18	19-24	33-40	17-23	
D. Rivier, BH12	22/12/08	5.8-6.3	11	56	2.3-2.7	0.1	1.8-4.0	11.-12	4.9-5.5	4.4-5.2	5.7-6.7
K.rivier, BH10	22/12/08	7.2-7.7	174-191	1200	0.1-1.0	0.4-0.7	1.8-4.8	214-254	74-91	45-53	199-246
K.rivier, BH13	22/12/08	8.4-8.7	118-121	820	0.1-0.7	2.2-2.7	1.4-4.6	121-171	1.8-4.7	1.2-3.8	211-292
K.rivier, BH14	22/12/08	7.6-8.2	408-517	4000	4.2-32	0.5-0.8	467-925	792-1026	99-150	142-190	446-743
M.chani, BH2	22/12/08	7.5-8.4	94-123	740	0.1-1	0.2-0.7	17-26	158-258	17-26	5.2-12	158-213
M.View, BH1B	22/12/08	7.7-8.1	200-207	1400	1.6-5.2	0.3-0.4	99-157	270-390	81-107	102-109	141-154
MV-1	30/11/12	7.9	110	634	<0.2	1.10	20	191	23	13	199
MV-2	11/12/12	7.5	196	1266	3.50	0.60	130	313	87	112	151
Rdale, BH8A	22/12/08	7.0-8.2	27-44	292	0.2-3.5	0.1-0.2	2.9-20	17-30	30-38	17-21	12.-14
S Edge, BH3	22/12/08	7.3-7.8	148-178	1090	0.1-0.3	0.6-1.0	81-102	262-346	84-115	32-76	105-181
S. land, BH17	22/12/08	7.9-8.3	210-299	1770	2.7-11	0.9-1.1	137-152	367-591	36-74	63-102	294-333
S.stroom, BH22	2/02/09	5.7-6.3	6.1-6.5	46	0.4-2.4	0.1-0.2	0.8-2.4	7.4-10	2.6-10	2.1-3.1	3.3
SAND-1	30/11/12	7.1	337	2056	0.70	0.80	233	721	98	182	329
SAND-2	30/11/12	7.9	95.6	540	<0.2	0.80	21	141	31	34	124
SAND-3	30/11/12	7.6	41.7	252	0.40	0.30	<5	53	18	18	47
BH20C	2/02/09	8.0-8.5	81-83	540	0.1-2.3	0.6-0.8	2.9-8.3	84-116	7.0 -25	3.6-5.4	134-175
W.poort, BH11	22/12/08	6.2-6.5	75-163	980	0.3-11	0.1	34-62	222-455	26-64	29-71	51-147
Wlands, BH6C	22/12/08	7.6-8.1	98-120	760	2.8-7.7	0.3-0.5	28-60	139-197	32-45	28-36	114-161
WILD-1	30/11/12	6.7	49.9	286	<0.2	0.40	18	55	31	20	36

The study area is characterized by a variety of groundwater quality ranges reflecting the salt content of different rock types in which the water occurs. A contour map of the TDS data against the geology as background is provided below. Samples with elevated salts are associated with local recharge to the Karoo strata and the better quality water is derived from the Soutpansberg Mountain via structure. Water quality within the Moleletsane alluvium has particularly high TDS values indicating leaching of salts from the upper Karoo strata which recharge the alluvium.

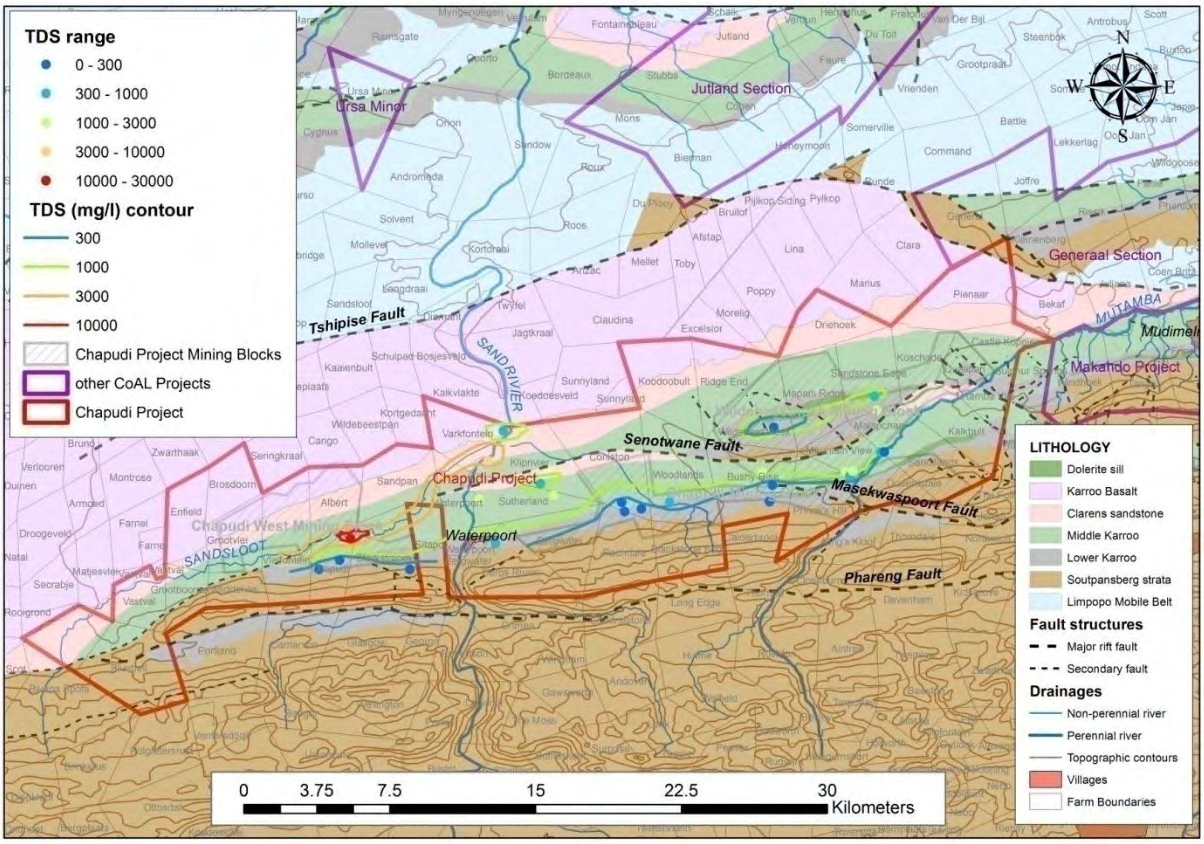


Figure 39: TDS contour map with geology

1.2.8.4.2 Micro chemistry (Trace metals)

Table 30: DWA Water Quality Threshold Classification – Micro chemistry

Element	Al	As	B	Cd	Co	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	V	Zn
Unit	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Drinking	500	50		5		50	1300		400			10	50	100	5000
Agriculture(irrigation)	5000	100	500	10	50	100	200		20	10	200	200	20	100	1000
Agriculture(livestock)	5000	1000	5000	10	1000	1000	500		10000	10	1000	100	50	1000	20000

Concentrations exceeding the WQT for any of the above uses are marked in red. It must be noted that concentrations exceeding the WQT are often below the detection limit for some elements.

Table 31: Micro chemistry from historical data and baseline studies

Element	Al	As	B	Cd	Co	Cr	Cu	Fe	Mn	Mo	Ni	Pb	Se	V	Zn
Unit	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Brise-BH1								<0.01	0.12						
Brise-BH2								<0.01	0.02						
Brise-BH3								<0.01	0.43						
Brise-BH5	<0.009	<0.010			<0.001	<0.003	0.01	<0.001	0.15		0.004	<0.001	0.03	0.01	0.13
Brise-BH4	<0.009	<0.010		0.02	<0.001	0.009	0.01	0.09	0.08		0.005	<0.001	0.2	0.02	0.22
Chap-BH21	<0.009	<0.010			<0.001	<0.003	0.03	0.04	0.23		<0.003	0.005	0.015	0.006	0.72
Chap-BH25	<0.009	<0.010		<0.010	<0.001	<0.003	<0.002	<0.001	0.11		<0.003	0.005	0.01	0.005	0.025
Chap-BH26	<0.009	<0.010		<0.010	0.009	<0.003	<0.002	<0.001	0.31		0.004	0.005	0.61	0.04	0.13
Con-4								<0.001	0.22						
Con-BH9	<0.009	<0.010		0.009	<0.001	<0.003	<0.002	<0.001	0.07		<0.003	0.005	0.04	0.01	<0.003
Klip-BH10	<0.009	<0.010		<0.010	0.007	<0.003	<0.002	0.02	0.12		<0.003	0.005	0.15	0.01	0.14
Klip-BH13	<0.009	0.09		0.007	<0.001	0.005	<0.002	<0.001	<0.001		<0.003	0.005	0.11	0.009	<0.003
Klip-BH14	<0.009	<0.010		0.06	0.01	0.003	<0.002	<0.001	0.08		<0.003	<0.001	0.28	0.06	0.15
Mal-BH2	<0.009	<0.010		<0.010	<0.001	<0.003	<0.002	<0.001	0.200		<0.003	0.005	0.16	0.02	0.01
Mv- BH1B	<0.009	0.12		0.005	<0.001	<0.003	<0.002	<0.001	0.1		<0.003	0.005	0.25	0.04	0.08
MV-1	<0.010	<0.010	0.257	<0.005	<0.025	<0.025	<0.025	176	<0.025	<0.025	<0.025	<0.020	<0.020	<0.025	0.044
MV-2	0.0145	<0.010	0.326	<0.005	<0.025	<0.025	<0.025	<0.001	0.036	<0.025	<0.025	<0.020	<0.020	<0.025	<0.025
Roch- BH8A	<0.009	<0.010		0.007	0.005	<0.003	0.002	<0.001	0.150		<0.003	0.005	0.04	0.001	0.8
Sedge- BH3	<0.009	<0.010		0.01	0.002	<0.003	<0.002	<0.001	0.680		0.005	0.005	0.660	0.02	0.26
Sand-BH17	<0.009	<0.010		0.01	<0.001	<0.003	<0.002	<0.001	<0.001		<0.003	<0.001	0.510	0.05	0.04
Sterk-BH22	<0.009	<0.010		0.02	<0.001	<0.003	0.140	0.02	0.03		<0.003	<0.001	0.015	0.006	0.03
SAND-1	0.0162	<0.010	0.629	<0.005	<0.025	<0.025	<0.025	0.446	0.038	<0.025	<0.025	<0.020	<0.020	<0.025	<0.025
SAND-2	<0.010	<0.010	0.312	<0.005	<0.025	<0.025	0.058	0.656	0.069	<0.025	<0.025	<0.020	<0.020	<0.025	0.245
SAND-3	0.0512	<0.010	0.168	<0.005	<0.025	<0.025	<0.025	4.41	0.243	<0.025	<0.025	<0.020	<0.020	<0.025	0.031
Vark-BH20C	<0.009	<0.010		0.006	<0.001	<0.003	<0.002	0.05	0.1		<0.003	0.005	0.07	0.008	0.007
Wpoort-BH11	<0.009	<0.010		0.01	0.03	0.01	0.02	0.26	0.25		0.07	0.005	0.12	0.01	0.59
WILD-1	0.01	<0.010	0.223	<0.005	<0.025	<0.025	<0.025	0.03	0.12	<0.025	<0.025	<0.020	<0.020	<0.025	<0.025
Woo-BH6C	<0.009	<0.010		0.01	0.006	<0.003	<0.002	<0.001	0.31		0.007	0.005	0.13	0.005	0.13

The table indicates elevated cadmium and selenium in certain boreholes in the study area. The manganese content is above the limit for irrigation purposes in most samples but is not abnormally high for groundwater. The higher Iron in some samples is probably associated with the Soutpansberg Group rocks.

1.2.8.5 Groundwater Use

Groundwater use figures were derived from various sources i.e. estimates of cultivated land areas using google images from January 2009 to determine cleared lands and evaluating irrigated areas (Figure 40), verbal communication with farmers, the registered use (WARMS data) and the various report estimates.

The irrigation use was estimated by using an irrigation application of 7 880 m^3/ha/annum. Irrigation use is mainly on the farms Bergwater, Enfield, Waterpoort, Koodoobult, Varkfontein, Coniston, Albert, Princes's Hill, Kliprivier, Wildebeesthoek, Bushy Rise and Vleifontein.

Chapudi MRA area is about 40 375 ha or 403 750 000 m^2. Average annual recharge over the area is taken as 4.7mm/annum (see chapter 6.4) or 0.0047m/annum. Therefore average annual recharge volume is 403 750 000 X 0.0047 = 1 897 625 m^3 or 5200m^3/day. This is less than half of what irrigation is abstracting hence existing drawdown cone as a result of irrigation.

Of the other groundwater uses the relatively high use on the farms Sandstone Edge, Castle Koppies and M'tamba Vlei is mainly for aesthetic purposes i.e. irrigation of gardens around the lodges and filling of water holes.

Groundwater use within the Chapudi Project area is summarized in Table 32.

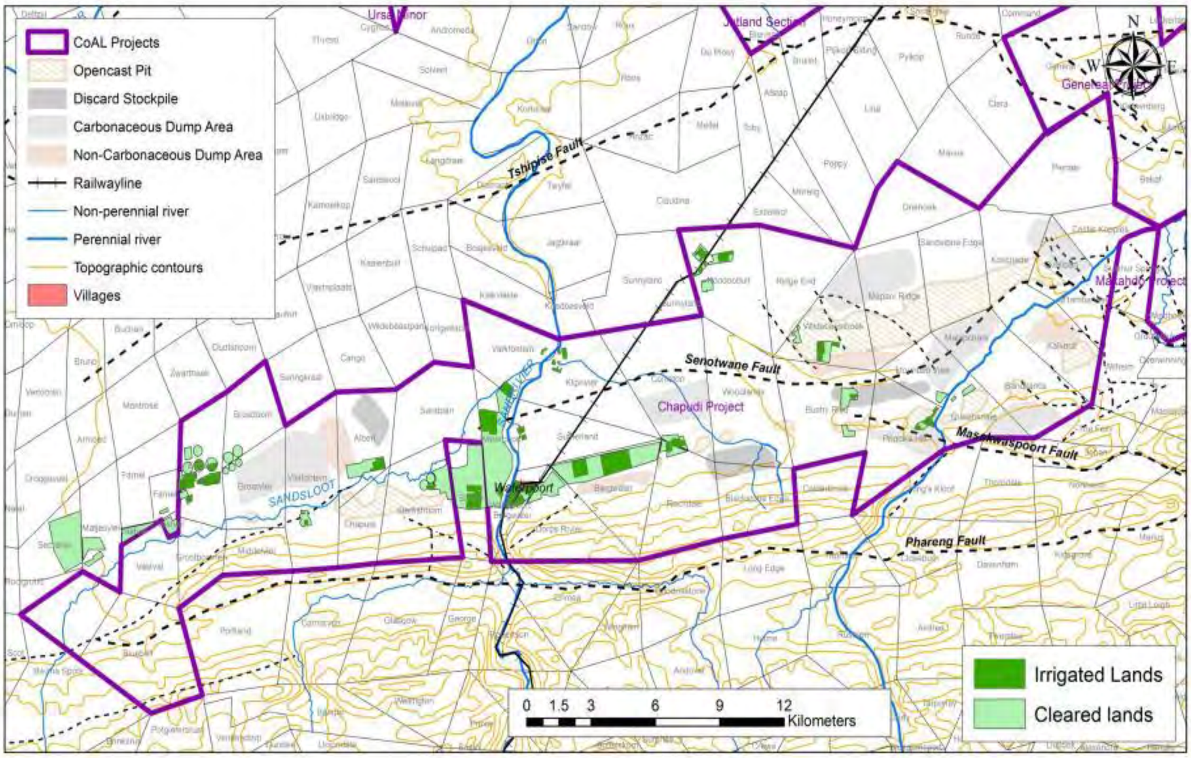


Figure 40: Irrigation areas

Table 32: Groundwater use per farm

Owner/Business	Farms	Total farm unit area (ha)	Census data- current pump equipment capacity (Kl/day)	Cleared area measured off Google earth (ha)	Irrigated area estimate (ha)	Ground water use - irrigation area in Kl/day	Groundwater use - other Kl/day	WARMS Registration Volume (Ml/ annum/ farm	Overall Estimated Ground water Use (Ml/ annum)
	Castle Koppies	659	130	0	0	0	130	0	
	Kalkbult	915	0	0	0	0	0	3	
	Koschade	1154	43	0	0	0	43	6	
Ekland Safaris	M'tamba Vlei	547	282	0	0	0	282	0	182
	Pienaar	1865	14	0	0	0	14	0	
	Qualipan	606	9	0	0	0	9	3	
	Sandilands	1262	22	0	0	0	22	0	
	Malapchani	500	8	0	0	0	8	0	
Bertha Trust	Sandstone Edge	1273	376	0	0	0	376	0	142
	Mapani Ridge	1411	6	0	0	0	6	0	
L Erasmus	Mountain View	687	205	16	0	0	10	0	4
Taylor/Smith etc	Princes's Hill	1371	296	30	14	296	0	0	108
Unknown	Queensdale	737	5	16.7	0	0	5	0	2
	Albert	1063	410	40	19	410	0	168	150
J.Pauer	Chapudi	666	266	0	0	0	7	30	3
	Sterkstroom	1531	No data	16	0	0	5	715	2
	Bergwater	1318	No data	420	159	3439	0	870	1255
Fanie Steyn	Bergwater-2	387	No data	80	0	0	14	5	5
	Dorprivier	1416	No data	0	0	0	5	442	2
Unknown	Brosdoorn	779	No data	36	0	0	5	0	2
HML Boerdery	Coniston	1954	552	40	25	540	7	72	200
Unknown	Enfield	1038	No data	194	110	2375	0	0	867
Unknown	Grootvlei	1003	No data	22	0	0	7	648	3
Knoetze/Burchill	Kliprivier	1484	193	91	9	194	0	45	71
Fick	Koodoobult	1584	936	150	43	928	8	321	342
Unknown	Rochdale	1361	5	45	0	0	5	284	2
JJB Knoetze	Sutherland	1072	11	20	0	0	11	57	4
MJ Scheepers	Varkfontein	1012	879	120	40	864	15	921	321
Unknown	Waterpoort	772	No data	453	100	2159	0	790	788
Piet Espag	Wildebeeshoek	1224	168	78	8	173	0	4	63
	Blackstone Edge	1019	11	0	0	0	11		
Brink Schlesinger	Bushy Rise	1690	562	70	6	121	0	32	50
	Woodlands	1850	5	0	0	0	5		
Unknown	Bluebell	1836	No data	0	0	0	5	0	2
Unknown	Bwana Spots	858	No data	0	0	0	5	0	2
Unknown	Driehoek	1032	No data	0	0	0	5	0	2
Unknown	Grootboomen	629	No data	0	0	0	5	0	2
Unknown	Middelvlei	581	No data	0	0	0	5	100	2
Unknown	Ridge End	1225	No data	0	0	0	5	0	2
Unknown	Sandpan	1300	No data	0	0	0	5	0	2
Unknown	Vastval	777	No data	84	0	0	5	0	2
Unknown	Vleifontein	1670	No data	28	5	106	0	0	39
	Totals	47117		2050	537	11604	1050		**4619**

The total groundwater abstraction for the Chapudi Project mine application area is estimated at a maximum of 4 619 Ml per annum.

1.2.8.6 Regional Groundwater Flow

To determine the orientation of groundwater flow on a regional scale, water levels were available from 965 boreholes. Historic data from 657 boreholes was obtained from the National Groundwater Database (NGDB), and the remainder was collected by hydrocensus during the study for Makhado Colliery Project and the present study. These data were converted to absolute water levels by determining borehole elevation from Google Earth. The MODFLOW model (Section 6, ANNEX-3), was utilised to generate current water levels as a piezometric map (Figure 41). The model was also utilised to generate a map of water level under virgin conditions (Figure 42).

Regional groundwater flow is oriented northeast towards the Limpopo River (Figure 42). Flow volumes are extremely low due to the low permeabilities and low recharge, especially in the northern half of the catchment underlain by the Limpopo Mobile Belt and overlain by alluvium.

In the south, where the catchment is underlain by Karoo and Soutpansberg rocks and where mining is proposed, a local northward hydraulic gradient is present due to high recharge in the Soutpansberg Mountains. A significant cone of depression exists around the Sand River directly north of the Soutpansberg Mountains due to the large scale irrigation from groundwater (Figure 41). Quantifying abstraction is problematic, since not all the lands are irrigated every year. Irrigation was estimated from lands identified as being irrigated on the most recent Google Earth images, i.e. 2009.

Under natural conditions, groundwater drains via localised springs, as base flow to the perennial tributaries flowing from the Soutpansberg, and by evapotranspiration by riverine vegetation along the main river channels.

Groundwater is of good quality in the Soutpansberg rocks, which is the main recharge zone; however, increased salinity occurs northwards as groundwater flows through saline Karoo sediments, accumulating salts. Low recharge rates in the drier terrain north of the Soutpansberg also results in low recharge rates to dilute these salts. The movement of groundwater passing through saline deposits of the Karoo rocks, and subsequent evapotranspiration by riverine vegetation, causes a rapid salt accumulation northward, with a peak salt load along the fringes of the channels lying over Karoo rocks, like the Mutamba, the Brak and Sand Rivers, resulting in poor natural water quality.

The Mufungudi entering Nzhelele dam, the Kandanama River a tributary of the Mutamba River, entering the catchment in the south along the N1 highway, and the upper reaches of the Mutamba emerging from the Soutpansberg are perennial, but lose water to groundwater as they flow out of the Soutpansberg, becoming ephemeral. This water is abstracted by boreholes for irrigation on the farms Windhoek, Grootgeluk and Overwinning along the Kandanama, and by irrigation boreholes along the Sand River on Sterkstroom, Sitapo, Sutherland and Waterpoort, or is utilized by riparian vegetation. Very little surface runoff is believed to recharge the regional aquifers north of the Soutpansberg, since high salinity levels in the Karoo aquifers suggest it is not recharged by fresh water from the river. In comparison, groundwater is of good quality in the Karoo aquifer along the southern tributaries such as the Kandanama River, where river losses take place. Isotope studies conducted during the Makhado Colliery Project investigation confirm this.

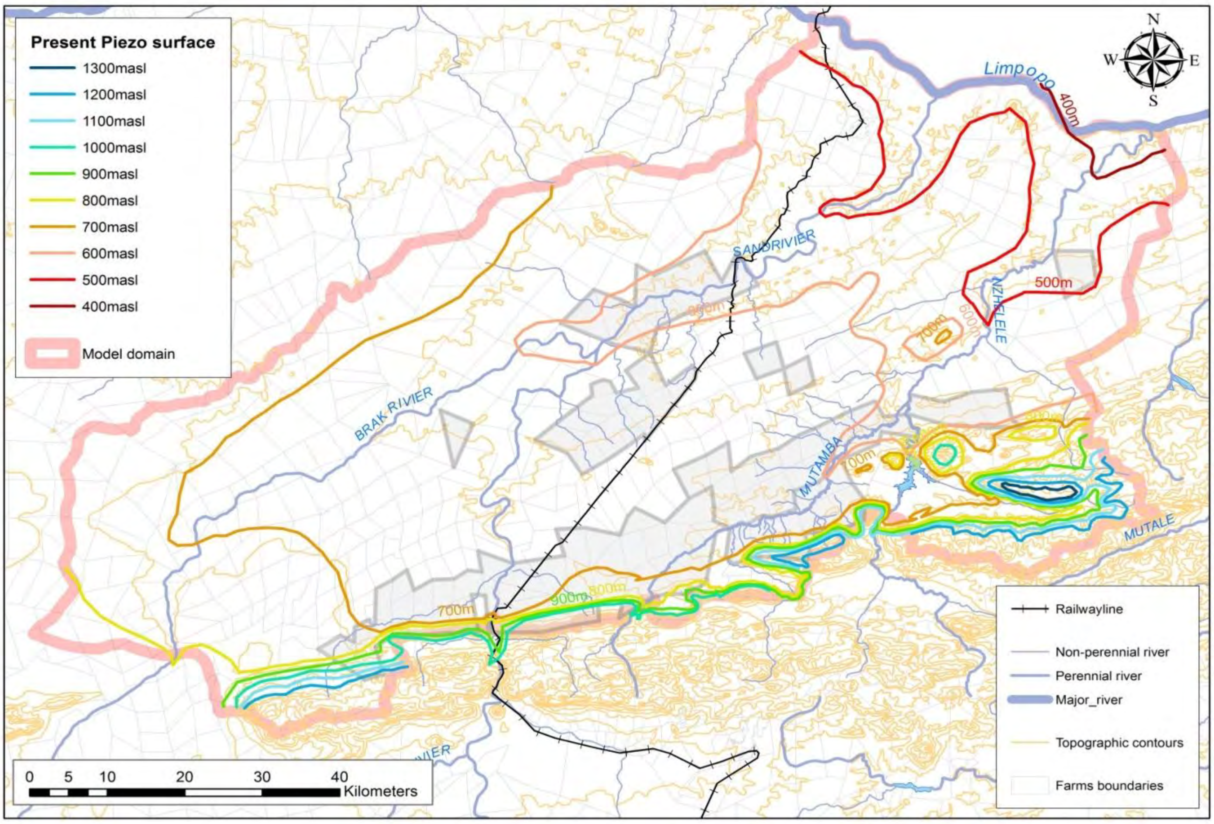


Figure 41: Steady state water levels under current conditions (mamsl)

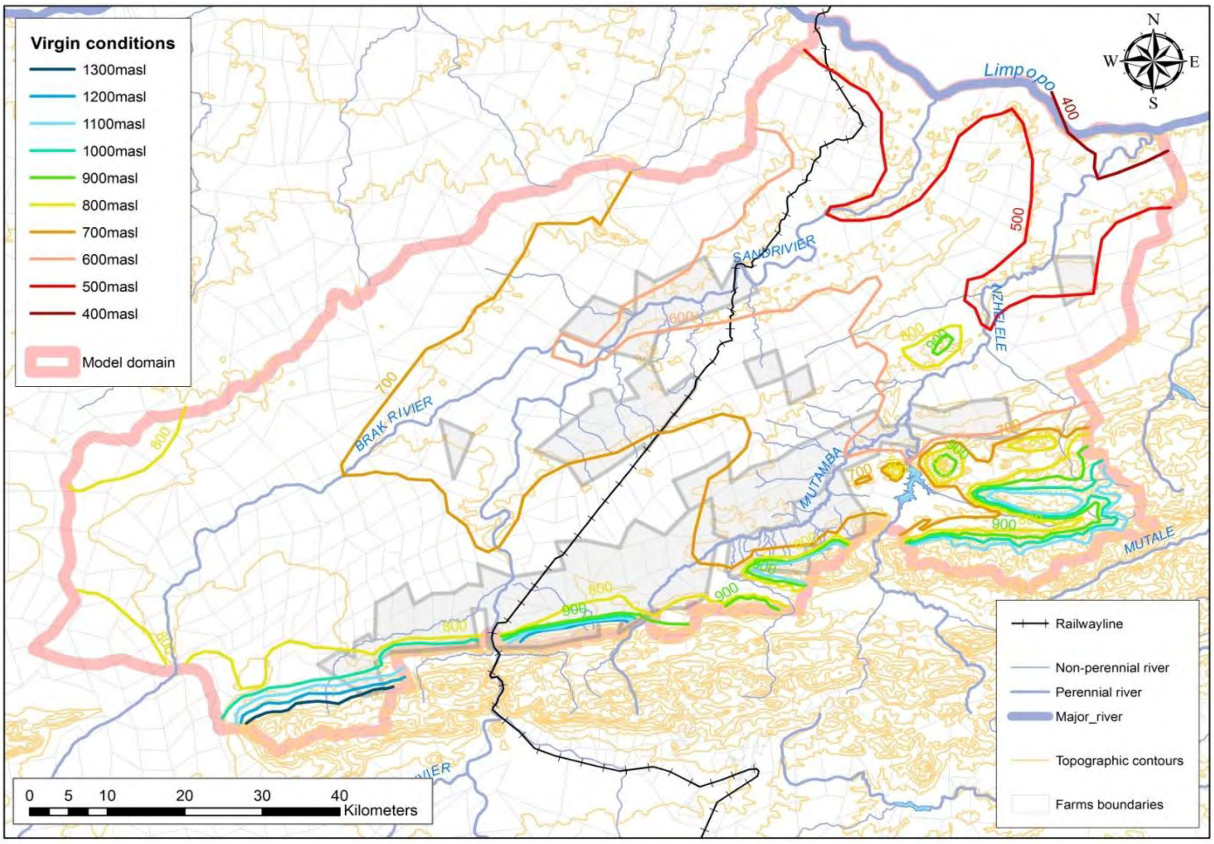


Figure 42: Steady state water levels under virgin conditions (mamsl)

1.2.9 AIR QUALITY

1.2.9.1 Baseline Air Quality

A detailed emissions inventory for the Chapudi Project area is not available. Based on satellite imagery and the baseline studies carried out by SRK Consulting, the following sources of air pollution have however been identified. These sources are important when considering cumulative impacts on air quality in the region:

- Domestic fuel burning;
- Agricultural activities;
- Unpaved roads; and
- Veld fires.

1.2.9.1.1 Domestic fuel burning

The surrounding area can be classified as predominantly rural. The use of domestic fuels is anticipated in low income households and communities such as the Waterpoort Town, Soja Village, Mamvuka Village, Mudimeli and Manyii for cooking and space heating. The use of coal, wood and paraffin for both cooking and heating purposes is a common medium used, as the resource is cheap and easily attainable.

Biomass and coal smoke contain a large number of pollutants and known health hazards, including criteria pollutants such as Particulate matter, Carbon monoxide, Nitrogen dioxide, Sulphur dioxide (mainly from coal) as well as formaldehyde, and polycyclic organic matter, including carcinogens such as benzo[a]pyrene (Ezzati and Kammen, 2002).

The combustion of coal is an incomplete process which results in the emission of carbon monoxide, methane and nitrogen dioxide. 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).

Even in electrified areas, households make use of domestic fuels due to high electricity costs and due to continued traditional use of such fuels.

1.2.9.1.2 Agricultural activities

Agricultural activity can be considered a significant contributor to particulate emissions, although tilling, harvesting and other activities associated with field preparation are seasonally based. 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. Vegetables and fruits such as tomatoes, pepper-dew, sweet corn, water melon, guavas, citrus, butternut, mangos and lucerne are produced in the Chapudi Project area under irrigation. The activity associated with irrigation farming includes the application of pesticides, herbicides, weed control, fertilizers, harvesting activities, phosphate and nitrogen addition.

Little information is available with respect to the emissions generated due to the growing of crops. The activities responsible for the release of particulates and gases to atmosphere would however include:

- Particulate emissions generated due to wind erosion from exposed areas;
- Particulate emissions generated due to the mechanical action of equipment used for tilling and harvesting operations;
- Vehicle entrained dust on paved and unpaved road surfaces;
- Gaseous and particulate emissions due to fertilizer treatment; and
- Gaseous emissions due to the application of herbicides and pesticides.

1.2.9.1.3 <u>Unpaved roads</u>

A concern resulting from unpaved road in the Chapudi Project area is fugitive dust emissions and particulate matter. Dust is transport by the prevailing wind condition. When vehicles travel on unpaved roads, the force of the wheels on the road surface causes the pulverisation of surface materials. Particle are lifted and dropped from the rolling wheels and the road is exposed to stronger air currents in turbulent shear with the surface.

1.2.9.1.4 <u>Veld fires</u>

Limpopo has a high risk of veld fires. A veld fire is defined as 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 a 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).

The major pollutants from veld burning are PM, CO and VOCs. Nitrogen oxides are emitted at rates of from 1 to 4 g/kg burned, depending on combustion temperatures. Emissions of SOx 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).

1.2.9.2 Ambient Monitoring

SRK Consulting was commissioned by Chapudi Coal (Pty) Ltd to undertake baseline monitoring for the proposed mining area. Dust fallout sampling and gas monitoring for sulphur and nitrogen dioxide was conducted during 2008-2009 on 10 locations expanding throughout the Chapudi and Wildebeesthoek Sections (Figure 43 and Figure 44 respectively).

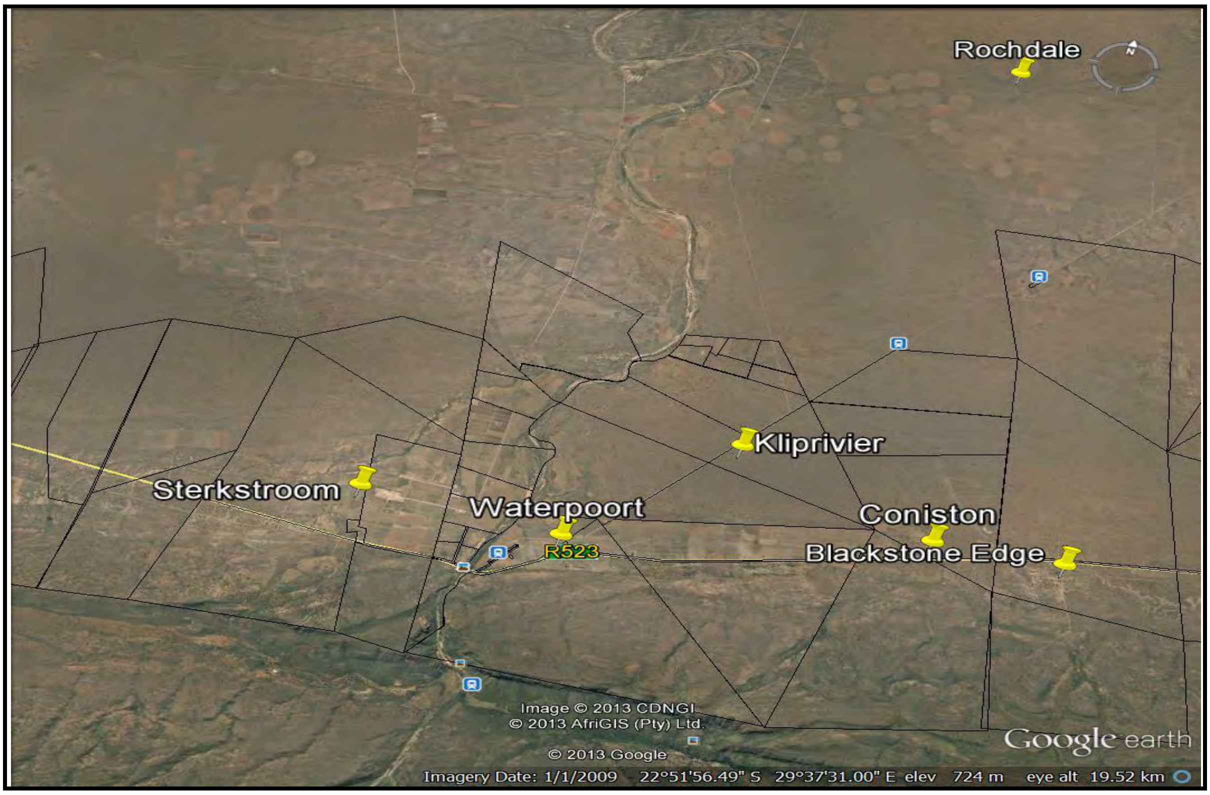


Figure 43: Ambient monitoring points at Chapudi Section (SRK, 2009)

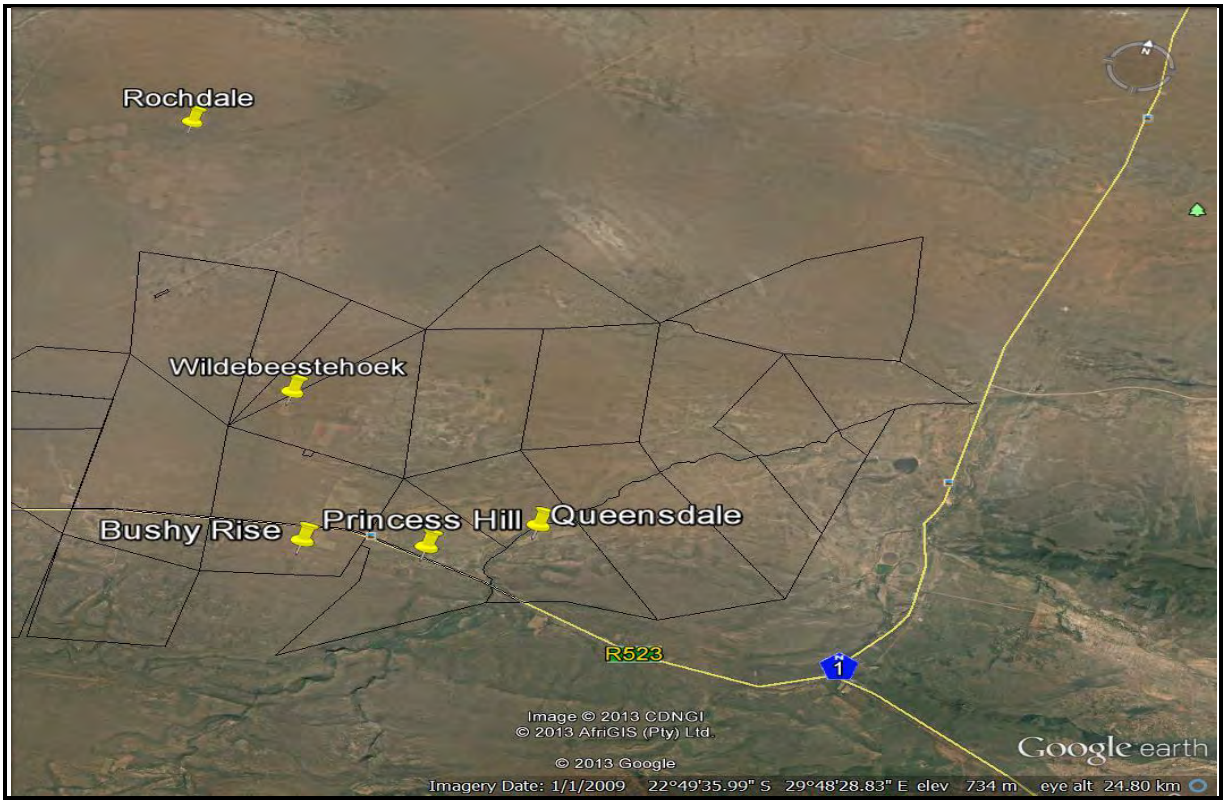


Figure 44: Ambient monitoring points at Chapudi Section (SRK, 2009)

1.2.9.2.1 Dust fallout monitoring

Figure 45 below illustrates the dust fallout monitoring conducted by SRK Consulting during the July 2008 to June 2009 monitoring period. Majority of the dust fallout results remained within the residential limit of 600 mg/m2/day. The following sites exceeded the residential limit of 600 mg/m^2/day:

- Kliprivier – 735 mg/m^2/day (June '08), 794 mg/m^2/day (Oct '08), 753 mg/m^2/day (Nov '08) and 748 mg/m^2/day (Feb '09).
- Waterpoort – 963 mg/m^2/day (Aug '08) and 784 mg/m^2/day (Jun '09).
- Princess Hill – 623 mg/m^2/day (Dec '08).
- Wildebeestehoek – 806 mg/m^2/day (Sep '08), 719 mg/m^2/day (Feb '09) and 665 mg/m^2/day (Mar '09).

There were two exceedences of the 1200 mg/m^2/day non residential limit which occurred at the site Coniston with 1391 mg/m2/day and 1301 mg/m^2/day during the month of October and November respectively.

The activities contributing to the dust fallout in the area can arise from farming and agricultural activities as well as the action of vehicles on unpaved roads.

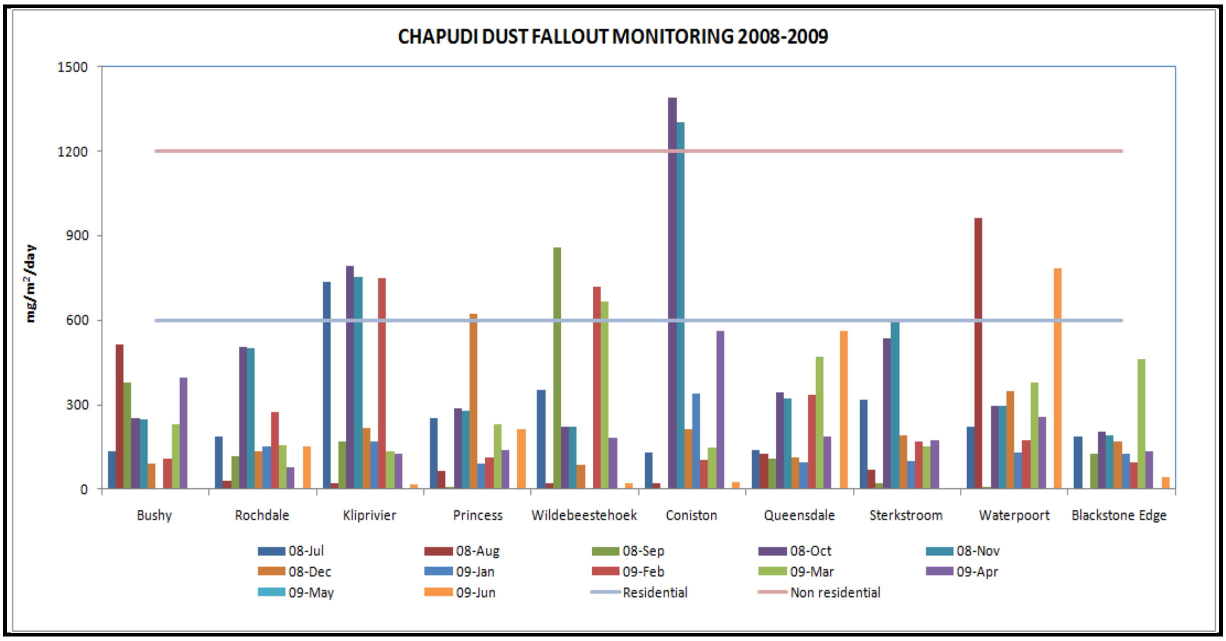


Figure 45: Dust fallout monitoring results for the Chapudi project

1.2.9.2.2 Gas monitoring

Gas monitoring was carried out by SRK consulting using Radiello passives. Table 33 and Table 34 show the concentration of So_2 and No_2 for the June 2008 to June 2009 monitoring period.

Table 33: Sulphur dioxide concentration (µg/m^3) for the June 2008 – June 2009 monitoring period

Sites	Jun Jul' 08	Jul Aug' 08	Aug Sep '08	Sep Oct '08	Nov'08	Dec'08	Jan'09	Feb'09	Mar'09	Apr'09	May'09	Jun'09
Sterkstroom	0.01	0.2	0.04			0.01	0.14	0.06	0.03	0.04		0.061
Kliprivier	0.11	0.09	0.03	0.02	0.02	0.1	0.06	0.07	0.03	0.01		0.037
Waterpoort	0.11	0.07	0.02	0.02	0.02	0.1	0.05	0.01	0.03	0.02		0.135
Rochdale	0.13	0.09	0.03	0.04	0.02	0.12	0.06	0.04	0.05	0.02		0.073
Coniston	0.15	0.16	0.04	0.02	0.02	0.14	0.11	0.05	0.03	0.02		0.049
Blackstone	0.11	0.12	0.02	0.01	0.01	0.1	0.09	0.03	0.01	0.01		0.061
Bushy	0.14	0.11	0.02	0.02	0.02	0.13		0.03	0.03	0.02		
Queensdale	0.14	0.09	0.02	0.01	0.01	0.13	0.06	0.03	0.01	0.01		0.073
Princess		0.09	0.03	0.02	0.02	0.1	0.06	0.05	0.03	0.02		0.049
Wildebeesthoek		0.11	0.04	0.03	0.03	0.14		0.04	0.08	0.05		0.061
South African Standard	125	125	125	125	125	125	125	125	125	125	125	125

Table 34: Nitrogen dioxide concentration (µg/m^3) for the June 2008 – June 2009 monitoring period

Sites	Jun Jul' 08	Jul Aug' 08	Aug Sep '08	Sep Oct '08	Nov'08	Dec'08	Jan'09	Feb'09	Mar'09	Apr'09	May'09	Jun'09
Sterkstroom	0.01	0.01	0.03	-	-	0.01	0.01	0.02	0.02	0.02	-	0.004
Kliprivier	0.01	0.01	0.02	0.003	0.004	0.01	0.01	0.02	0.01	0.02	-	0.002
Waterpoort	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02	-	0.003
Rochdale	0.01	0.01	0.03	0.01	0.01	0.01	0.01	0.03	0.01	0.02	-	0.003
Coniston	0.01	0.02	0.03	0.01	0.01	0.01	0.01	0.02	0.01	0.01	-	0.002
Blackstone	0.01	0.02	0.02	0.001	0.001	0.01	0.01	0.02	0.002	0.02	-	0.002
Bushy	0.01	0.01	0.02	0.01	0.01	0.01	-	0.02	0.01	0.01	-	-
Queensdale	0.01	0.01	0.02	0.003	0.003	0.01	0.01	0.02	0.004	0.02	-	0.0005
Princess	-	0.01	0.03	0.004	0.004	0.01	0.003	0.02	0.02	0.02	-	0.002
Wildebeesthoek	-	0.01	0.02	0.01	0.01	0.01	-	0.02	0.02	0.02	-	0.002
South African Standard	200	200	200	200	200	200	200	200	200	200	200	200

1.2.9.2.3 Makhado ambient monitoring

The Makhado Project currently carries out dust fallout monitoring at three locations, Fripp, Windhoek and MCC. Figure 46 illustrates the dust fallout for the monitoring period of August 2010 – April 2013. The industrial limit of 1200 mg/m^2/day was exceeded at the MCC monitoring point during August 2012 (1254 mg/m^2/day). The domestic standard of 600 mg/m^2/day was exceeded at the MCC monitoring point on 7 occasions. The domestic standard of 600 mg/m^2/day was exceeded at the Windhoek monitoring point on 4 occasions. The Fripp monitoring point recorded no exceedences during the monitoring period.

There is a correlation between the Chapudi and Makhado dust monitoring concentrations. High dust fallout were noted during the winter and spring months. The predominant wind direction is south easterly. Chapudi project lies west of the Makhado monitoring sites.

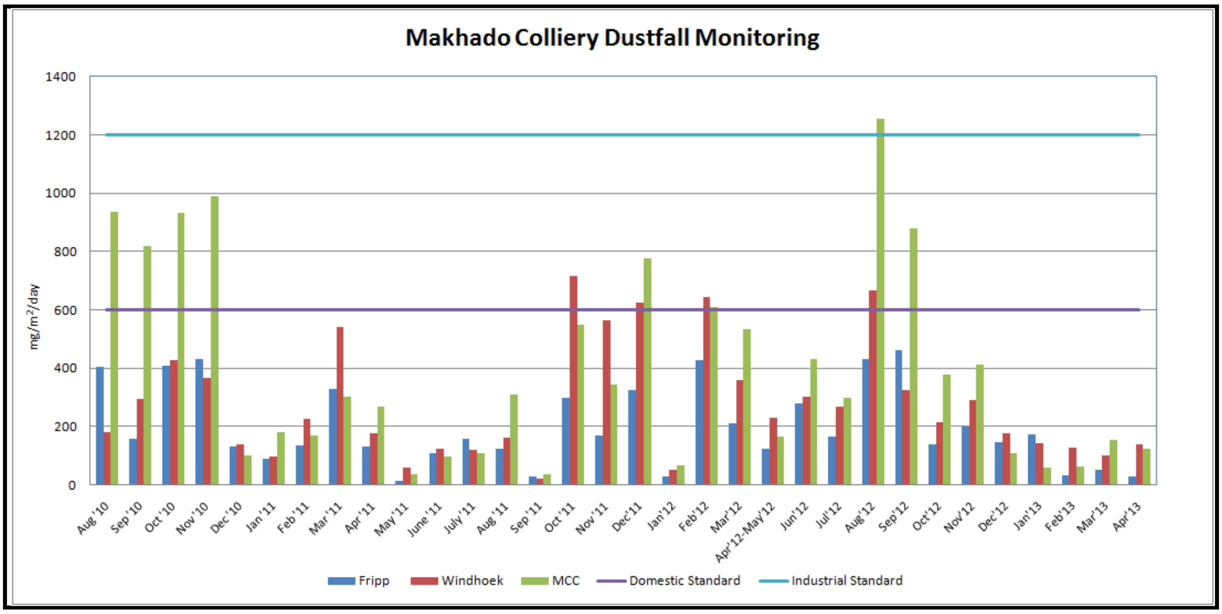


Figure 46: Makhado Colliery dust fallout monitoring Aug 10 – Apr 13 monitoring period

Ambient monitoring of Particulate Matter (PM) is carried out within the Mudimeli village using the Grimm and Davis monitoring equipment, which meets the quality standards of SANS (South African National Standards). Figure 47 below illustrates PM_{10} and $PM_{2.5}$ levels for the July 2012 to April 2013 monitoring period. Figure 48 below illustrates the predominant wind direction during the July 2012 to April 2013 monitoring period, mainly from the south eastern region. Variable levels of PM were experienced. The SANS standard of 120 µg/m^3 were exceeded on 5 occasions. There were no exceedences of the newly gazetted $PM_{2.5}$ standard of 65 µg/m^3.

Based on the dust fallout and PM monitoring data, it is evident that peak concentrations are highest during the winter months (June, July and August). Low concentrations are experienced during the summer months (December, January and February). Dust suppression techniques for example continuous watering should be considered during the dry and windy seasons in order to limit the impacts of dust fallout within the area.

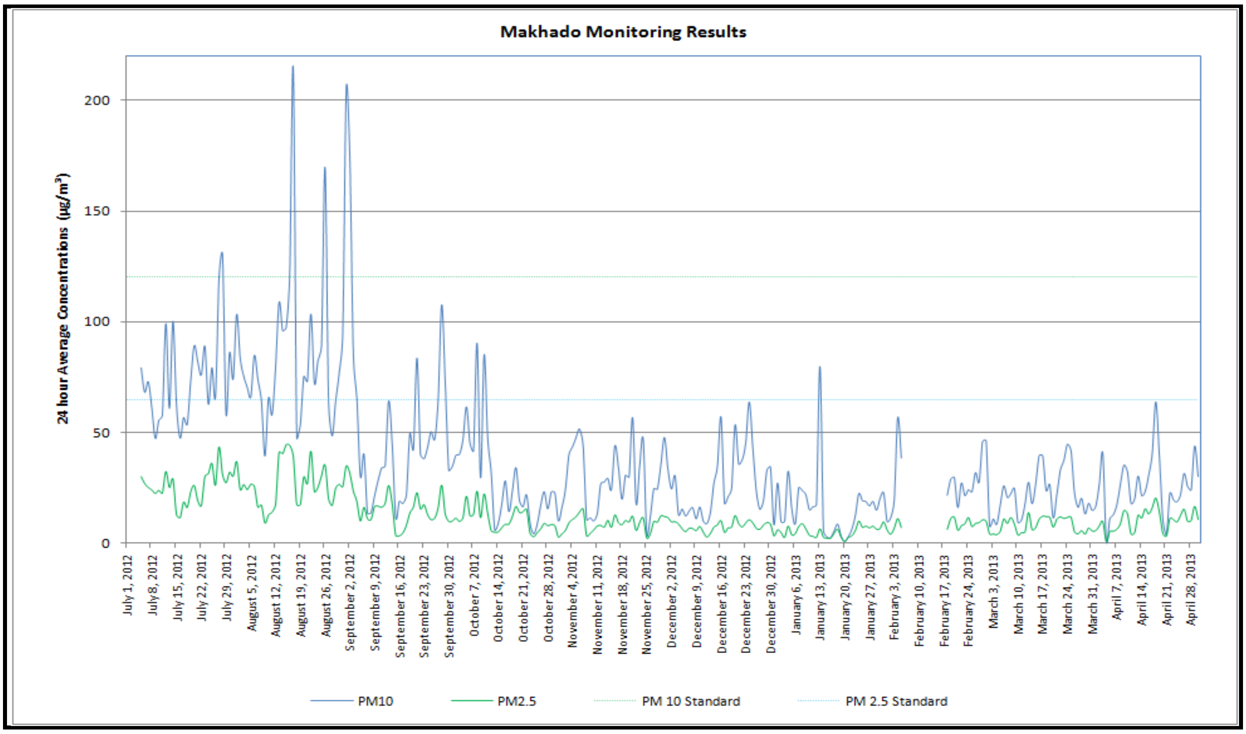


Figure 47: Makhado PM monitoring results July 2012 – April 2013

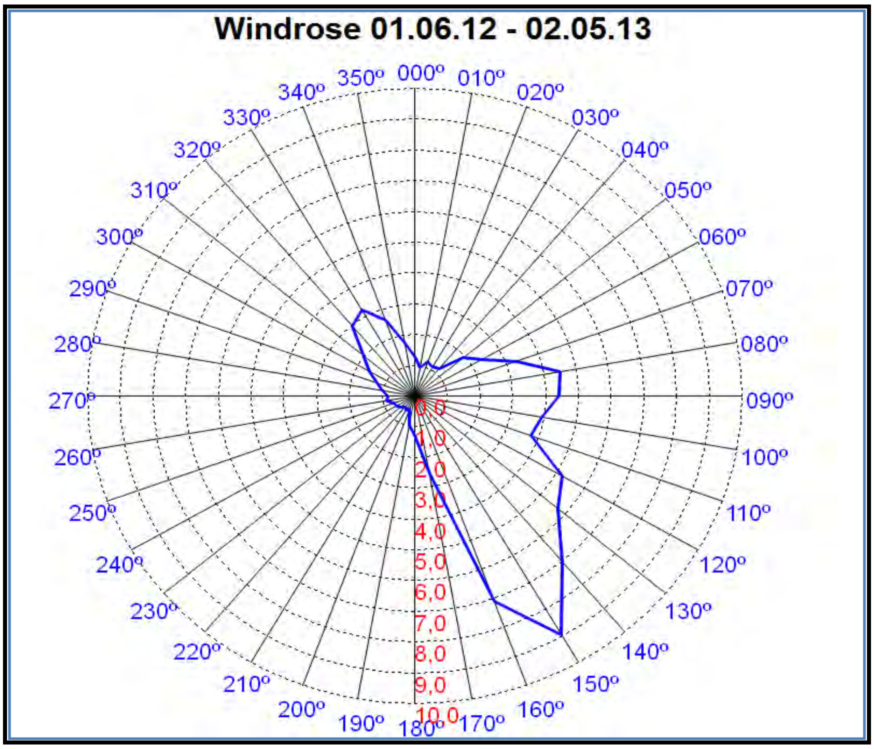


Figure 48: Period wind rose for the Makhado Grimm for the July 2012 – April 2013 monitoring period

1.2.10 AMBIENT NOISE

1.2.10.1 Noise Criteria of Concern

The criteria that will be used to determine the significance of the noise impact during the EIA phase were drawn from the criteria for the description and assessment of environmental impacts from the EIA Regulations, published by the DEA (April 1998) in terms of the NEMA, SANS 10103 as well as guidelines from the World Health Organization (WHO).

There are number of criteria that are of concern for the assessment of noise impacts. These can be summarised in the following manner:

- Increase in noise levels: People or communities often react to an increase in the ambient noise level they are used to, which is caused by a new source of noise. With regards to the Noise Control Regulations (promulgated in terms of the ECA), an increase of more than 7 dBA is considered a disturbing noise. This is also the criteria promoted to define the potential on potentially sensitive receptors. Refer to Figure 49.
- Zone Sound Levels: Also referred as the acceptable rating levels, it sets acceptable noise levels for various areas. Refer to Table 35.
- Absolute or total noise levels: Depending on their activities, people generally are tolerant to noise up to a certain absolute level, e.g. 65 dBA. Anything above this level will be considered unacceptable.

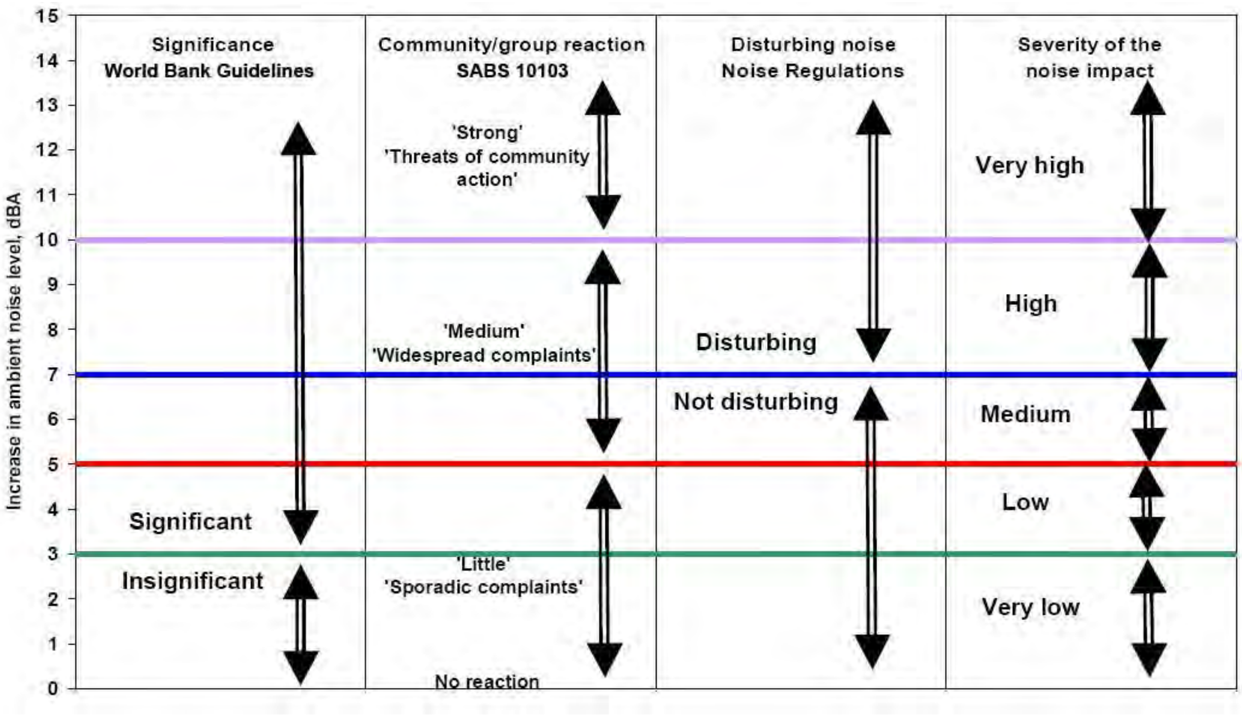


Figure 49: Criteria to assess the significance of impacts stemming from noise

In South Africa the document that addresses the issues concerning environmental noise is SANS 10103 (Edition 6 of 2008 – refer to Table 35). It provides the maximum average background ambient sound levels, $L_{Req,d}$ and $L_{Req,n}$, during the day and night respectively to which different types of developments may be exposed. Based on onsite measurements, considering both the $L_{Aeq,10min}$ and L_{A90} measurements, the ambient sound levels on and around the proposed activity correspond to the rating levels for an rural area. Zone Sound Levels therefore used would be:

- Day (06:00 to 22:00) – $L_{Req,d}$ = 45 dBA.
- Night (22:00 to 06:00) – $L_{Req,n}$ = 35 dBA.

SANS 10103 also provides a guideline for estimating community response to an increase in the general ambient noise level caused by an intruding noise. If Δ is the increase in noise level, the following criteria are of relevance:

- Δ ≤ 3 dBA: An increase of 3 dBA or less will not cause any response from a community. It should be noted that for a person with average hearing acuity, an increase of less than 3 dBA in the general ambient noise level would not be noticeable.
- < Δ ≤ 5 dBA: An increase of between 3 dBA and 5 dBA will elicit 'little' community response with 'sporadic complaints'. People will just be able to notice a change in the sound character in the area.
- < Δ ≤ 15 dBA: An increase of between 5 dBA and 15 dBA will elicit a 'medium' community response with 'widespread complaints'. In addition, an increase of 10 dBA is subjectively perceived as a doubling in the loudness of a noise. For an increase of more than 15 dBA the community reaction will be 'strong' with 'threats of community action'.

Table 35: Acceptable zone sound levels for noise in districts (SANS 10103)

1	2	3	4	5	6	7
Type of district	**Equivalent continuous rating level ($L_{Req.T}$) for noise,** dBA					
	Outdoors			**Indoors, with open windows**		
	Day-night $L_{R,dn}$[a]	**Day-time** $L_{Req,d}$[b]	**Night-time** $L_{Req,n}$[b]	**Day-night** $L_{R,dn}$[a]	**Day-time** $L_{Req,d}$[b]	**Night-time** $L_{Req,n}$[b]
RESIDENTIAL DISTRICTS						
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
NON RESIDENTIAL DISTRICTS						
d) Urban districts with some workshops, with business premises, and with main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

In addition, the number of $L_{A,max}$ events above 60 dBA (60 dBA outside, 45 dBA inside a dwelling assuming 15 dBA attenuation) should be identified and where possible defined, to confirm whether there exist a risk of loud noises that could result in sleep disturbances. Where identified, management measures should be considered to minimize the significance of this impact

1.2.10.2 Existing Ambient Sound Levels

1.2.10.2.1 Measurement procedure

Ambient (background) noise levels were measured at appropriate times in accordance with the South African National Standard SANS 10103:2008 "The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication". The standard specifies the acceptable techniques for sound measurements including:

- type of equipment (Class 1);
- minimum duration of measurement;
- microphone positions and height above ground level;
- calibration procedures and instrument checks; and
- supplementary weather measurements and observations.

1.2.10.2.2 Limitations: Acoustical Measurements and Assessments

Limitations due to environmental acoustical measurements include the following:

- Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. A high measurement may not necessarily mean that noise levels in the area are always high. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of the day, faunal characteristics, vegetation in the area and meteorological conditions (especially wind). This is excluding the potential effect of sounds from anthropogenic origin. It is impossible to quantify and identify the numerous sources that influenced one 10-minute measurement using the reading result at the end of the measurement;
- Defining ambient sound levels using the result of one 10-minute measurement will be very inaccurate (very low confidence level in the results) for the reasons mentioned above. The more measurements that can be collected at a location the higher the confidence levels in the ambient sound level determined (at that location). The more complex the sound environment, the longer the required measurement (especially when at a community or house);
- Determination of existing road traffic and other noise sources of significance are important (traffic counts etc);
- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises;
- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high due to faunal activity which can dominate the sound levels around the measurement point. This generally is still considered naturally quiet and understood and accepted as features of the natural soundscape, and various cases sought after and pleasing;
- Considering one sound descriptor is not sufficient for and acoustical assessment. Parameters such as L_{AMin}, L_{AIeq}, L_{Aeq}, L_{Ceq}, L_{AMax}, LA_{10}, LA_{90} and spectral analysis forms part of the many variables to be considered;
- It is technically difficult to correctly measure the spectral distribution of a large equipment in an industrial setting due to the other noise sources active in the area;

- Exact location of a sound level meter in an area in relation to structures, vegetation and external noise sources will impact on the measurements; and
- As a residential area develops the presence of people will result in increased sounds. These are generally a combination of traffic noise, voices, animals and equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as an area matures.

1.2.10.2.3 <u>Ambient sound measurements</u>

Ambient sound measurements were collected for the Chapudi Project from the morning of 16 September to the afternoon of 19 September 2013. A total of five different Class-1 sound level meters as well as two portable weather stations were used. The internal clocks were set to GMT+2. All the instruments were set to measure the appropriate variables in 10-minute bins till the measurements were stopped. The sound level meters therefore would measure "average" sound levels over a period of 10 minutes, save the data and start with a new 10-minute measurement till the instrument is stopped.

Measurement locations were numbered as CBN01 to CBN09 as shown in Figure 50 and described in see Table 36. These measurements were conducted over a period of approximately 20 – 24 hours.

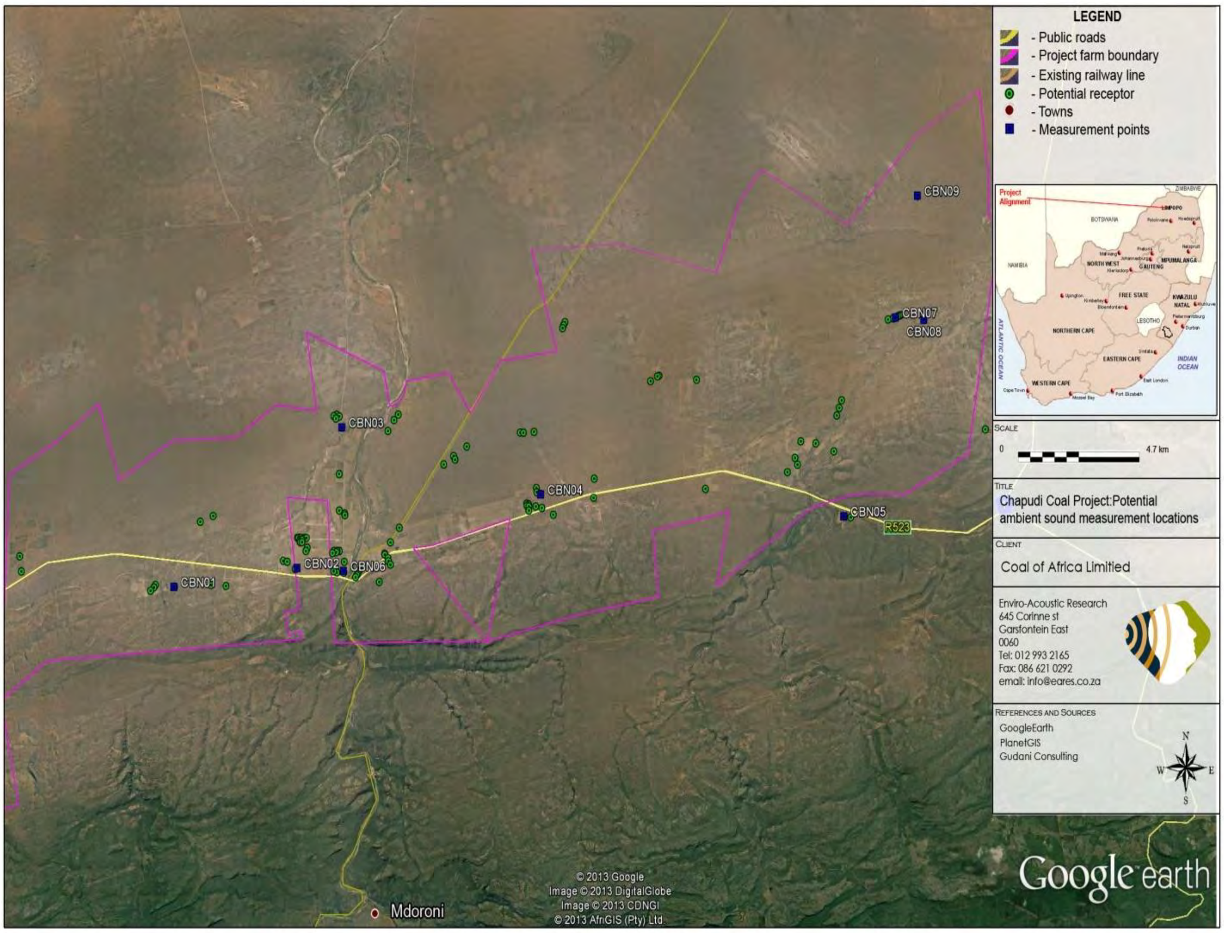


Figure 50 : Localities of ambient sound level measurements

Table 36: Chapudi Day/night-time measurement locations (Datum type: WGS 84)

Point name	Description	Latitude	Longitude
CBN01	Portion 1 of the farm Vleifontein 691 MS: Mr. Koos Pauer	-22.910331°	29.542404°
CBN02	Farm Sitapo 690 MS: Mr. Awie Wright	-22.904723°	29.591518°
CBN03	Portion 1 of the farm Varkfontein 671 MS: Farm of Mr. Fleuriot	-22.862403°	29.608919°
CBN04	Portion 3 of the farm Coniston 699 MS: Dwelling of Mr. Breytenbach	-22.882683°	29.688756°
CBN05	Farm King's Kloof 738 MS: Dwelling of Mrs. Joan Buitendag	-22.889203°	29.809701°
CBN06	Portion 9 of the farm Waterpoort 695 MS: Dwelling of Mr. Swart	-22.905588°	29.609867°
CBN07	Farm Koschade 657 MS: Ekland Safaris – The Lodge	-22.829125°	29.831294°
CBN08	Farm Qualipan 655 MS: Ekland Safaris – Rock Lodge	-22.829789°	29.842715°
CBN09	Farm Pienaar 635 MS: Ekland Safaris – Pienaar Lodge	-22.791903°	29.840518°

1.2.10.2.4 Traffic Counts

Traffic counts were done on both the R523 and the N1. This is because road traffic is one of the major sources of noise in the world, especially in urban areas. In quiet rural areas traffic can be heard as far as 2 000 meters from a road, impacting on ambient sound levels up to 1 000 meters from that road.

Traffic counts on the R523 indicated that this road carries a significant portion of heavy vehicles, with the road reported to carry traffic (especially heavy vehicles till late in the evenings). Traffic counts during the site visit indicated that almost 50% of the vehicles being heavy articulated trucks. Total traffic ranges between 3 vehicles to 14 vehicles per 10 minute count. An hour count the afternoon of 17 September indicated 37 vehicles, of which 16 vehicles were large trucks. While this road were not busy enough to significantly impact on the spectral characteristics, the effect will still be noticeable in the measurements collected at locations within a few hundred meters from the road.

Traffic counts (19 and 20 September 2013) on the N1 indicated a relatively busy road, with traffic ranging between 200 vehicles per hour during the afternoon) to less than 60 vehicles per hour (between 02:00 and 04:00). Approximately 10 – 15% of these vehicles are heavy articulated trucks. This road is busy enough to significantly impact on the sound levels (and spectral characteristics) up to a distance of up to 1,000 meters from the road.

1.2.10.2.5 Results – SANS 10103:2008 Rating Level

- ***CBN01***: While the developmental character of the area conforms to a rural area, measured daytime data indicate sound levels typical of an area with a suburban to urban district character. Night-time levels however are far higher than expected for a rural area, conforming more to a commercial district zone sound level. Considering the spectral frequencies measured, the source of the noise were natural (wind and faunal). Considering the L_{A90} and developmental character of the area it is the opinion of the specialist that a rating level typical for a sub-urban area would be acceptable. Daytime measured $L_{Aeq,f}$ levels during the day conforms to the recommendation of 55 dBA respectively by the World Health Organization (WHO), World Bank and International Finance Corporation (IFC) for a residential area. Night-time levels however are higher than these guidelines, but, with the source being natural it will have a high acceptability to the receptors in the area.

- ***CBN02***: The proximity of the main road would likely change the SANS 10103:2008 district to urban (with one or more of the following; main roads, business or workshops). Measured daytime data indicate sound levels typical of an area with a suburban to urban district character. Night-time levels are also far higher than expected, conforming more to a commercial district zone sound level. Considering the spectral frequencies measured, the source of the noise was natural (faunal). Considering the L_{A90} and developmental character of the area it is the opinion of the author that a rating level typical for an urban area (with one or more of the following; main roads, business or workshops) would be acceptable. Daytime measured $L_{Aeq,f}$ levels during the day conforms to the recommendation of 55 dBA respectively by the WHO, World Bank and IFC for a residential area. Night-time levels however are higher than these guidelines, but, with the source being natural it will have a high acceptability to the receptors in the area.
- ***CBN03***: An error with the data card resulted in no measurements being recorded to the memory card. It was selected not to redo the measurement due to the amount of birds in the vicinity of the dwelling (due to the presence of fig trees).
- ***CBN04***: Measured daytime data indicate sound levels typical of an area with a suburban district character. Night-time levels are however higher than expected, conforming more to an urban (with one or more of the following; main roads, business or workshops) district zone sound level. Considering the spectral frequencies measured, the source of the noise was natural (faunal and wind-induced), and potentially seasonal. Considering the L_{A90} and developmental character of the area it is the opinion of the author that a rating level typical for an urban area would be acceptable. Measured $L_{Aeq,f}$ levels conforms to the recommendation of 55 and 45 dBA by the WHO, World Bank and IFC for a residential area for the day and night-time periods respectively.
- ***CBN05***: Daytime measured data indicate sound levels typical of an area with a suburban district noise character although night-time levels are more typical of a urban area (with main roads). Considering the L_{A90} and developmental character of the area it is the opinion of the author that a rating level typical for an urban area would be acceptable. Measured $L_{Aeq,f}$ levels conforms to the recommendation of 55 and 45 dBA by the WHO, World Bank and IFC for a residential area for the day and night-time periods respectively. Without sound recordings or spectral analysis it is not possible to define the origin, but, considering the data collected in the area it is likely a combination of road traffic noises and natural (both wind and faunal).
- ***CBN06***: Daytime measured data indicate sound levels typical of an area with an urban district noise character although night-time levels are more typical of a urban area (with main roads). Considering the L_{A90} and developmental character of the area it is the opinion of the author that a rating level typical for an urban area would be acceptable. Daytime measured $L_{Aeq,f}$ levels during the day conforms to the recommendation of 55 dBA

respectively by the WHO, World Bank and IFC for a residential area. Night-time levels however are higher than these guidelines.

- ***CBN07***: Daytime measured data indicate sound levels typical of an area with a rural district noise character although night-time levels are more typical of a suburban area. Considering the L_{A90} and developmental character of the area it is the opinion of the author that a rating level typical for a suburban area would be acceptable. Daytime measured $L_{Aeq,f}$ levels conforms to the recommendation of 55 and 45 dBA respectively by the WHO, World Bank and IFC for a residential area (for the day and night time periods respectively).
- ***CBN08***: Daytime measured data indicate sound levels typical of an area with a rural district noise character although night-time levels are more typical of an urban area. Daytime measured $L_{Aeq,f}$ levels conforms to the recommendation of 55 and 45 dBA respectively by the WHO, World Bank and IFC for a residential area (for the day and night time periods respectively).
- ***CBN09***: Daytime measured data indicate sound levels typical of an area with an urban character (with one of the following: business, workshops and/or main roads) with night-time levels being typical of a commercial area. Considering the L_{A90} and developmental character of the area it is the opinion of the author that a rating level typical for a suburban area would be acceptable. Daytime measured $L_{Aeq,f}$ levels conforms to the recommendation of 55 dBA by the WHO, World Bank and IFC for a residential area. Night-time levels exceed their recommended level of 45 dBA.

Equivalent sound levels varied significantly from location to location, with all locations experiencing noisy single events at times that impact on the sound levels (both L_{Aeq} and L_{A90}). L_{A90} levels indicate an area with potential to be quiet at times. Equivalent daytime ambient sound levels were measured around between 46 – 59 dBA, ranging between 25 and 77 dBA (10-minute measurements). Equivalent night-time ambient sound levels were measured around between 42 – 62 dBA, ranging between 19 and 69 dBA (10-minute measurements). Night-time measurements were generally higher than the day-time measurements, relating to increased faunal activity due to the spring (mating) season.

Table 37: Summary of noise district rating levels

Point name	Noise district rating based on L_{Aeq} measurement data (Day / Night)	Noise district rating based on all data and character of area	Existing ambient sound levels conforming to international recommended levels? (Day / Night)
CBN01	Rural / urban	Suburban	Yes /no
CBN02	Urban / commercial	Urban	Yes /no
CBN04	Suburban / urban	Urban	Yes / yes
CBN05	Suburban / urban	Urban	Yes / yes
CBN06	Urban / Urban with roads	Urban	Yes / no
CBN07	Rural / suburban	Suburban	Yes / yes
CBN08	Rural / urban	Rural	Yes / yes
CBN09	Urban / commercial	Urban	Yes / no

Due to the significant variance in ambient sound measurements it is recommended that the project use the guideline levels for residential use as set by international institutions such as World Health Organization, World Bank and International Finance Corporation for residential areas. Seasonal changes in ambient sound levels must however be considered as well as spectral character, especially in areas where the sound levels may be exceeded due to the activities of the proposed mine.

Receptor type	One hour L_{Aeq} (dBA)	
	Daytime 07:00 - 22:00	Night-time 22:00 – 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

1.2.11 VISUAL ASSESSMENT

1.2.11.1 Aesthetics

The Chapudi Project is located on the north-facing slopes of the Soutpansberg that forms major regional topographic feature in the area. The southern section of the Chapudi Project area is characterised by high hills and ridges with flatter, gently undulating topography to the north. Some ridges occur on the north-eastern side of the area. The highest altitude is around 1,300 meters above mean sea level with the plains at around 700 to 800 mamsl (SRK, 2009).

The proposed Chapudi Project is located within the Savannah biome, characterized by a grassy ground layer and a distinct upper layer of woody plants (trees and shrubs). Where this upper layer is near the ground (low growing) the vegetation may be referred to as Shrubveld, where it is tall and dense, as Woodland, and the intermediate stages are locally known as Bushveld (BGIS, 2011).

The shrub-tree layer may vary from 1 to 20 m in height, but in the Chapudi Project area typically varies from 3 to 7 m. The shrub-tree element may come to dominate the vegetation in areas which are being overgrazed. The shrub-tree layer can provide some visual absorption for the infrastructure depending on the height of the infrastructure and the location of the observer. Figure 51 indicates the topography of the Chapudi Project area and surrounds.

1.2.11.2 Visual Character of the Area

The project area is characterised by high agricultural potential and areas of prominent cultivation situated in close proximity to the Moleletsane and Sand Rivers, mainly due to the accessibility to a water supply for irrigation purposes in this area. The climate is suitable for growing a wide range of crops and is also favourable for year round production. The other agricultural enterprises found in this and adjacent areas are game ranching, extensive cattle production and eco-tourism (SRK & Agriconcept, 2009).

The sense of place of the area can be described as mainly peaceful rural area with natural thicket and woodland, with some transformed areas in close proximity to the Sand River and the Waterpoort Village that can be described as busier areas. The tourism and hunting sector relies heavily on the rural peaceful character of the area to market their establishments. The R523, railway line and gravel roads contribute to the noise and dust pollution in the area.

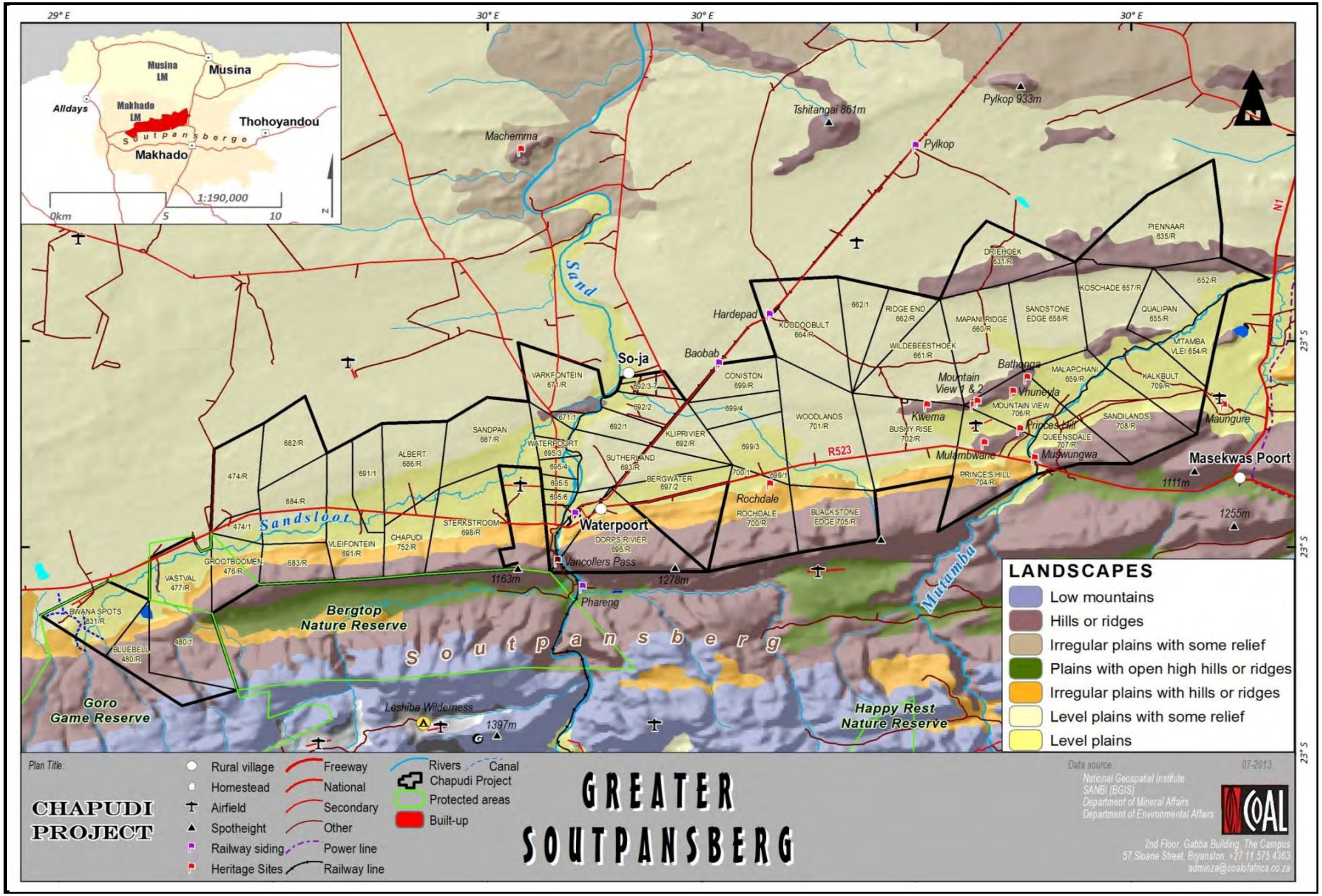


Figure 51: Topography map indicating location of hills and ridges

1.3 ENVIRONMENTAL ASPECTS THAT MAY REQUIRE PROTECTION OR REMEDIATION

1.3.1 SENSITIVE LANDSCAPES

1.3.1.1 River systems

River systems are always considered to be ecologically sensitive, and are thus given a very high (No-Go) sensitivity. This is due to the unique habitats they provide and support for several flora and fauna species. The river systems provide migration corridors for many species. River systems are particularly important due to the water transport and associated biological, economic, health and cultural values. The provision of clean and healthy water to people, agriculture and natural biological systems is of utmost importance in this arid region.

The following is recommended:

- No mining development can be supported within the 1:100 year flood-line on both sides of the rivers. A further buffer zone will be needed to protect the major rivers from effects of mining, especially from pollution and erosion;
- Care should be taken that no erosion takes place along the river banks;
- The rivers and river bank areas should be included in an open space plan, where the indigenous vegetation is protected and no development allowed; and
- All alien woody species on the river banks should be removed and controlled.

1.3.1.2 Wetland systems

Legislative requirements were used to determine the extent of buffer zone required for each group of wetland systems depending on whether a group is considered wetland/riparian habitat or not:

- Due to the ephemeral nature of the drainage lines, not all drainage lines could be considered riparian habitat as defined by NWA No 36 of 1998. Therefore, distinction was made between drainage lines with riparian zones and drainage lines without riparian zones. Smaller drainage lines with riparian zones are defined as watercourses. If any activities are to take place within 100 meters or the 1:100 year flood lines exemption terms of Regulation GN 704 of the NWA, 1998 needs to be obtained. Section 21 of the NWA as well as General Notice No. 1199 of 2009 as it relates to the NWA will also apply and therefore a Water Use License will be required.
- Smaller drainage lines without riparian zones are not considered wetlands but are still defined as watercourses. If any activities are to take place with the 1:100 year flood line exemption terms of Regulation GN 704 of the NWA, 1998 needs to be obtained, however Section 21 of the NWA as well as General Notice No. 1199 of 2009 as it relates to the NWA does not apply and therefore no Water Use Licence will be required.

Based on the findings of the aquatic assessments and sensitivity of the wetland systems, it is recommended that the project should be designed and operated on the basis that no mining activities should take place within 100m from the edge of the 1:100 year flood-line of the major drainage lines, i.e. Sand River, Moleletsane River and Mutamba River.

In addition, the bulk of the mining support structure such as the plant ROM facilities and the associated pollution control facilities are planned in this area on the farm Woodlands 701 MS / Blackstone Edge 705 MS. These activities in the area are likely to severely impact on the GSPC W1 wetland leading to the permanent destruction of the wetland features. Since the infrastructure in this area is not resource dependent, the infrastructure could be moved to an alternative location without compromising on the mining resource. Due to the unique nature of this feature and the biodiversity it supports, with special mention of the known presence of protected species and the high probability of occurrence of other species of conservation concern, it is strongly recommended that the infrastructure be moved from this area to an area which where these activities will have a significantly lower impact on wetland resources.

1.3.2 FORMAL CONSERVATION INITIATIVES IN THE REGION

1.3.2.1 Vhembe Biosphere Reserve

Biosphere reserves are protected environments which are important for conservation and sustainable utilization of natural resources. They are building blocks for bio-regional planning and economic development. Biosphere reserves are community driven initiatives assisted by government departments or agencies. Biosphere reserves are important ecosystems designated as protected areas by the United Nations Education, Science and Cultural Organization (UNESCO).

The objectives of a Biosphere Reserve are to (LEDET, 2008):

- Preserve special bio-diverse environments for future generations;
- Create and encourage a balance between conservation and economic development;
- Place a priority on encouraging local communities to become involved and to become direct beneficiaries of the benefits flowing from a Biosphere; and
- Establish a social contract between all stakeholders and create an integrated ownership and management structure.

Worldwide Biospheres all have three distinct zones:

- A legally constituted ***Core area*** or areas devoted to long-term protection, according to the conservation objectives of the Biosphere Reserve;
- A ***Buffer zone*** or zones clearly identified and surrounding or contiguous to the core areas, where only activities compatible with the conservation objectives can take place; and
- An outer ***Transition area*** where sustainable resource management practices are promoted and developed.

Limpopo Province has three Biosphere Reserves namely the Waterberg Biosphere Reserve (WBR), the Kruger to Canyon Biosphere (K2C) and Vhembe Biosphere Reserve (VBR).

Figure 52 shows the VBR with its core areas and buffer zones. Although the Chapudi Project falls within the boundary of the VBR, it is not within or adjacent to any of the core areas. It does however border on a buffer zone area identified as the Limpopo Central Bushveld (Soutpansberg West) buffer zone to the south.

1.3.2.2 Protected areas

Figure 52 shows both the formal and informal protected areas within the VBR boundary (SANBI BGIS, 2013). Protected areas in the vicinity of the site include:

- Bergtop Nature Reserve to the South;
- Goro Game Reserve to the South;
- Studholme Nature Reserve to the South;
- Hangklip State Forest to the South;
- Happy Rest Nature Reserve to the South;
- Roodewal State Forest to the South;
- Entabeni State Forest to the South; and
- Langjan Nature reserve to the West.

Protected areas that will be affected or that are directly adjacent to the site include Bergtop Nature Reserve and Goro Game Reserve. The Bergtop Nature Reserve forms the southern boundary of the farms Endfield 474 MS, Middelfontein 683 MS and Vleifontein 693 MS and extend all the way to the farm Dorpsrivier 696 MS.

The Chapudi Project area falls within (partly) the Priority Area 1 {North Eastern Escarpment} for conservation as determined by the National Biodiversity Assessment (NBA) as contemplated in the National Protected Area Expansion Strategy (LEDET, 2008). The study area also falls within the following important biodiversity areas:

- Soutpansberg centre of endemism;
- key vegetation community (Soutpansberg);
- delineation of the Soutpansberg escarpment; and
- special habitat for crested guinea fowl.

1.3.2.3 Avifauna

1.3.2.3.1 <u>Ground Hornbill research and conservation project</u>

At present Southern Ground Hornbills are considered ‘vulnerable’ and a protected species under TOPS regulations (2007) but their numbers are still declining. Over 70% of this species natural habitat has been lost due to farming / agriculture and cattle over the past 50 years. Indirect poisoning, indirect trapping and snaring, loss of large nesting trees, the trade in exotic birds, an increase in ancient cultural uses and electrocution on power transformer boxes are some reasons provided for the decline in numbers.

The Mabula Ground Hornbill Research and Conservation Project are addressing these issues by:

- Harvesting and hand-rearing of second hatched chicks which die of starvation in the nests.
- Re-introduction and augmentation of non-viable groups in the wild.

- Provision of artificial nests for wild groups without nests.
- Research on behaviour and other important unanswered questions.
- Awareness Campaigns to educate the general public regarding:
    - unintentional poisoning;
    - trade in ground hornbills; and
    - secondary trapping and snaring.

In conjunction with the Musina Game Study Group, artificial nest boxes are being supplied to compensate for the lack of suitable nesting trees in the Musina area.

1.3.2.3.2 <u>Cape Vulture</u>

The Blouberg Mountains (extension of the Soutpansberg Mountain Range) is home to the largest breeding colony of Cape Vultures in the world. Furthermore 'Vulture Mountain' on the farm Buffelspoort 222 IS is in close proximity to the south of the Soutpansberg Mountain. They are attracted to this area due to the height and topography of the mountain, together with the food offered by the surrounding game farms. Cape vultures may have a 300 km foraging area surrounding their roosting sites.

The Cape Vulture is a scavenger of animal carcasses, and relies on leftover food from kills made by large predators (lions, leopards, etc). This bird also feeds off animals that have died from natural causes. Thus vultures are natures' way of controlling animal carcasses. This bird has adapted to a life of flying extensive distances for food. As the proposed mining area falls within the birds feeding grounds, the large game will be removed due to the selling of the farms they inhabit. This will result in a decrease of food for the Cape Vulture.

Cape Vultures are SA's only endemic vulture species and is listed as a TOPS regulated species as well as CITES I. It is classified as vulnerable by the International Union for Conservation of Nature and Natural Resources ("IUCN") and is species of special concern for South Africa.

Figure 52: Protected areas and conservation initiatives within the Vhembe Biosphere Reserve

1.4 DESCRIPTION OF LAND USE, CULTURAL AND HERITAGE ASPECTS AND INFRASTRUCTURE

1.4.1 LAND USE ACTIVITIES ON SITE AND NEIGHBOURING PROPERTIES

Socio-economic activities in the area are mixed between intensive irrigated agriculture, hunting and tourism.

The intensive irrigated agricultural activities are focused along the Sand River catchment and neighbouring areas. The land use in the Wildebeesthoek Section of the Chapudi Project is predominantly hunting, game farming and ecotourism. The Chapudi Section has a combination of hunting/game farming and irrigated / dry land agriculture. The Chapudi West Section has portions of intensive agriculture, the further south-west portions are utilised for conservation, hunting and ecotourism. The significance of the intensive agricultural area is utilised for predominantly vegetable production and is known as the winter pantry (production area) of South Africa. Some of the properties are also focused on mixed farming, with a mixture of livestock, game and irrigated agriculture. A number of pack houses for fresh commodities are operational in the region. The fresh produce markets remain a major outlet for fresh produce. Direct marketing is also a popular marketing outlet and producers deliver direct to chain stores such as Woolworths, Pick ‘n Pay etc. This information will be confirmed during the detail SEIA.

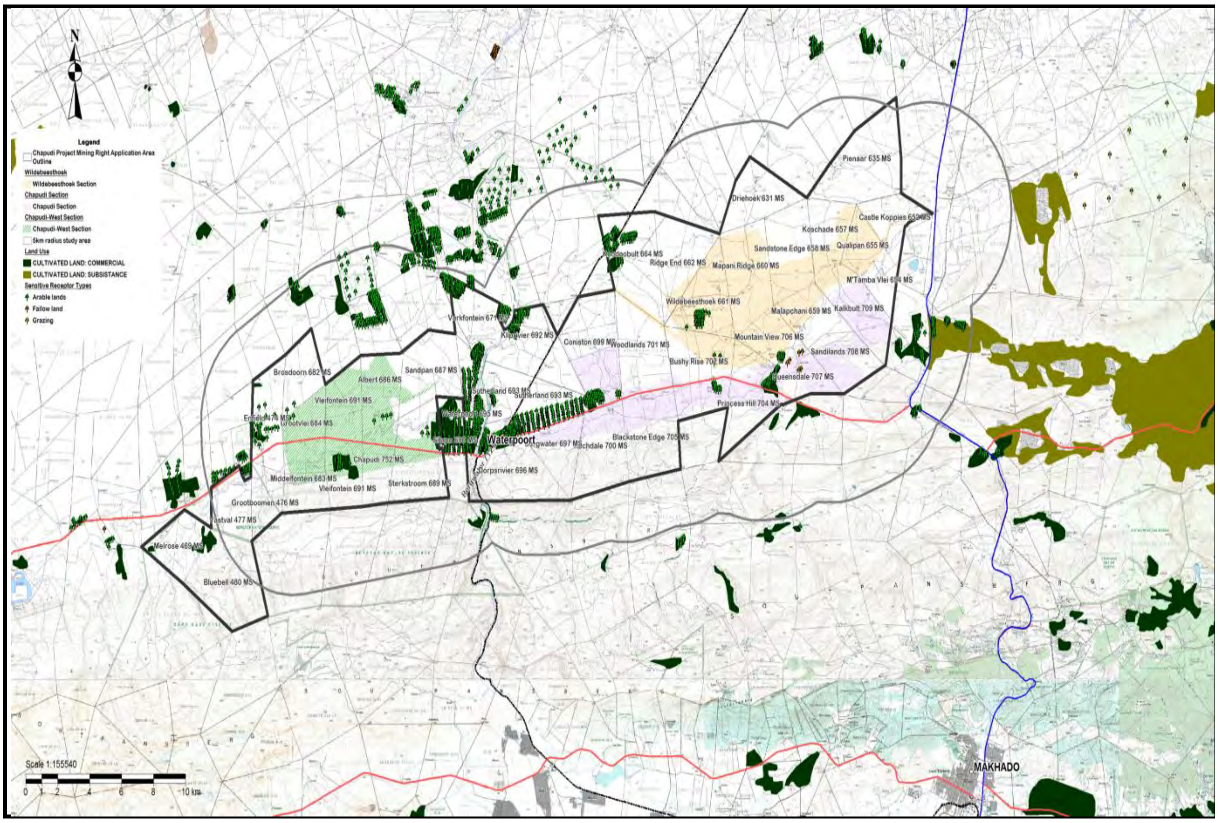


Figure 53: Detected agricultural activities

Hunting, game trading and Ecotourism is an established socio-economic driver in the area. There are a number of properties utilized for trophy (for local and foreign tourists) and biltong hunting with ecotourism spin-off activities. The figure below indicates where hunting camps and other game activities could be determined via aerial photography. The information will be confirmed and further investigated during the EIA Phase.

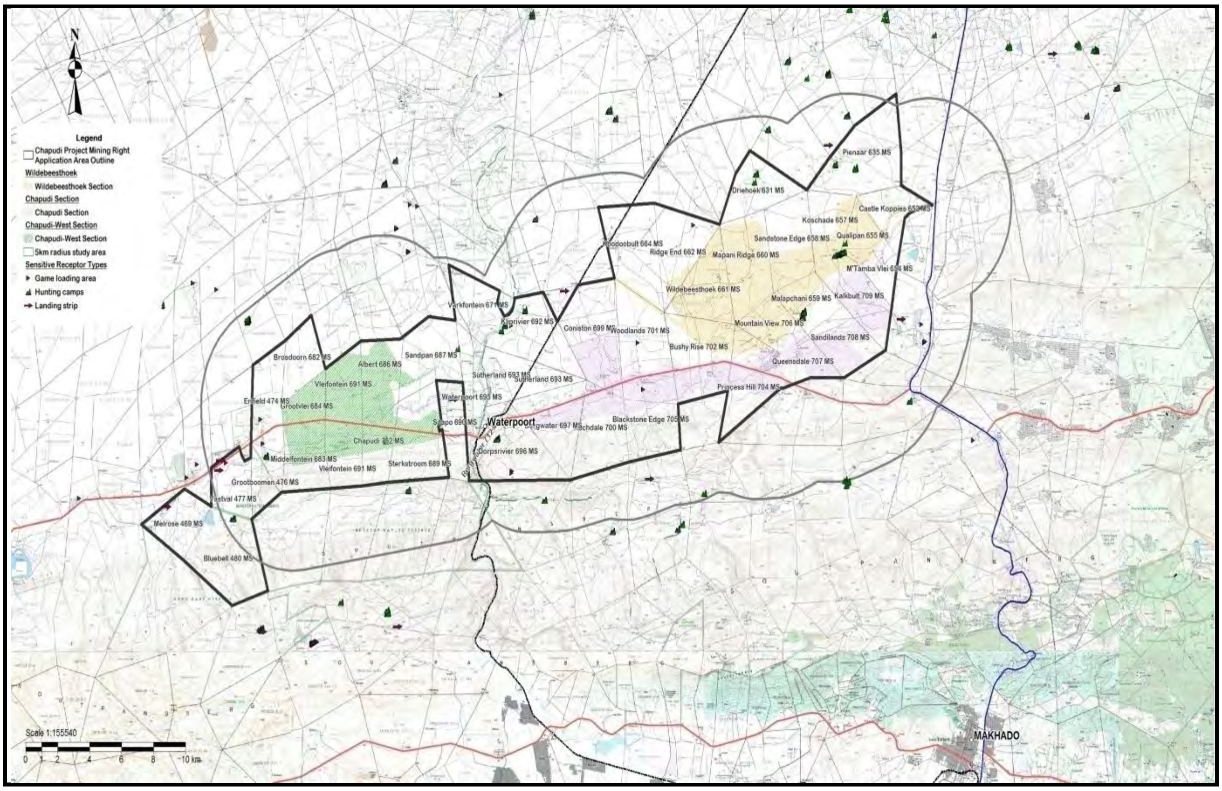


Figure 54: Hunting Facilities and/or Activities

The location of all structures, houses, institutional buildings such as schools, post offices, etc is important in the evaluation of their susceptibility to nuisance, noise, visual and air quality impacts. Changes to the sense of place and ambiance of the area have an impact on the socio-economic environment. Housing, labour houses and other structures are scattered throughout the area, as can be seen in the figure below.

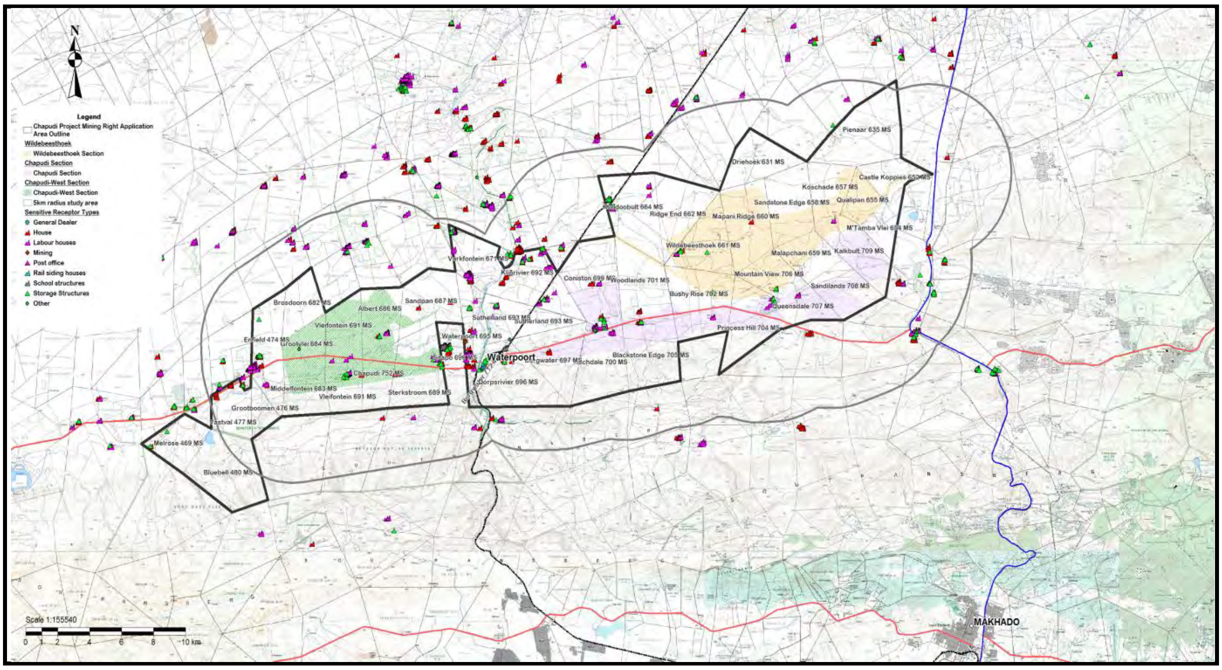


Figure 55: Houses, labour houses and other structures

The area is known locally to be water scarce therefore livelihoods in the project area largely rely on water sources to be able to sustain their socio-economic activities. Surface and groundwater is captured in dams for utilization on the various properties. In collaboration with the surface and groundwater specialists the water resources utilized and the purpose will be determined to evaluate the secondary socio-economic dependencies on water use in the area.

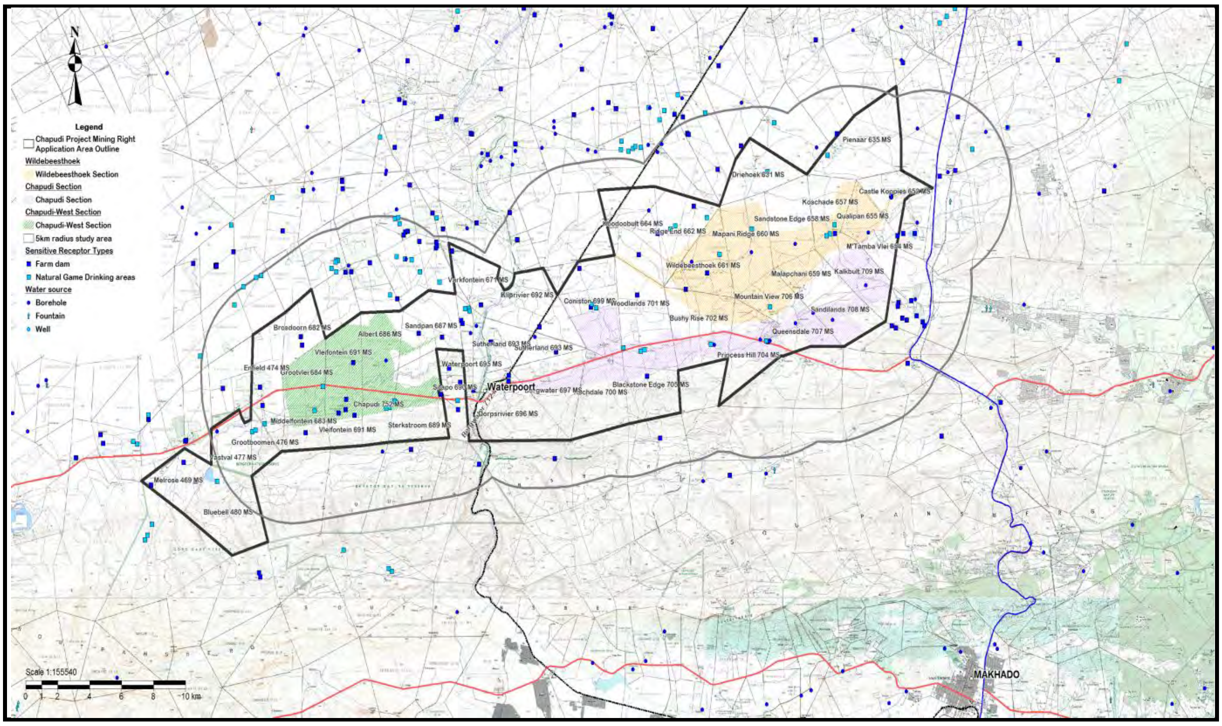


Figure 56: Water sources and infrastructure

1.4.2 CULTURAL AND HERITAGE RESOURCES

1.4.2.1 Theoretical Framework

Archaeological reconstruction of the cultural sequence in South Africa provides a theoretical frame of reference to aid the identification of heritage resources in the area of development. Such background knowledge on heritage resources that can be expected in the area is obtained largely from a scan of existing archaeological literature.

1.4.2.1.1 The Stone Age Culture

South Africa's human history and heritage span more than 3 million years. Hominid sites and their fossil remains are largely confined to dolomite caves on the highveld in Gauteng, Limpopo and Northwest Provinces (Deacon & Lancaster, 1986). The Stone Age which dates back more than 1 million years marks a more diagnostic appearance of the cultural sequence divided into three epochs, the Early, Middle and Late Stone Ages. Stone and bone implements manifest the technology of the period and fall into distinct typologies indicating chronological development. Material evidence of human activities is easily detectable in caves, rock-shelters and riverside sites, and very rarely seen in open country. The Late Stone Age is also associated with the execution of paintings mostly in rock shelters and caves.

Early Stone Age

The Early Stone Age marks the earliest appearance of stone artefacts about 1.4 million years ago. Such tools bore a consistent shape such as the pear-shaped hand axe, cleavers and core tools (Deacon & Deacon, 1999). These tools, which have been called Acheulian after a site in France, were probably used to butcher large animals such as elephants, rhino and hippo that had died from natural causes. Acheulian artefacts are usually found near sites where they were manufactured and thus in close proximity to the raw material or at butchering sites. The early hunters are classified as hominids meaning that they have not evolved to the present human form.

Middle Stone Age (MSA)

The Middle Stone Age (MSA), which appeared 100 000 years ago, is marked by the introduction of a new tool kit which included prepared cores, parallel-sided blades and triangular points hafted to make spears. By then men had become skilful hunters, especially of large grazers such as wildebeest, hartebeest and eland. It is also believed that by then, men had evolved to become anatomically modern. Caves were used for shelter suggesting permanent or semi-permanent settlement. Furthermore there is archaeological evidence from caves indicating that people had mastered the art of making fire. These were two remarkable steps in cultural advancement (Deacon &Deacon, 1999).

Later Stone Age (LSA)

By the beginning of the LSA, humans were classified as *Homo sapiens* which refer to the modern physical form and thinking capabilities. Several behavioural traits are exhibited, such as rock art and purposeful burials with ornaments, became a regular practice. The practitioners of the Rock Art are definitely the ancestors of the San and sites abound in the whole of South Africa. LSA technology is characterised by microlithic scrapers and segments made from very fine-grained rock. Spear hunting probably continued, but LSA people also hunted small game with bows and poisoned arrows. Because of poor preservation, open sites are usually of less value than rock shelters.

1.4.2.1.2 <u>The Iron Age Culture</u>

The Iron Age culture, which supplanted the Stone Age at least 2000 years ago, is associated with the introduction of farming and the use of several metals and pottery. Scholars have analyzed existing archaeological evidence using various models the earliest attempts of which arrived at the conclusion that a sudden synchronized appearance of these technologies occurred in South Africa, indeed in the whole region of Eastern and Southern Africa suggesting a fairly rapid movement of people (Phillipson, 2005). Overall, since these people are indigenous to Africa, current theoretical positions are in support of a gradual “expansion” or “spread” (rather than a migration in the strict sense) of populations of speakers of Bantu languages from a source or sources in the north. Pottery, even though broken into shards has a high survival rate, and has been a handy means for characterizing and identifying archaeological traditions within the broad Iron-using culture and to further isolate geographical variations, which have been called facies (Evers, 1988). Ceramic classifications rely largely on shape and decoration similarities and variations. Coupled with radiocarbon dates, which have been obtained at several sites, it has been possible to reconstruct a picture of the chronological and spatial development of Iron Age traditions.

Early Iron Age

Metalworking represents a new technology not found among the Stone Age hunters.

As mixed farmers, they practiced agriculture and kept domestic animals such as cattle, sheep, goats and chicken. There is however increasing evidence that sheep might have moved into the area much earlier than the Iron Age.

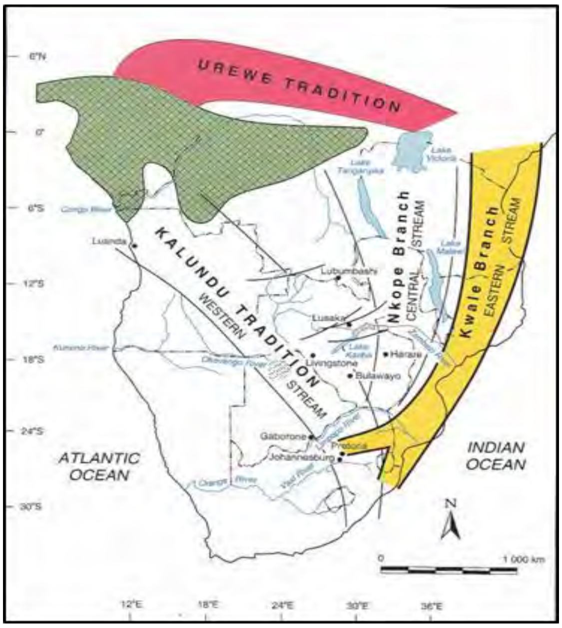
According to Huffman (2007) there were two streams of Early Iron Age (EIA) expansion converging in South Africa, one originating in east Africa which has been called the Urewe-Kwale Tradition (or the eastern stream) and another from the west spreading through Zambia and Angola called and the Kalundu Tradition (or western stream).

Urewe Tradition spawned the following facies:

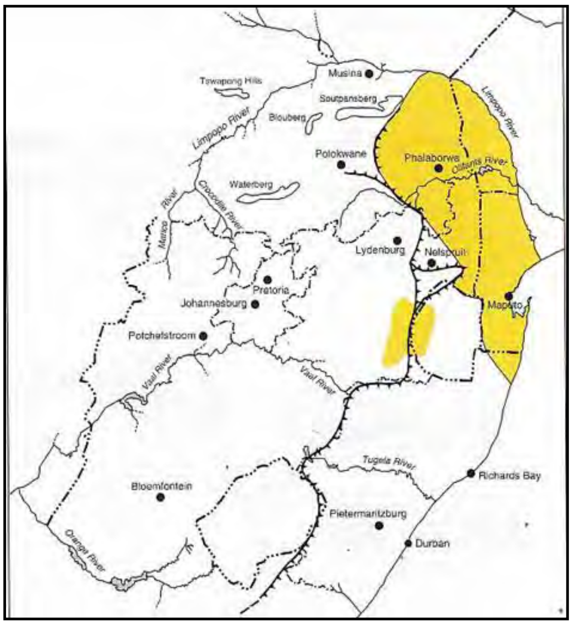
- Matola (eastern seaboard)
- Mzonjani facies (Broederstroom) AD 450 – 750)

Kalundu Tradition spawned the following facies:

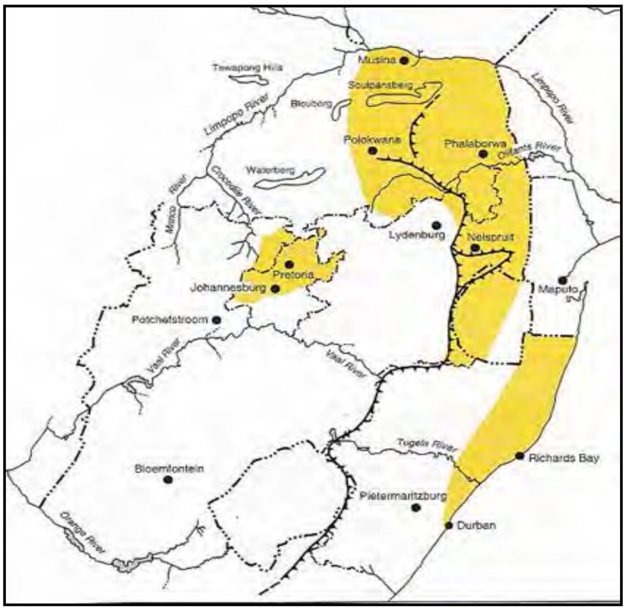
- Benfica Sub-branch:
  - Bambata facies AD 150 – 650
- Happy Rest Sub-branch:
  - Happy Rest facies AD 500 – 750
  - Malapati facies AD 750 – 1030



A: Spread of the Kalundu & Urewe Traditions in Southern Africa (Huffman 2007: 122)



B: Matola (Silver Leaves) Facies of the Urewe-Kwale Tradition (Huffman 2007: 123)



C: Broederstroom facies (later than Matola) (Huffman 2007: 127)

Late Iron Age (LIA)

Around the turn of the first Millennium AD, archaeologists have noticed the growing importance of cattle in the economy of farmers as houses and grain bins were arranged around a central area for cattle. This settlement behaviour dubbed the 'Central Cattle Pattern' commonly occurs in South Africa, with sites usually sited near water and good soils that could be cultivated with an iron hoe. The growing importance of cattle in defining social and economic rank is seen at K2 at the confluence of the Shashi and Limpopo Rivers. Subsequently and close by at Mapungubwe World Heritage Site cultural landscape (approximately 100km from the Project area) further transformation in the spatial organisation of settlements occurred where the “Central Cattle Pattern” changed into the Zimbabwe Pattern which defines political elites.

Various factors contributed to these cultural and settlement changes, but important was the surplus wealth from the East Coast Gold and Ivory trade and the intensive cultivation of the Limpopo flood plains. From about 1300 AD, there is evidence of Sotho-Tswana settlement in the area north of the Soutpansberg. They are recognised by their distinctive pottery, known after the farm Icon where the pottery was first found. After 1400 AD, there appear to have been movements from across the Limpopo River introducing the Zimbabwe-Khami culture. The relationship between the Venda and Khami is a subject of on-going debate and research (Nemaheni, pers. com). There appear to be three chronological layers representing intrusions by the Ngona, Lembethu/Mbedzi/Thavhatsindi and Singo groups, possibly all coming from across the Limpopo River in that order. There are two stonewalled sites in the Project Areas, namely Verdun and Machema, which have been confirmed. Both ruins fall within the Mapungubwe-Thulamela-Dzata continuum. Dzata, which dates to the 18th century, appears to be the youngest of the Zimbabwe type settlements is located approximately 50km to the east of the Project area.

Various LIA facies have been identified on the basis of pottery typology and radiocarbon dates.

- Moloko (Sotho-Tswana) Branch
- Icon facies AD 1300 – 1500: This pottery is associated with the first Sotho Tswana people entering the country.
- Eiland facies AD 1000 – 1300
- Mapungubwe facies AD 1250 – 1300
- Mutamba facies AD 1250 – 1450
- Khami facies AD 1430 – 1680
- Thavhatshena facies AD 1450 – 1600
- Letaba facies AD 1600 – present

Letaba pottery is associated with modern day Venda people and can be found in any Venda village.

Machema Ruins is 18km north-west of the Chapudi Project area. The site is believed to represent early Venda settlement typologically belonging to the Khami group as exemplified by the presence of the check pattern and bi-chrome effect of alternating course of black stones (schist) and brown sandstones. They are historically associated with the Machema people said to have been subordinated to the higher political order at Mapungubwe. These ruins are on a private farm on the western side of the Sand River. Dzata, which dates to the 18th century, appears to be the youngest of the Zimbabwe type settlements, and is located approximately 40km to the east of the Chapudi Project area.

Machema Ruins (Huffman 2007: 420)

Six (6) stonewalled sites have been confirmed one in the Chapudi Project area, all located on the farm Bushy Rise 702 MS. From a typological perspective these sites fall within the Mapungubwe-Thulamela-Dzata continuum.

1.4.2.1.3 Other Heritage Concepts

Historical Archaeology

The frame of archaeological application is extended to cover the historical period.Archaeological evidence can be used to complement the large corpus of historical and oral data. One archaeologist has noted that one of the rulesof historical archaeology "is that documentary and archaeological data are kept distinct to avoid circular arguments as one is tested against the other". In other words written and oral documents are seen as independent sources of data.

The coming of the Voortrekkers in the area and the introduction of commercial farming in the 19th and early 20th centuries has a strong archaeological footprint in the Chapudi Project Area.Wehave noted a prevalence of house remains associatedwith pioneer commercial farmers and shifting semi-permanent dwellings of farm workers. Several graves both with inscriptions and "anonymous" mostly associated with pioneer farmers or their workers were also recorded. Thus the Archaeology of the historical and industrial periods brings forth new terminology – Historical Archaeology and Industrial Archaeology - to denote emerging sub-disciplines which find relevant application to this study, even if to complement the corpus of written records (Pikirayi 1993).

Cultural Landscapes

Over the past twenty years a territorial approach to heritage has shifted emphasis from sites to the recognition of broad territorial attributes of heritage. Within the international discourse which has ensued, a genre of heritage called Cultural Landscapes has emerged. Article 47 of the Operational

Guidelines for the Implementation of the World Heritage Convention (2005) defines Cultural Landscapes as:

Cultural landscapes are cultural properties that represent the "combined works of nature and of man" designated in Article 1 of the World Heritage Convention. They are illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal.

Broadly, the Chapudi Project Area, which is approximately 80 km Southeast of Mapungubwe, may be considered as part of the Greater Mapungubwe Cultural Landscape. The following genres of cultural landscapes have been encountered in the Chapudi Project area:

Organically evolved cultural landscapes result from an initial social, economic, administrative, and/or religious imperative and have developed its present form by association with and in response to its natural environment. Such landscapes reflect that process of evolution in their form and component features. They fall into two sub-categories:

- A relict (or fossil) landscape is one in which an evolutionary process came to an end at sometime in the past, either abruptly or over a period. Its significant distinguishing features are, however, still visible in material form; and
- A continuing landscape is one which retains an active social role in contemporary society closely associated with the traditional way of life, and in which the evolutionary process is still in progress. At the same time it exhibits significant material evidence of its evolution over time.

Associative cultural landscapes have powerful religious, artistic or cultural associations of the natural element rather than material cultural evidence, which may be insignificant or even absent.

Intangible Cultural Heritage

The elevation of Intangible Cultural Heritage has evolved out of a post-colonial discourse largely nurtured in the developing world. South Africa has participated actively in the debates which culminated in the UNESCO Intangible Heritage Convention passed in 2003.

The "intangible cultural heritage" means the practices, representations, expressions, knowledge, skills – as well as the instruments, objects, artefacts and cultural spaces associated there with – that communities, groups and, in some cases, individuals recognize as part of their cultural heritage. This intangible cultural heritage, transmitted from generation to generation, is constantly recreated by communities and groups in response to their environment, their interaction with nature and their history, and provides them with a sense of identity and continuity, thus promoting respect for cultural diversity and human creativity.

Intangible values give meaning to heritage sites.

1.4.2.2 Results

1.4.2.2.1 Current Conservation Status of Heritage Resources

The Chapudi Project area is under various land use systems including commercial farming (cattle ranching, game farming and crop irrigation). While it is noted that archaeological sites under irrigation fields have been disturbed, these new activities create a cultural landscape layer of heritage value. Cattle and game farming are practiced and we note that archaeological sites tend to remain stable under such activities. The Chapudi Project area still retains good natural woodlands some of which are fine examples of forest product harvest cultural landscapes.

1.4.2.2.2 National and Provincial Heritage Sites (Monuments)

According to record, there are no proclaimed Grade 1 sites in the Chapudi Project area. Machema Ruins is situated west of the Sand River, approximately 18 km from the Chapudi Project area and outside the mine operations area. These ruins are substantial although their grading is yet to be ascertained.

1.4.2.2.3 Summary Data on Heritage Resources

Ninety-four (94) heritage sites have been recorded under 6 typologies as follows:

	Heritage Typology	Quantity/Description
1	Grave Sites	23
2	Stone Age Archaeological Sites	1
3	Later Iron Age Archaeological Sites	18
4	Later Iron Age Ruins	6
5	Sites of the commercial farming period (historical archaeology)	37
6	Cultural Landscapes (forest products)	9
TOTAL NUMBER OF SITES		94

A ranking system has been used to isolate sites that will need attention before or during the operation phase of the project. Twenty-nine (29) heritage sites have been prioritized under Categories 1 and 2 as deserving the highest attention before or during the operation phase of the project.

	Ranking	Explanation	No of sites
1	Very high	23 burials (Section 36 of NHRA) require stakeholder consultations before relocation or other mitigation measures are considered. 5 ruins have high cultural and architectural significance; these must not be disturbed.	28
2	High	Substantial archaeological deposits (1 site). It requires mitigation.	1
3	Medium	Archaeological deposits (4 sites); Cultural landscapes (Mopani, Baobab, commercial farmsteads) (14); and 1 small ruin. They may require mitigation	19
4	Low	Heritage sites deemed of less importance. These are mostly sites with pottery but belonging to the relatively recent commercial farming period. Decisions on mitigation will be made by a heritage expert including options of destruction with or without salvage.	46
		TOTAL	94

The conclusions from the HIA are that:

- Twenty-nine (29) heritage sites have been prioritized under Categories 1 and 2 as deserving the highest attention before or during the operation phase of the project. These are five (5) stonewalled sites of the Zimbabwe Tradition, 23 graves and 1 late Iron Age settlement site which may require consultation with local communities and other stakeholders before any action on them is considered. The fate of Baobab trees in the mineral extraction areas must be decided in consultation with SAHRA and other stakeholders.
- Nineteen (19) heritage sites are considered to be of medium significance. These include 2 cultural landscapes exemplifying non-timber forest product exploitation.
- Forty-six (46) sites are considered to be of less importance. As they have been recorded as minimum requirement, they may be disposed of with or without salvage.

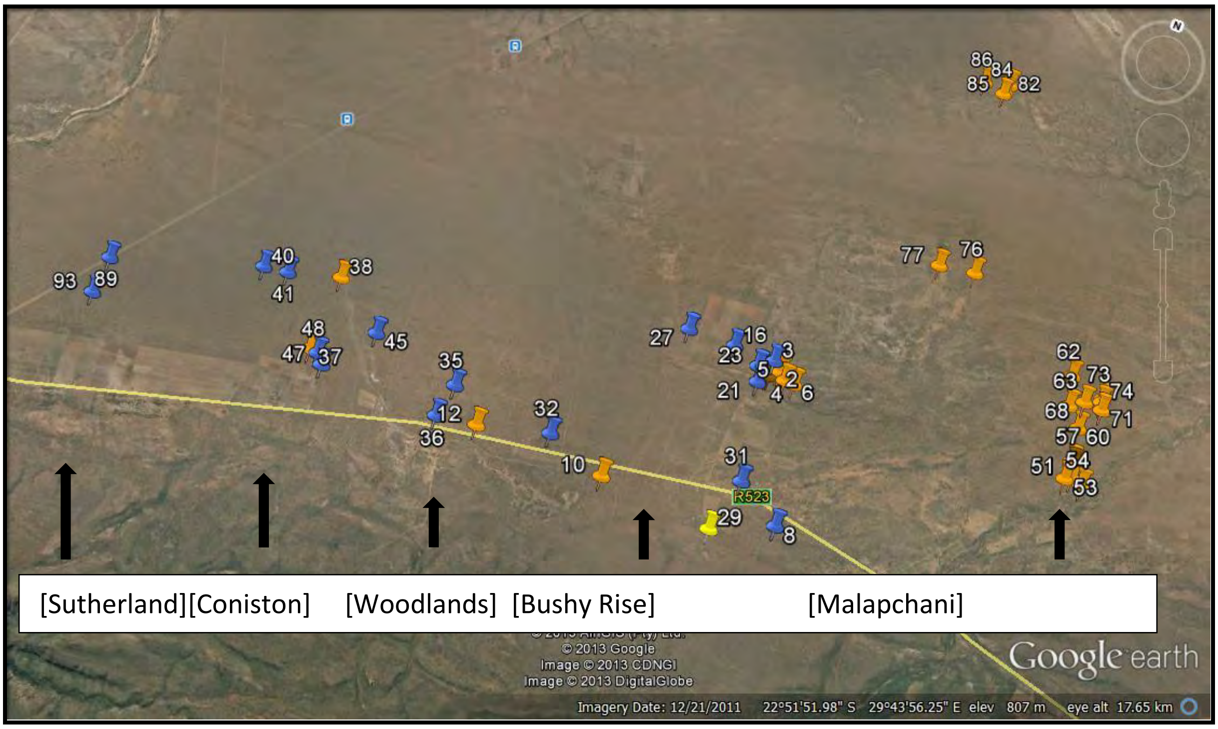


Figure 57: Map showing Category 1, 2 and 3 heritage sites

1.4.3 INFRASTRUCTURE (BUILT ENVIRONMENT)

The Chapudi Project is situated in the magisterial district of Vhembe, in the Limpopo Province, approximately 20 km (direct) and 35 km (via road) north-west of the town Makhado in the Makhado Local Municipal area. Musina is situated approximately 65 km to the north – refer to Figure 2. Musina and Makhado are connected by well developed road infrastructure.

The N1 national road pass the mining right application (MRA) area (Wildebeesthoek and Chapudi Sections) in the east with the R523 running through the site from east to west. Both of these roads carry sufficient traffic to impact on the ambient sound levels a distance away from these roads. There is an undefined road just west of the Waterpoort Station that appears to carry heavy traffic. The Makhado-Musina railway line runs in a north-south direction through the Chapudi Project area

Access to the Wildebeesthoek Section is by way of the N1 towards Musina, turning west onto a new proposed intersection with the N1 where the D745 intersects east towards the Nzhelele Dam. The main entrance to the Wildebeesthoek Section is approximately 12 km along the new route following the Mutamba River in a westerly direction from the N1 intersection. It is envisaged that a more appropriate route may be from the R523, this will be investigated during the feasibility phase. This road will have a gravel wearing surface.

Access to the Chapudi Section site is by way of the N1 towards Musina, turning west onto the R523. The main entrance to the Chapudi Section is approximately 15 km along this route and crosses the Mutamba River along the way. The access road to the mining site will have a gravel wearing surface. From the farm Princess Hill 704 MS towards the west the R523 needs to be rerouted. During the feasibility phase a significant road study will be commissioned to evaluate this. The new road will be a surfaced road to Provincial Standards. The mine entrance should be located on the relocated R523.

The Chapudi Project is close to the railway line running southwards from Beitbridge / Musina and is an important link to the main hub of the Transnet Freight Rail (TFR) network connecting at Pyramid South, near Pretoria. An important junction occurs at Groenbult, where a connecting line joins the Hoedspruit – Kaapmuiden – Komatipoort export channel avoiding the Pretoria complex.

The following communities reside on or in close proximity to the Chapudi Project area:

- Waterpoort Town consisting of a general dealer, bottle store, filling station, post office, police station and Mondi packing material warehouse. Less than 5 houses are located within the town and are limited to workers in the above economic activities.
- Soja Village is a ‘Share Block Scheme’ Village in close proximity to the old So-Ja mineral baths. There are 47 houses on this property with 11 permanent residents. The remaining houses are used over the weekends and during the holidays.
- Waterpoort Property Labour Tenant Village consisting of approximately 20 extended families residing in two locations on the property.

1.5 SENSITIVE RECEPTOR MAP

A sensitive receptor for the purpose of this study is defined as a person or place where involuntary exposure to pollutants released by the proposed project could take place. Receptors surrounding the proposed site were identified from a site visit and through satellite imagery (Figure 58). They are as follows:

- Waterpoort Town, Soja Village and the Waterpoort Property Labour Tenant Village.
- Farm houses, guesthouses, lodges and local residences on farms.
- Schools located within the vicinity of the Chapudi Project area.
- Clinics.

Other sensitive receptors within the area would be the local fauna and flora. It has been identified that dust may result in sickness and associated lung disease for wildlife and human which will arise as a result of mining operations.

The current land use activities and sensitive receptors within and surrounding the Chapudi Project area is discussed in detail in Sections 4.4 and 4.5 of the SEIA (ANNEX-9).

1.6 SPECIALIST STUDIES

A number of specialist studies were performed as part of this EIA study, in line with the Plan of Study presented in the Scoping Report for the Chapudi Project, August 2013. These are attached as Annexures as listed below.

Annexure	Aspect	Independent Consultant
ANNEX-1	Soils, Land Use & Capability	Gudani Consulting - EcoSoil Consortium
ANNEX-2	Surface Water	WSM Leshika Consulting (Pty) Ltd
ANNEX-3	Groundwater	WSM Leshika Consulting (Pty) Ltd
ANNEX-4	Biodiversity	Phaki Phakanani Environmental Consultants
ANNEX-5	Aquatic Systems	Scientific Aquatic Services
ANNEX-6	Ambient Noise	Gudani Consulting
ANNEX-7	Air Quality	Royal Haskoning DHV
ANNEX-8	Heritage Resources	Mbofho Consulting and Projects
ANNEX-9	Socio-Economic Aspects	Naledi Development Restructured (Pty) Ltd
ANNEX-10	Macro-Economic Aspects	Mosaka Economic Consultants cc

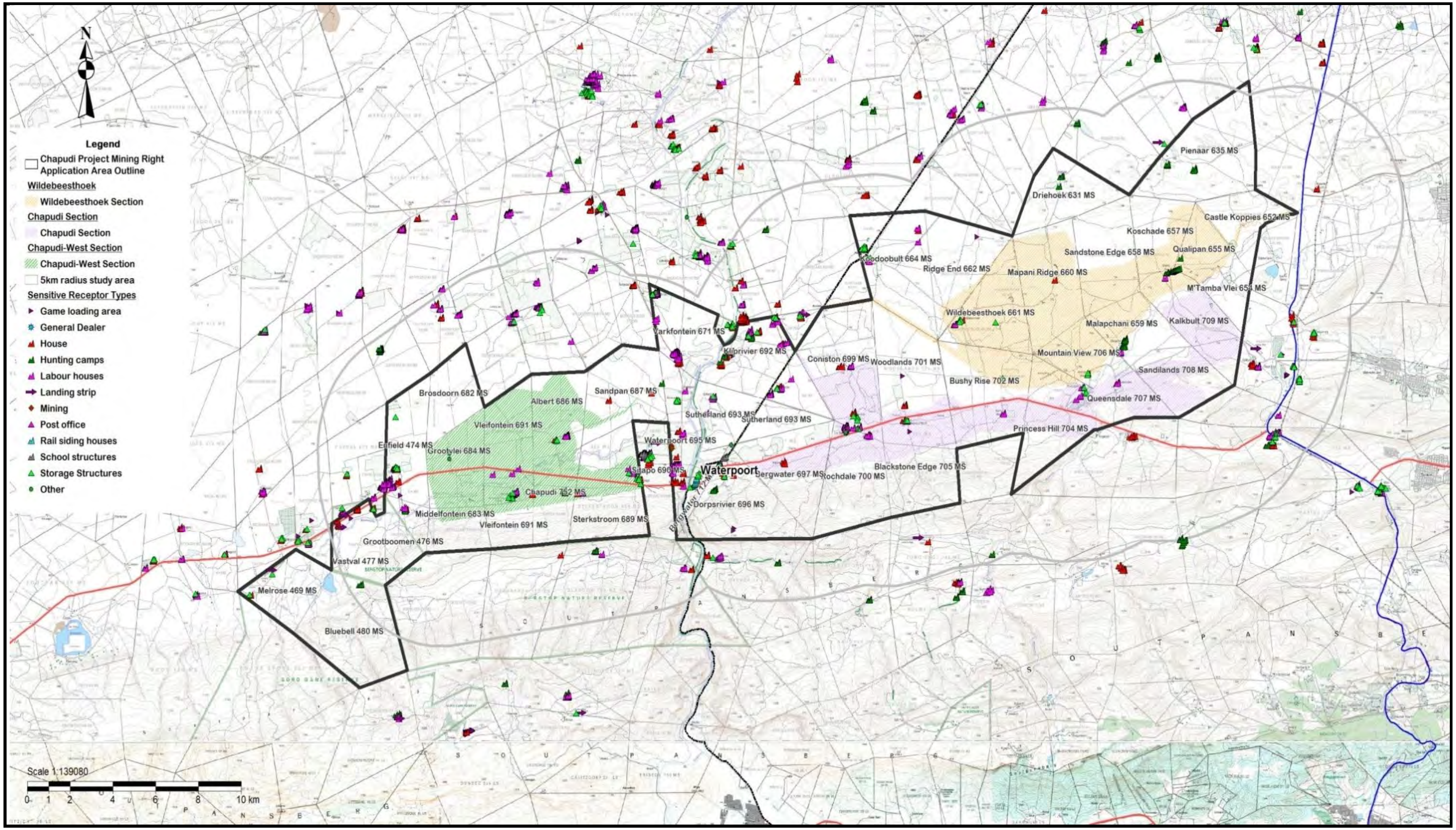


Figure 58: Sensitive receptor map for Chapudi Project

2 PROPOSED MINING OPERATION

2.1 MINERAL TO BE MINED

The Chapudi Project has the potential to produce good quality hard coking coal and a domestic thermal coal product. The current planning is that construction and mining will commence at the Wildebeesthoek Section first where the coking coal yields are the highest. It is expected that mining operations at the Chapudi Sections will only commence much later (in terms of current data towards 2033) as capacity in infrastructure is developed.

The Wildebeesthoek Section will be mined at 12.5 Mtpa, whilst the Chapudi and Chapudi West Sections combined will be mined at 12.5 Mtpa and the life of mine is expected to exceed 30 years.

The Chapudi Project is situated within an extension of the Tshipise Coalfield, a subdivision of the Soutpansberg Coalfield. This extension is referred to as the Waterpoort Coalfield in some of the literature. Within the Chapudi Project area, seven coal zones (or seams) are recognised, three of which occur in the Lower Ecca Group with the remaining four occurring in the Upper Ecca Group. In the literature, these seams are numbered from Seam 1 at the base to Seam 7 at the top, near the gritty sandstone marker horizon of the Fripp Formation which occurs in the Beaufort Group. The Fripp Formation reaches a maximum thickness of 40m in the Chapudi Section area. Although coal zones are referred to as “seams” they are effectively selected, potential mining horizons within the coal bearing-package. All seams comprise interbanded carbonaceous mudstones and coal. The coal component is usually bright and brittle and contains a high proportion of vitrinite. The resource outcrops and dips predominantly to the north at approximately 12°.

It is estimated that in most instances it is mineable to a depth of 200 m through open cut methods. Initial appraisal has led to the conclusion that only Seam 6 has economic potential at present, since Seam 7 has a high ash content and a low yield, i.e. a 40% ash product with a yield of 10%.

The Soutpansberg Coalfield is situated north of the Soutpansberg Mountain Range in the Limpopo Province stretches for ± 190km from Waterpoort in the west to the Kruger National Park in the east. The Soutpansberg Coalfield can be divided into 3 separate coal fields i.e. the Mopane Coalfield, the Tshipise Coalfield and the Pafuri Coalfield. The Pafuri Coalfield terminates at the northern limit of the Kruger National Park in the east and is in exploration phase of development.

The Mopane and Tshipise Coal fields are host to the Makhado Colliery as well as the GSP Projects, including the proposed Chapudi Project – Figure 59.

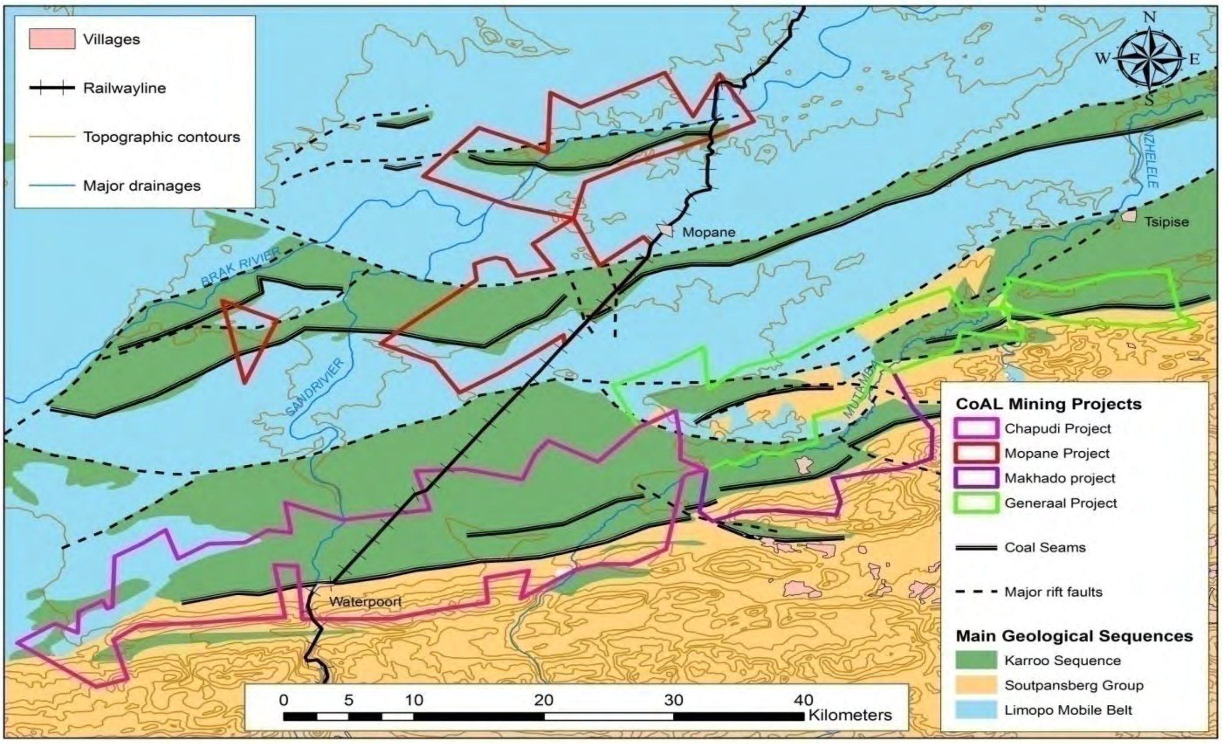


Figure 59: Regional Geology of CoAL Mining Projects within the Soutpansberg Coalfield

The regional geology consists of 3 main lithological groups, i.e. the Limpopo Mobile Belt, the Soutpansberg Group and the Karoo Sequence rocks:

- The ***Limpopo Mobile Belt*** (LMB); forms the gneissic basement on which the overlying strata (Soutpansberg Group and the Karoo Sequence) was deposited. The LMB rocks are the metamorphic expression of the collision and welding together of the Kaapvaal craton and the Zimbabwe craton. The LMB has a long and complex history of deformation occurring from 3200 Ma (million years) to 2000 Ma. The LMB gneisses are made up of inter-cratonic sediments and volcanics, deformed and metamorphosed to granulite facies and intruded and by granite bodies which have themselves been metamorphosed to varying degrees. The rift fault systems controlling the various basins, in which the Soutpansberg and Karroo strata have been preserved, are major zones of crustal weakness preferentially re-activated during periods of tectonic instability over time.
- The ***Soutpansberg/Waterberg Group*** strata were deposited into rift basins controlled by these major fault systems between 1900 Ma and 1600 Ma. The strata consist of basaltic lavas, arenites and shales attaining a maximum preserved thickness of 5000m. Dips can vary from 20° to 80° to the north.
- The ***Karoo Sequence*** strata were deposited on LMB basement and/or Soutpansberg Grp. strata between 300 – 180 Ma. Karoo deposits are preserved in the same reactivated rift basins and are often terminated against major east-west trending faults on their northern margins. The dips are between 3° and 20° to the north with coal located at the base of the sequence. The nature of the coal deposits changes from a multi-seam coal-mudstone

association (7 seams) approximately 40m thick in the west (Mopane Coalfield), to two thick seams in the east (Pafuri Coalfield in the Tshikondeni area).

The Chapudi Project is a 36 km strike length of coal deposited and preserved in a down fault basin at the base of the northern face of the Soutpansberg Mountain range. Karoo strata is deposited unconformably onto the Soutpansberg Group strata. The coal deposit targeted by the Chapudi Project has also been labelled as the Waterpoort Coalfield. The coal "seams" are numbered from the base as Seam 1 to 7 at the top. The top of the coal/carbonaceous package ends against a gritty sandstone marker (Fripp Formation). Current estimates indicate that only Seam 6 is economic at present. The strata dips on average at 12^0 to the north and can be mined open cast to a depth of 200m.

2.1.1 STRATIGRAPHY

The various stratigraphic units are described in chronological order from oldest to youngest:

Limpopo Mobile Belt rocks occur to the north of the MRA area as the up thrown block of the Tshipise Fault and was adequately described in the preceding section.

Soutpansberg Group strata form the mountain range to the south of the MRA area and consist of the following formations.

- Wylliespoort Formation, a thick weather resistant quartzite which forms the backbone of the Soutpansberg range;
- Musekwa Formation consists of amygdaloidal basalt lavas; and
- Nzhelele Formation consists of red shale and quartzite lenses.

Karoo Super Group strata for purposes of representation were divided into Lower Karoo, Middle Karoo, the Clarens Fm and the Letaba basalts. See Figure 60 and Figure 61 for the geological map and cross-section.

The ***Lower Karoo*** consists of a basal glacial deposit overlain by carbonaceous and coaliferous mudstones. From oldest to youngest the stratigraphy is as follows:

- Tshidzi Formation; a 10m thick basal conglomerate/diamictite and can be correlated to glacial Dwyka Tillite in the main Karoo basin.
- The Madzoringwe Formation; a succession of alternating black shale, micaceous sandstone, siltstones and inter-bedded coal seams attaining a thickness of 190m. The coals seams are of economic potential.
- The Mikambeni Formation overlying the above consists of dark grey mudstone and shale with subordinate sandstone attaining an approximate thickness of 140m. The Madzoringwe and Mikambeni Formations can be correlated with the Ecca Group of the main Karoo basin.

The ***Middle Karoo*** consists of overlying fluvial deposits made up of sandstones and grey, purple and red mudstones. The stratigraphy from oldest to youngest is as follows:

- The Fripp Sandstone Formation consists (10-20 m) of coarse feldspathic sandstone or "grit" and often forms a ridge on outcrop and marks a change from a mature meandering river depositional environment to a braided stream environment.
- The Solitude Formation; is a 110m thick inter-layered grey and purple shale with minor sandstone and grit intercalations.
- The Klopperfontein Formation (10-20 m) resembles the Fripp Sandstone Formation as a coarse, feldspathic "gritty" sandstone.
- The overlying Bosbokpoort consists of red very fine sandstone and dark red silty mudstone.
- The fluviatile Red Rocks Member (150m) of the overlying Clarens Formation is also placed in the Middle Karoo strata.

The ***Tshipise Member*** (150m) of the Clarens Formation caps the underlying fluvial sediments with aeolian sands as the final expression of sedimentary deposition in an ever increasingly arid environment.

The Letaba basalt ends Karoo Sequence deposition with widespread outpouring of continental lavas, heralding a period of tectonic instability and the start of the break-up of Gondwanaland.

Dolerite sills and dykes served as feeders to the basalt lava and are the hyperbyssal component of this event. A large sill has intruded approximately along the contact between the Middle and Lower Karoo strata to the east. According to exploration drilling the sill has not impacted on the coal seams but can act as a fractured aquifer with high water inflows into the pit.

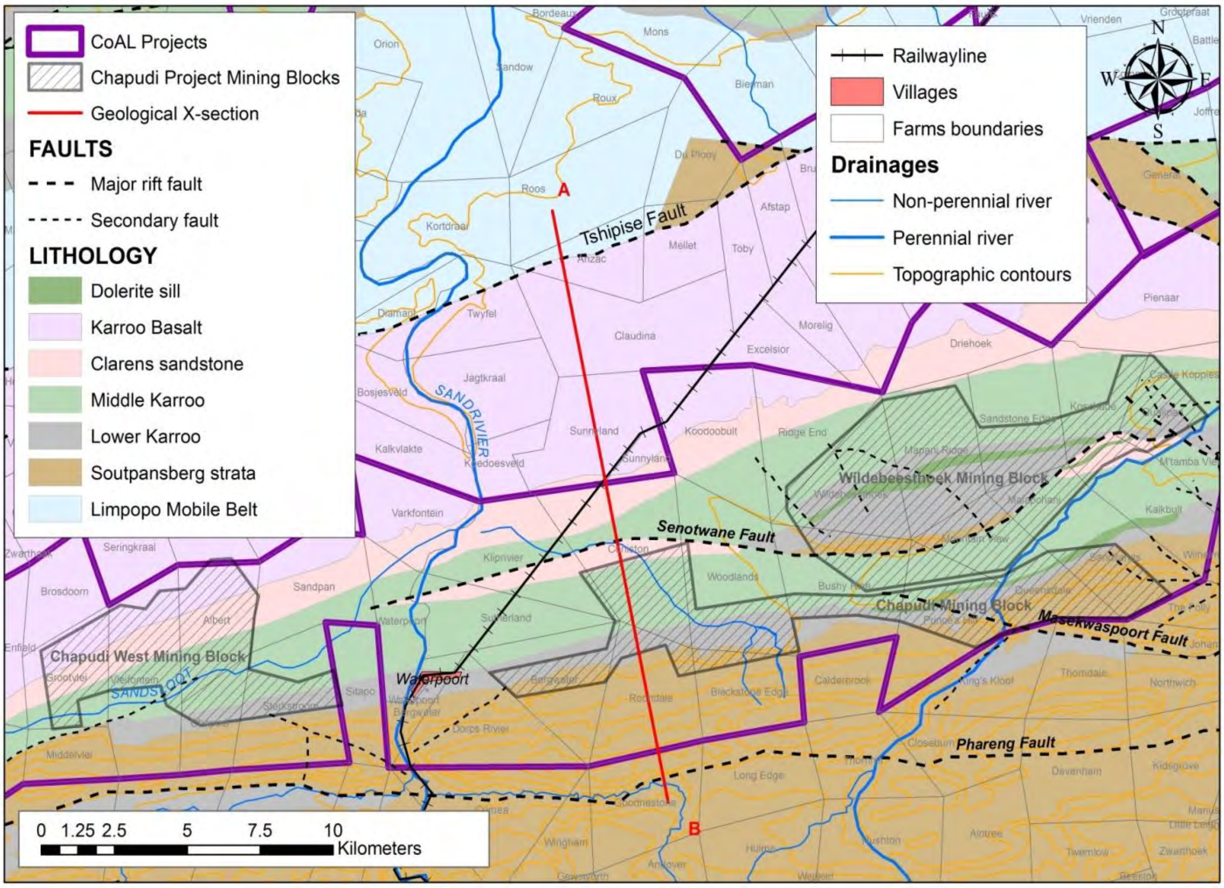


Figure 60: Chapudi Mining Project geology

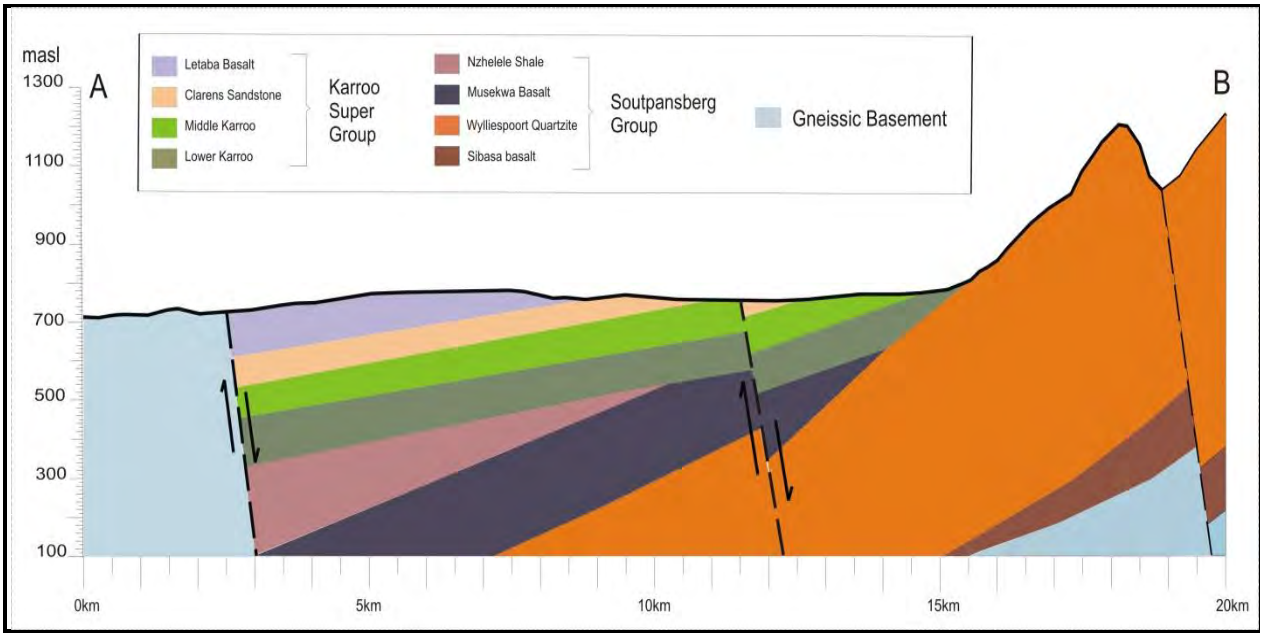


Figure 61: Chapudi Mining Project geological cross-section

2.1.2 QUATERNARY ALLUVIAL AND COLLUVIAL DEPOSITS

Various Quaternary age deposits occur within the study area. They consist of the following;

- Colluvium or slope scree deposited at the base of the mountain (colluvium) and can attain thicknesses of up to 30m in the west against fault scarp faces.
- Alluvium adjacent to the main drainages, i.e. the Sand River and the Moleletsane River.
- The area is covered by sandy soils thought to be at least partially of aeolian origin.

These deposits are generally unconsolidated but have been cemented in places with ferricrete and calcrete.

2.1.3 STRUCTURE

The main structural feature of the Chapudi basin is the westerly extension of the east – west trending Tshipise Fault which also forms the faulted contact between the Karoo strata and the LMB gneisses. The Tshipise Fault is a regional tectonic feature which forms the structural partition between the central zone of the LMB and the southern marginal zone.

The complete sedimentary sequence is duplicated by the Senotwane Fault - a normal E-W trending fault with a 30 km strike length occurring east of the Sand River. The fault terminates against another major fault striking NW at its' eastern limit. Both these faults are associated with high yielding boreholes exploited by the local farmers for irrigation purposes on the farms, e.g. Coniston, Wildebeesthoek, Mountain View and Bushy Rise.

Numerous wrench faults also occur in association with these faults and also host water in extractable quantities. Another east west trending fault occurs at the base of the mountain on the western portion of the MRA area. The fault terminates against the Phareng Fault and is also water bearing. The fault is origin to numerous springs along its strike and may have contributed salt to the evaporite salt pan deposit further west from whence the mountain range derived its name Soutpansberg.

2.2 EXTENT OF THE OPERATION

The Chapudi and Chapudi West Sections cover an area of 4 321 ha, and the Wildebeesthoek Section covers approximately 3 254 ha, for mining and infrastructure development.

The combined mining and infrastructure layouts are shown in Figure 62. This picture demonstrates the full extent of mining and is not a moment in time. The pits will be backfilled concurrent to mining and it is anticipated that no more than 600 ha will be open at any one time.

Infrastructure for supporting the mining activities has been laid out and engineered so as to best suit the topography and mining pit layouts, but can be influenced by the environmental impact assessments and stakeholder engagement process.

Each of the Wildebeesthoek, Chapudi and Chapudi West Sections will require a dedicated coal beneficiation plant. The total ROM capacity for the Wildebeesthoek beneficiation plant is 12.5 Mtpa. Two mining areas will be exploited for Chapudi coals with the Chapudi Section supplying

8 Mtpa to a large beneficiation plant and the Chapudi West Section supplying 4.5 Mtpa to a smaller beneficiation plant. The mine infrastructure areas (MIA) comprise all the facilities, roads, services and systems required for the mine to operate optimally. The individual mining sections will be provided with workshops and other necessary infrastructure required for the mining operation. The centrally located infrastructure will comprise a coal beneficiation plant, personnel support structures, vehicle support structures, water management structures and management and monitoring systems. Buildings will include management offices, production offices, change house, medical and fire fighting facility, shift changing facility, security and access control, training centre, control room and contractors accommodation camp (during construction only).

The major infrastructure items were designed and positioned to accommodate mining layouts at both pits, access to stockpiles, location of the beneficiation plants, and environmental requirements. Other mine infrastructure includes:

- Access and on-site haul roads;
- Topsoil stockpiles and berms;
- Overburden (carbonaceous and non-carbonaceous) stockpiles for initial placement, thereafter disposed in-pit;
- ROM coal storage area;
- Associated conveyors from the processing plant to the product storage areas;
- Product stockpile areas;
- Carbonaceous discards stockpile;
- Storm water management infrastructure (i.e. clean & dirty water run-off);
- On-site water management and reticulation systems;
- Wastewater (sewage) treatment plant;
- Bulk electricity supply infrastructure;
- Bulk water supply infrastructure; and
- Railway Siding and rail loop with Rapid Load-out Terminal (RLT).

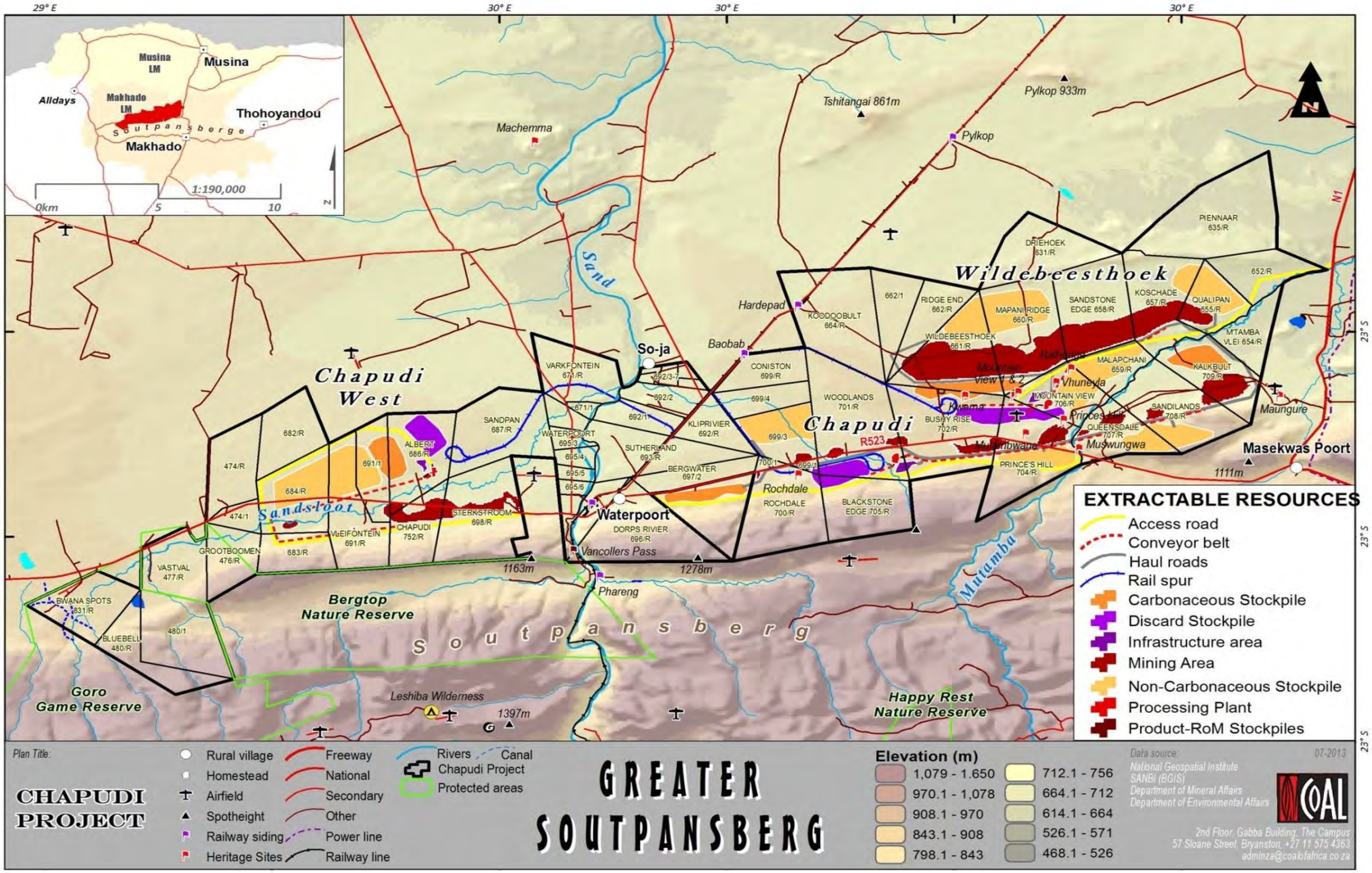


Figure 62: Mining and infrastructure layout for Chapudi Project

2.3 MINING OPERATIONS

2.3.1 MINING METHODOLOGY

The Chapudi Project is planned as open pit operations where the extraction of coal is a total extraction mining method using conventional truck and shovel. The mining process involves stripping, drilling, blasting, loading and hauling of overburden to the waste dumped and run of mine (ROM) stockpile or processing plant area.

A total extraction open pit mining method has been selected, where the open pit will be mined through conventional truck and shovel. The process involves stripping, drilling, blasting, loading and hauling of overburden to the waste dump and ROM stockpile or processing plant area. Drilling of blast holes is carried out by pneumatic or hydraulic crawler mounted drills and blasting will make use of commercial, emulsion type explosives delivered on site by an explosives manufacturer.

Recovery operations are intended to be conducted by large hydraulic excavators in backhoe configuration to manage the complexity of the deposit. A fleet of trucks at 220 tonne payload has been allocated for waste movement. Coal mining and reject haulage has been modelled with a fleet of trucks at 150 tonne payload. The scheduled waste demand to meet a 2.5 Mtpa coal product production rate is such that 1 coal excavator is required with 3 interburden excavators and 2 overburden excavators. The fleet will be exclusively diesel powered.

2.3.1.1 Mining Sequence

The mining sequence in the open pit environment is illustrated in Figure 63.

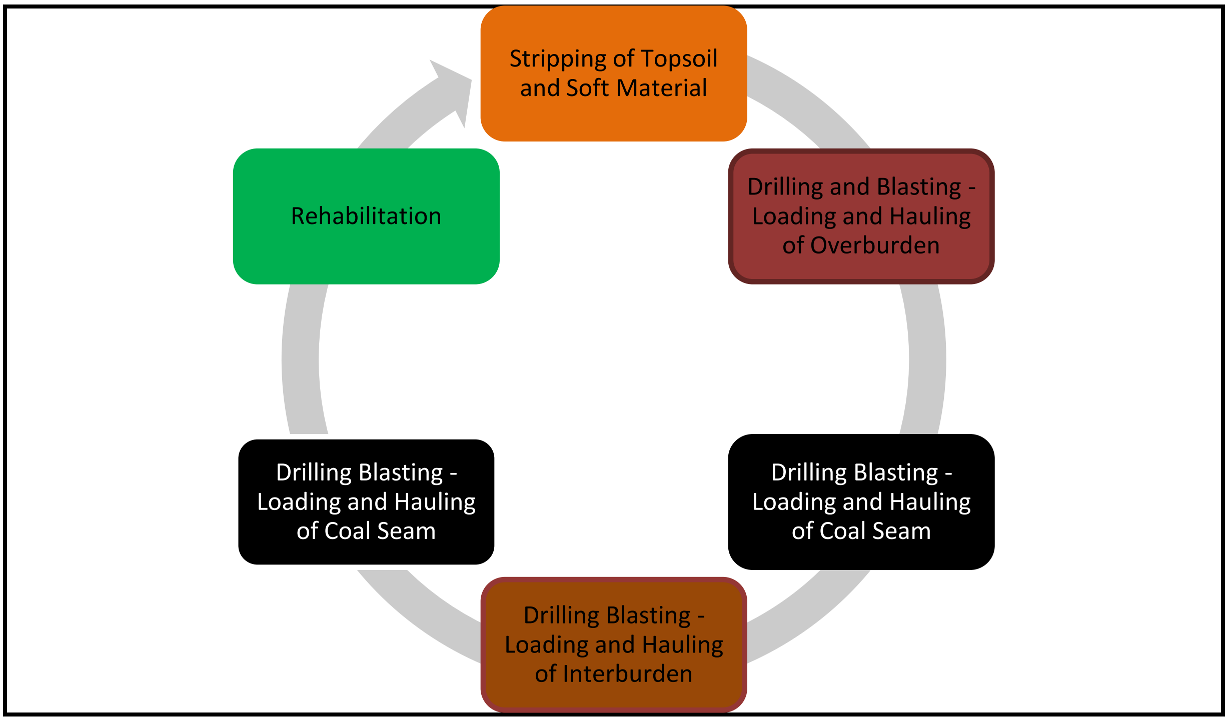


Figure 63: Typical mining sequence

Open pit terminology is illustrated in Figure 64.

2.3.1.2 Drilling and Blasting

- Drilling of blast holes by pneumatic or hydraulic crawler mounted drills;
- Blasting with commercial, emulsion type explosives delivered on site by an explosives manufacturer by means of an explosives delivery truck;
- Slope angles to be as per design; and
- Vertical benches as per design.

Figure 65 illustrates a typical layout of how the overburden and interburden drilling and blasting would be conducted.

2.3.1.3 Loading and Hauling

- Loading and hauling are done by means of shovels and/or front-end loaders into off-road haul trucks for hauling to the primary crusher or waste dump on site;
- Ramps will be from 20m to 30m at 1:10 gradients; and
- Operating lift height as specified in the design.

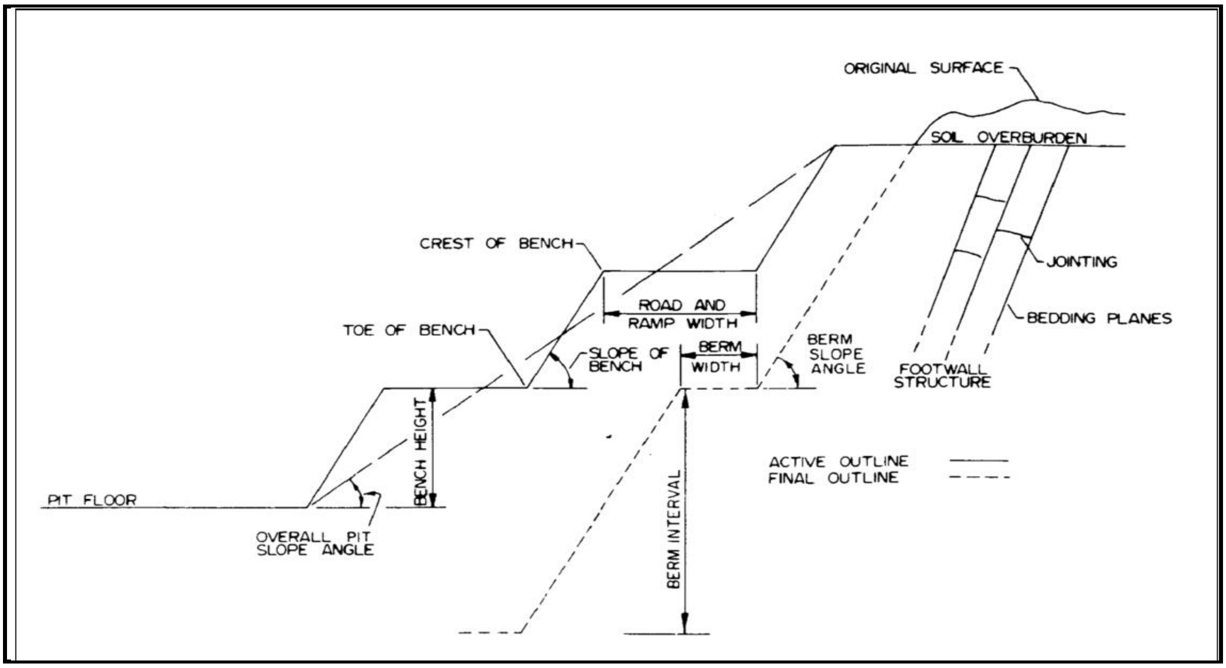


Figure 64: Open pit mining cross section layout

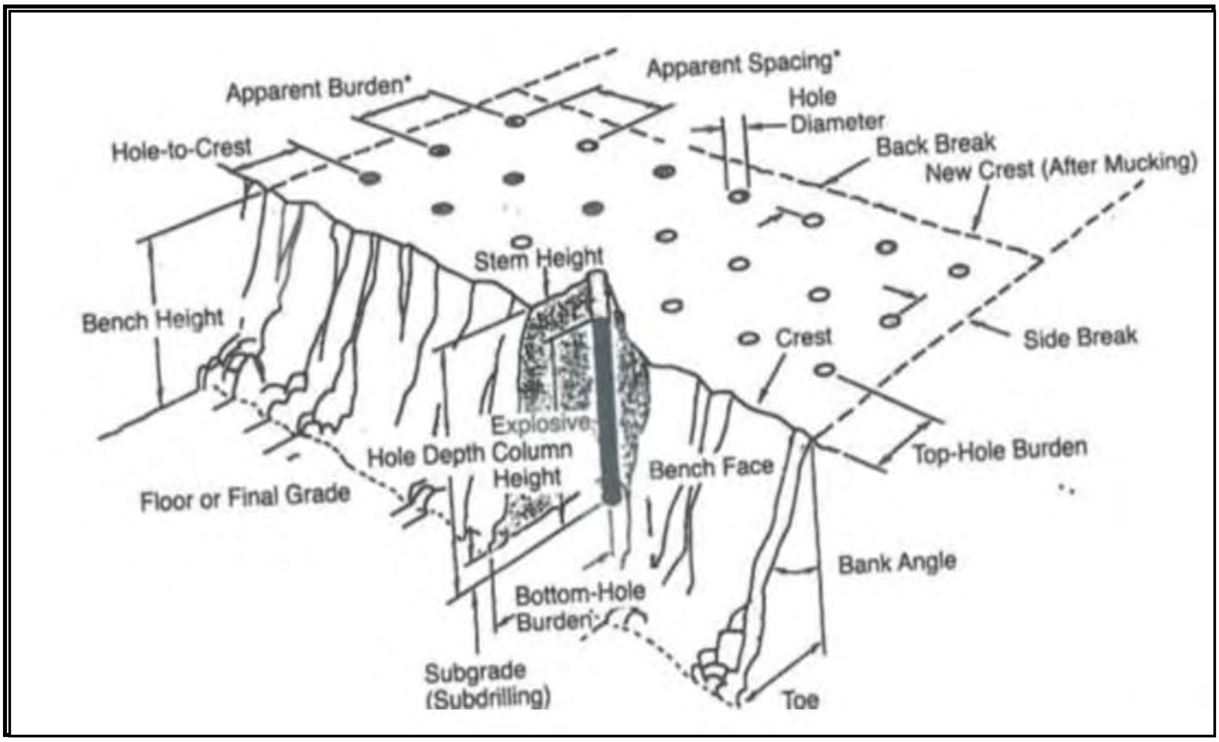


Figure 65: Schematic drilling and blasting pattern

2.3.2 MINING SCHEDULE

Within the Chapudi Project it is the Wildebeesthoek Section that is developed first and hence mine design details are further advanced. Further feasibility studies on Chapudi and Chapudi West will need to be undertaken during the life of the Wildebeesthoek Section.

2.3.2.1 Wildebeesthoek Section

The schedule runs over a period of approximately 31 years at a ROM production rate of 12.5 Mtpa including the ramp down phase in the 31st year. The waste volumes to be mined are at approximately 130 Mtpa for the first 5 years, 112.5 Mtpa for years 6 to 18, 120 Mtpa for years 19 to 25 and then ramps down from year 26 to LOM. The LOM production schedule with the relevant product types is illustrated in Figure 66.

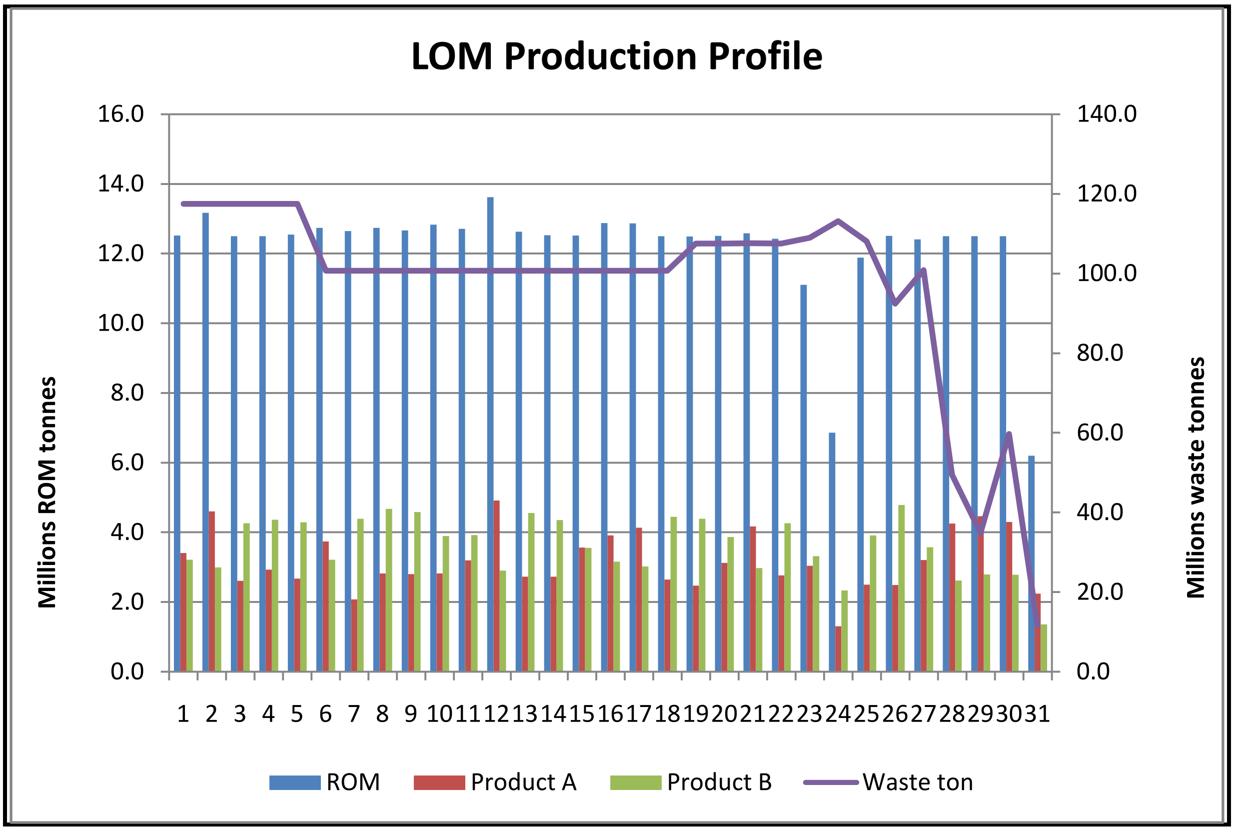


Figure 66: Wildebeesthoek Section - LOM Production Profile

2.3.2.2 Chapudi and Chapudi West Sections

Chapudi Section only starts mining operations in 2033 and the Chapudi West Section in 2041.

The estimated ROM coal production is 12.5 Mtpa with 100 Mtpa of waste mining and combined product of 7 Mtpa. The expected LOM is 43 years with year 1 starting in 2033.

The mine and infrastructure layout plans for the Wildebeesthoek, Chapudi and Chapudi West Sections are shown in Figure 67, Figure 68 and Figure 69, respectively.

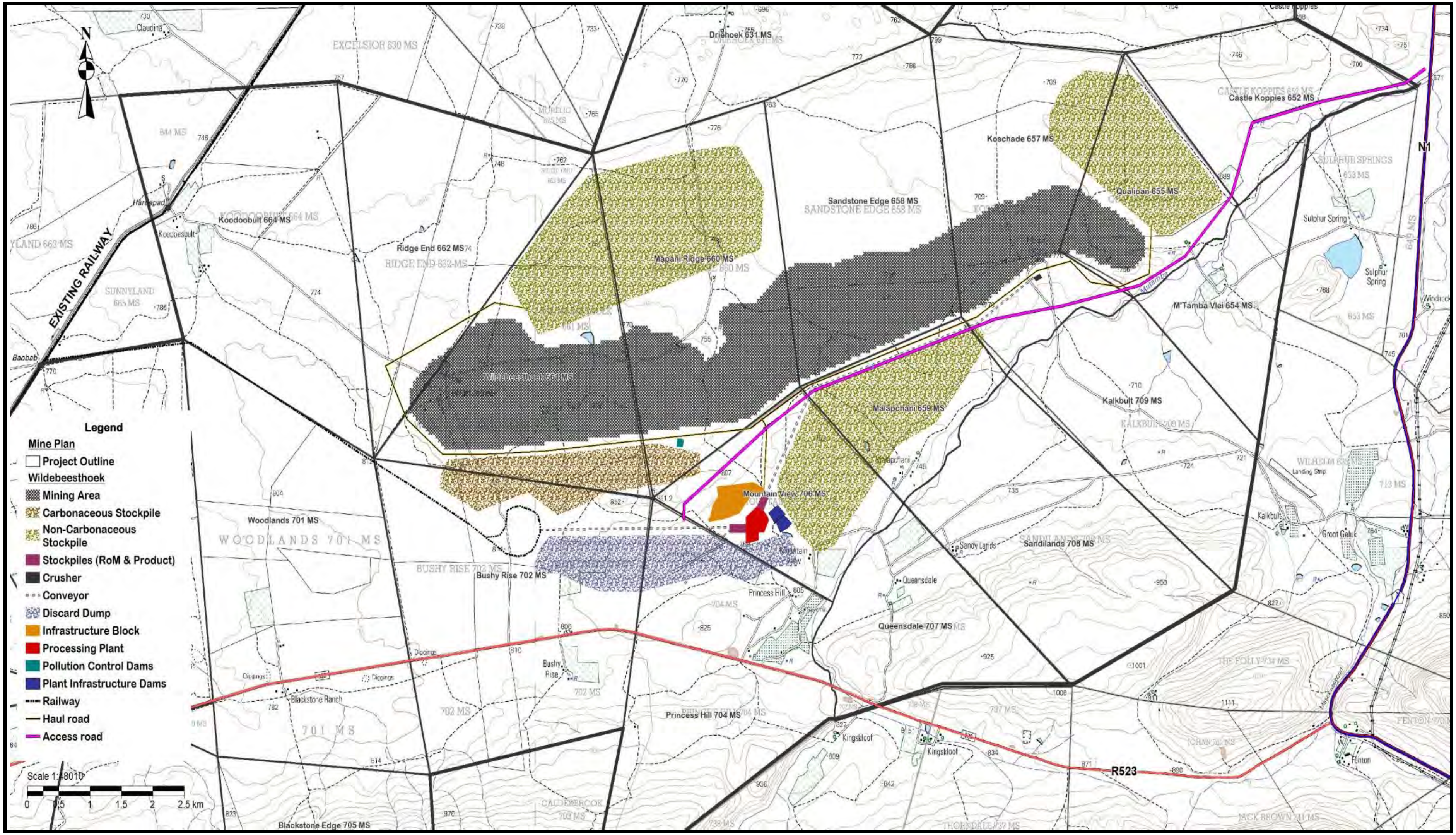


Figure 67: Wildebeesthoek Section - Mine and infrastructure layout plan

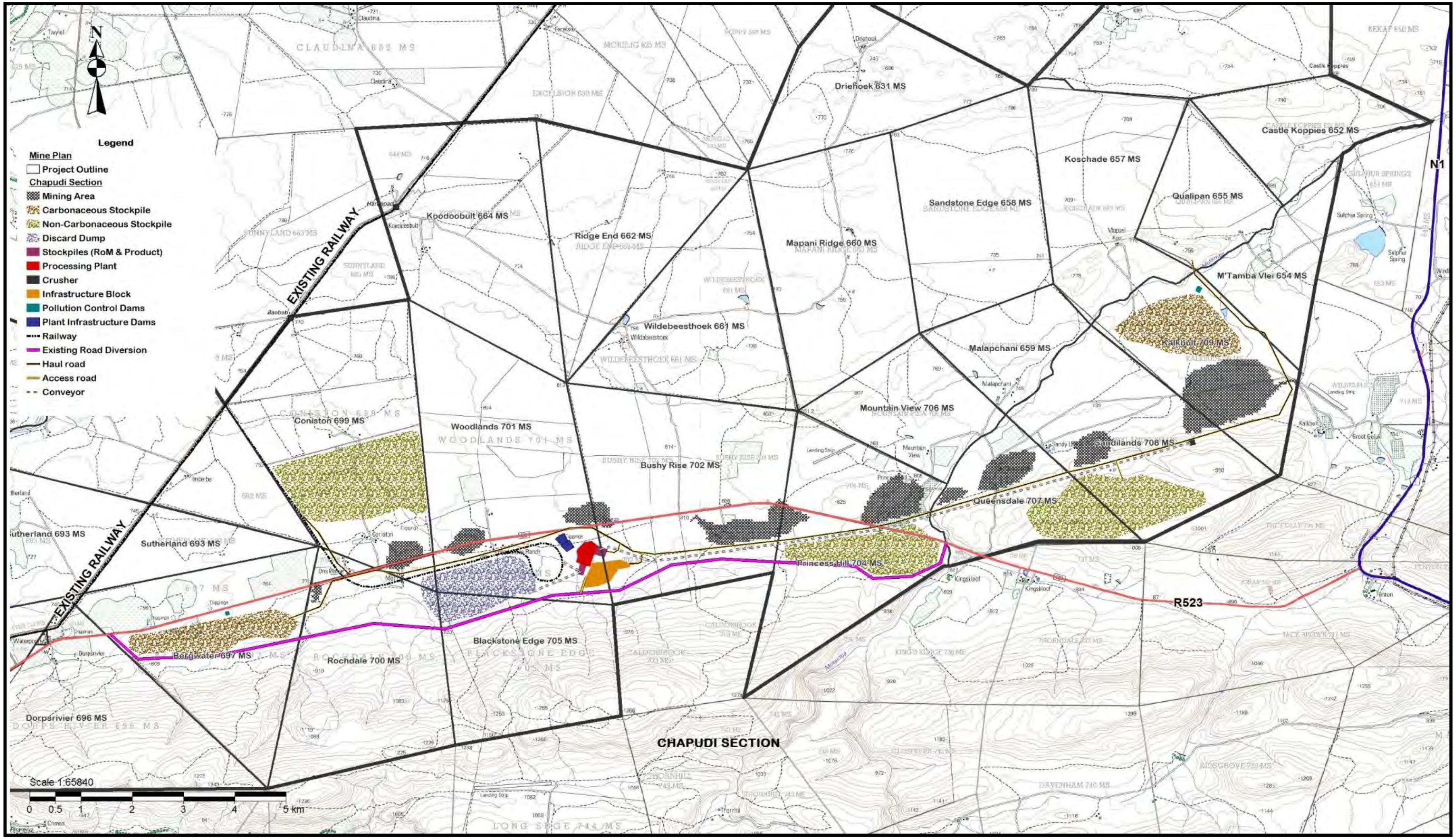


Figure 68: Chapudi Section - Mine and infrastructure layout plan

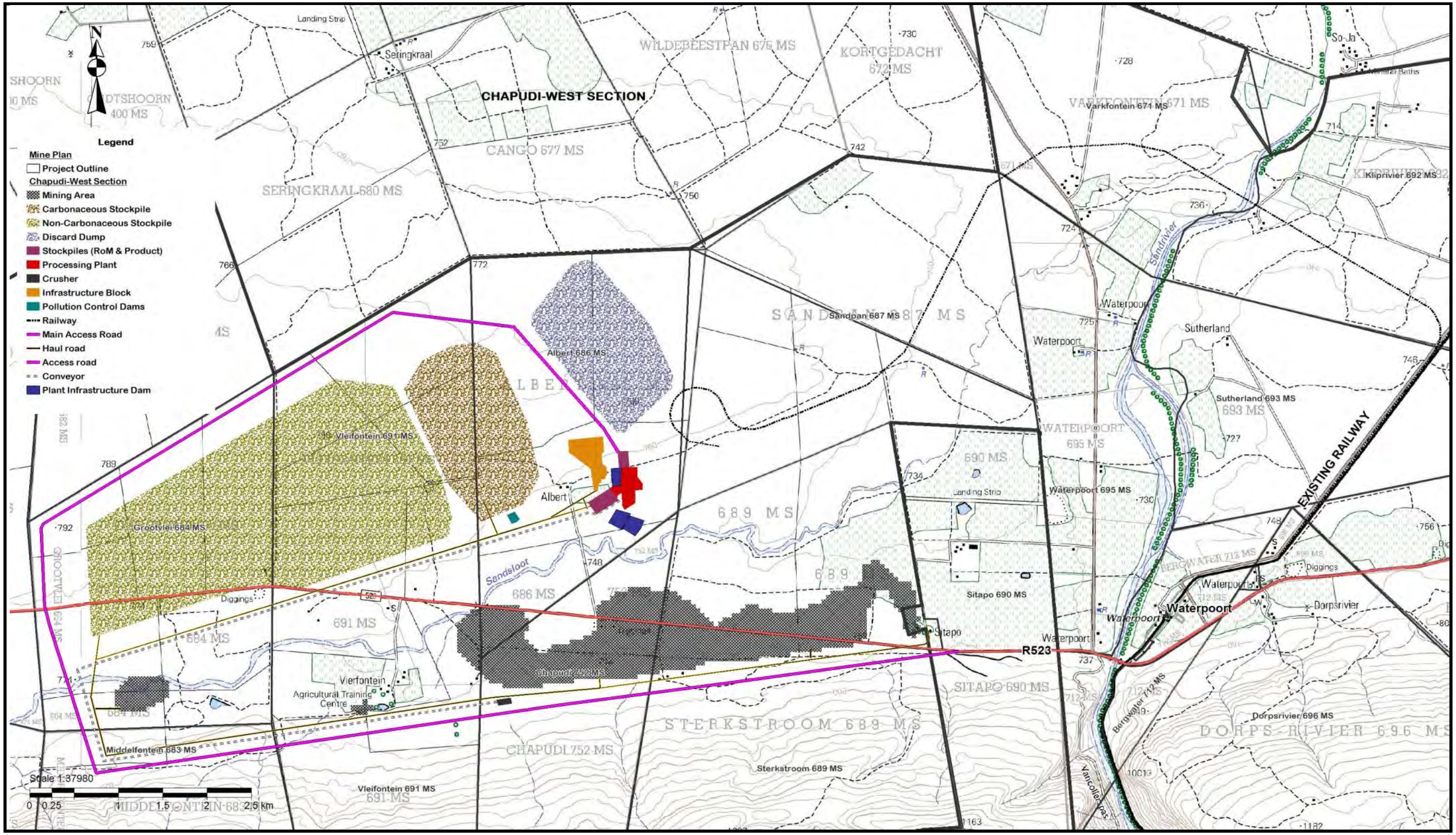


Figure 69: Chapudi West Section - Mine and infrastructure layout plan

2.3.3 COAL PROCESSING

Each of the Wildebeesthoek, Chapudi and Chapudi West Sections will require a dedicated coal beneficiation plant, situated on the farms Mountain View 706 MS, Woodlands 701 MS and Albert 686 MS, respectively. The necessary conveyor systems will be put in place to transport the run of mine (ROM) from the open pits to the respective beneficiation plants.

The total run of mine (ROM) capacity for the Wildebeesthoek beneficiation plant is 12.5 Mtpa. Two mining areas will be exploited for Chapudi coals with the Chapudi Section supplying 8 Mtpa to a large beneficiation plant and the Chapudi West Section supplying 4.5 Mtpa to a smaller beneficiation plant.

2.3.3.1 Design Overview

The design of the coal beneficiation plant was selected on the basis of using concepts that ensure efficient and effective beneficiation of the Chapudi resource at the required quality within reasonable capital and operating costs. The technologies selected are well proven in the coal industry, that is, two-stage dense medium separation (DMS) for coarse coal (50 x 1mm) beneficiation using cyclone separators, up-flow classification for recovery of fine coal (1 x 0.3mm) using reflux classifiers and two-stage flotation using micro-bubble and conventional mechanical technologies for the recovery of ultra-fine coking coal (-0.3mm) product.

The coal beneficiation plant will produce two products namely a middlings product with an ash content of 30% and a coking product with an ash content of 10%. The beneficiation plant will therefore use the following technologies:

- Primary crushing of raw coal using a rotary breaker and removal of coarse material (+50mm) as breaker rejects at the pit area to produce a clean plant feed product – refer to Figure 70;
- Two-stage DMS for coarse coal (50 x 1mm) beneficiation using cyclone separators to produce a coking and middlings product – refer to Figure 71 and Figure 72;
- Two-stage of up-flow classification for recovery of fine coal (1 x 0.3mm) using reflux classifiers to produce a coking and middlings product – refer to Figure 73; and
- Two-stage flotation using micro-bubble and conventional mechanical technologies for the recovery of ultra-fine coking coal (-0.3mm) product.

The rotary breaker reject will be discarded due to the very high ash content of that size fraction. The breaker was selected as it cleans and sizes the coal and any material that resists breakage is discharged at the end of the unit.

The selection of dense medium cyclones allows for the treatment of raw coal with large variation in yield that will be treated during the proposed life of the mine. The use of two-stage reflux classifiers in the fines circuit improves the overall yield of the middlings product. The combination of different technologies in the flotation circuit improves the efficiency of separation of coking coal from ultra fine particles. The coarse products will be dewatered by centrifuges while the fines will be dewatered by filtration.

Fine tails will be dewatered using a thickener followed by tailings filtration before being discharged on a common discard conveyor feeding the discards stockpile. The development of the discards stockpile will be done in phases and will be compacted and the sides of the dump soil clad to reduce the risk of heating or spontaneous combustion.

Coal discard will be dumped onto discard dumps until sufficient pit room is available, where after it will be disposed of into the open pit.

2.3.3.2 Process Plant Key Design Features

The plant feed size is reduced to -50mm to ensure that high quality coal is liberated and effectively beneficiated using DMS, fines recovery and flotation processing technologies. The rotary breaker is used to ensure that any competent shale is removed from plant feed upfront as discard before feeding the process plant.

The coal shall be extracted from the ROM stockpile, at a controlled rate, via vibrating feeders beneath the stockpile. The use of feeders will allow for blending of the coal by drawing material from different areas of the stockpile to keep the plant yield as consistent as possible.

The plant uses a two stage DMS that allows for simultaneous production of a coking product of high value and a middlings product. The HG DMS cyclone will operate with a medium RD of 1.8 and medium to ore ratio of 3.5 to 1 to ensure efficient separation of coal in the cyclone. The LG DMS cyclone will operate with a medium RD of 1.3 and medium to ore ratio of 3.5 to 1 to ensure efficient separation of coal in the cyclone. The desliming screens will be fitted with 1 x 8.8mm slotted panels with a cut point of 1mm to ensure effecting sizing of coal and to reduce the blinding of panels with fines. The circuit can handle a feed size of 0.8mm to allow for a decrease in bottom size feed to the DMS should this plant be found to be more efficient than the reflux classifier on the fines fraction of -1+0.8mm. Pulping water and spray water is added on the screen to ensure efficient separation of fines from the coarse DMS feed.

The reflux classifiers have been selected instead of spirals due to its ability to cut at lower densities. This allows for recovery of a -1+0.3mm coking product with a targeted ash content of 10%. The reflux units will be supplied with probes that allow for monitoring and control of the cut point for efficient operation. The RC2350 reflux classifier has a maximum feed rate of 130tph and can treat particles with a size range of -2+0.25mm. This unit therefore gives flexibility to change the feed top size from 0.8 – 2mm to increase the proportion of feed reporting to the fines circuit should the unit be found to be more efficient than the DMS in the recovery of finer coking coal Added benefits of these units over spirals is that they use less footprint for a similar tonnage and can cut at an RD as low as 1.40 compared to spirals that typically cut at 1.70.

The flotation circuit uses a combination of micro-bubble flotation and conventional mechanical flotation for the processing of ultra-fines. The selected micro-bubble cells are Jameson units which have proven higher organic efficiencies. The Jameson cells have a smaller footprint than mechanical cells and do not require any power for operation. Mechanical cells will be used as scavengers and also to reduce residual frother in the flotation tailings stream as excessive frother leads to the formation of froth on top of the thickener and other process tanks in the plant.

The concentrate filtration plant does not include a concentrate thickener ahead of dewatering as the design of the concentrate filter feed tank ensures sufficient froth breaking before feeding the concentrate filter. The use of a tailings filter ensures that most of the water is recovered and re-used in the plant and as such no slimes disposal facilities are required for discarding fine tailings. The fine tailings will be disposed off with coarse discard.

The use of centrifuges on coarse and fine products allows for maximum recovery of process water in the plant. This reduces the amount of raw make-up water required by the plant thus improving water use efficiencies.

The plant chutes, bins, tanks and other areas prone to abrasive and impact wear will be adequately lined to withstand high wear rates. Lining will typically consist of VRN 400 steel liners, high density alumina tiles, epoxy lining, rubber lining and use of HDPE pipes.

Instrumentation in the plant will ensure effective operation of process units within optimum operating parameters. This allows for monitoring and control of process units to ensure efficient product recovery by the beneficiation plant coupled with automatic sampling, feed rate measurement and use of weighbridges to form the backbone of the metallurgical accounting system. Instrumentation will mainly consist of mass meters, nuclear density meters, level transmitters, level probes, pressure transmitters, flow meters and automatic samplers. A SCADA system will be used in the process control room to ensure effective process management.

2.3.3.3 Product Handling

The coarse coking product (-50+1mm) from the DMS plant, fine coking product from the fines circuit (-1+0.3mm) and product filter cake from the product cake stockpile (-0.3mm) are transported to the 2,000 tonne product silo via a product conveyor. The conveyor is fitted with a mass meter and an automatic sampler for metallurgical accounting purposes.

The product is withdrawn from the silo using a belt feeder that discharges onto common overland conveyors to transport final product to the Rapid Load-out Terminal (RLT). The product silo has an overspill chute which feeds an emergency stockpile when the silo is full. The emergency stockpile has an additional 50,000 tonne holding capacity and the product from the emergency stockpile can be reloaded onto the overland product conveyor by means of a re-load conveyor that is fed using front-end loaders.

The coarse middlings (-50+1mm) from the DMS plant and the fine middling from the fines circuit (-1+0.3mm) are transported to the 2,000 tonne middlings silo via a middlings conveyor. The conveyor is fitted with a mass meter and an automatic sampler for metallurgical accounting purposes.

The middlings silo feeds the common overland conveyors via vibrating feeders to transport middlings to the RLT. The common overland conveyors can only carry one product at a time to the RLT. The middlings silo has an overspill chute which feeds an emergency stockpile when the silo is full. The emergency stockpile has an additional 50,000 tonne holding capacity and the middlings from the emergency stockpile can be reloaded onto the overland product conveyor by means of a re-load conveyor that is fed using front-end loaders.

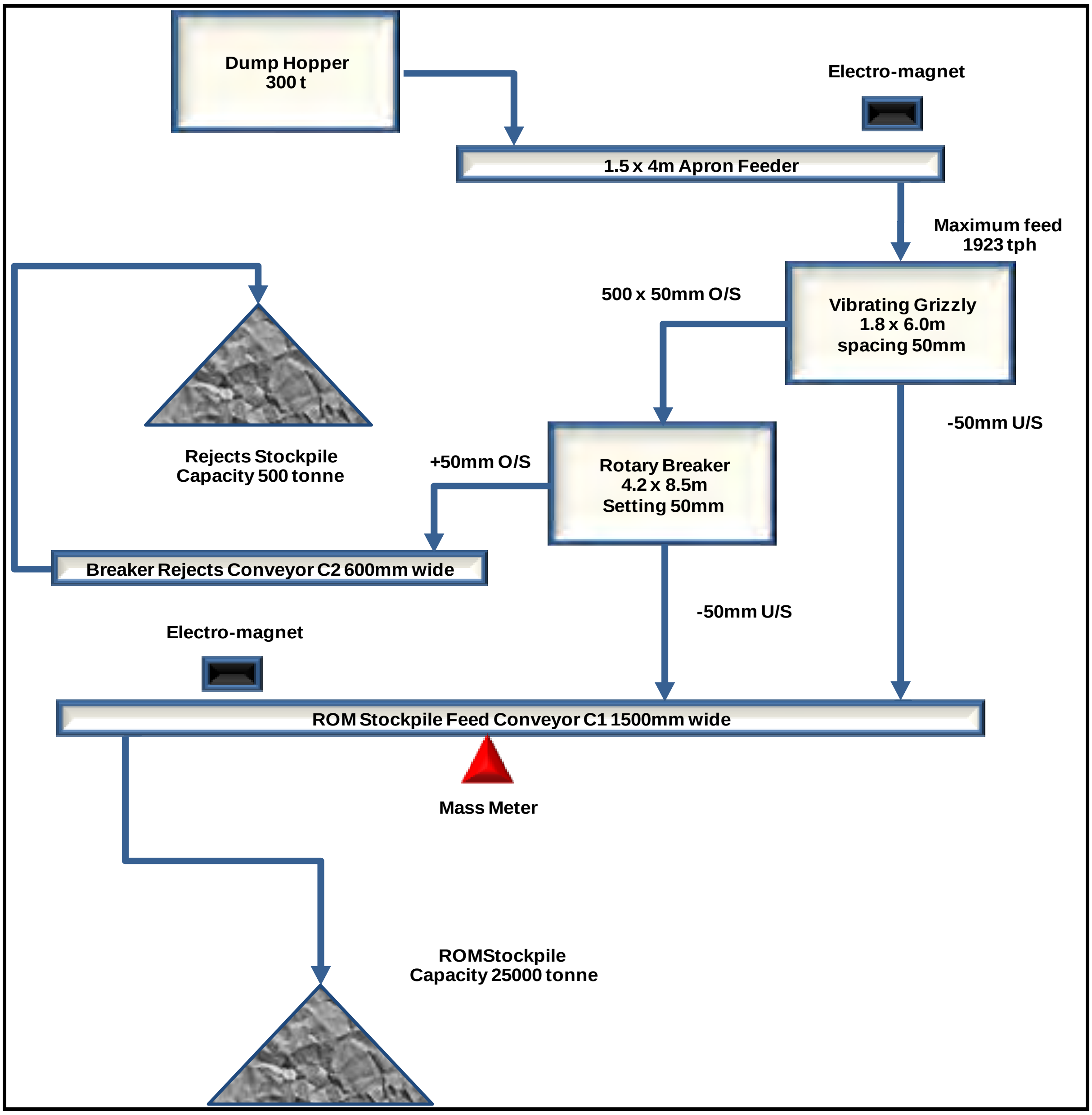


Figure 70: Wildebeesthoek Section – block flow diagram ROM Handling

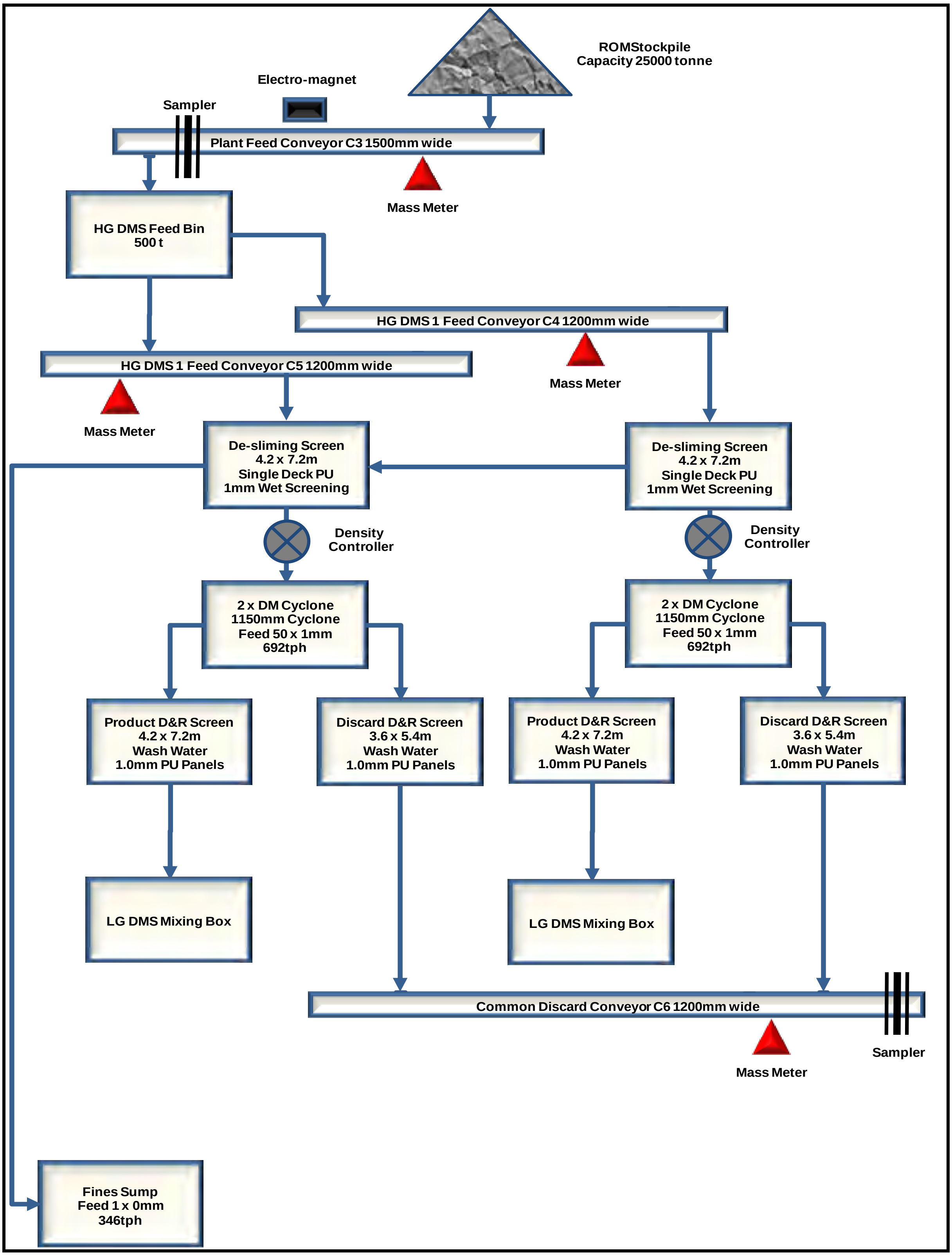


Figure 71: Wildebeesthoek Section – block flow diagram HG DMS

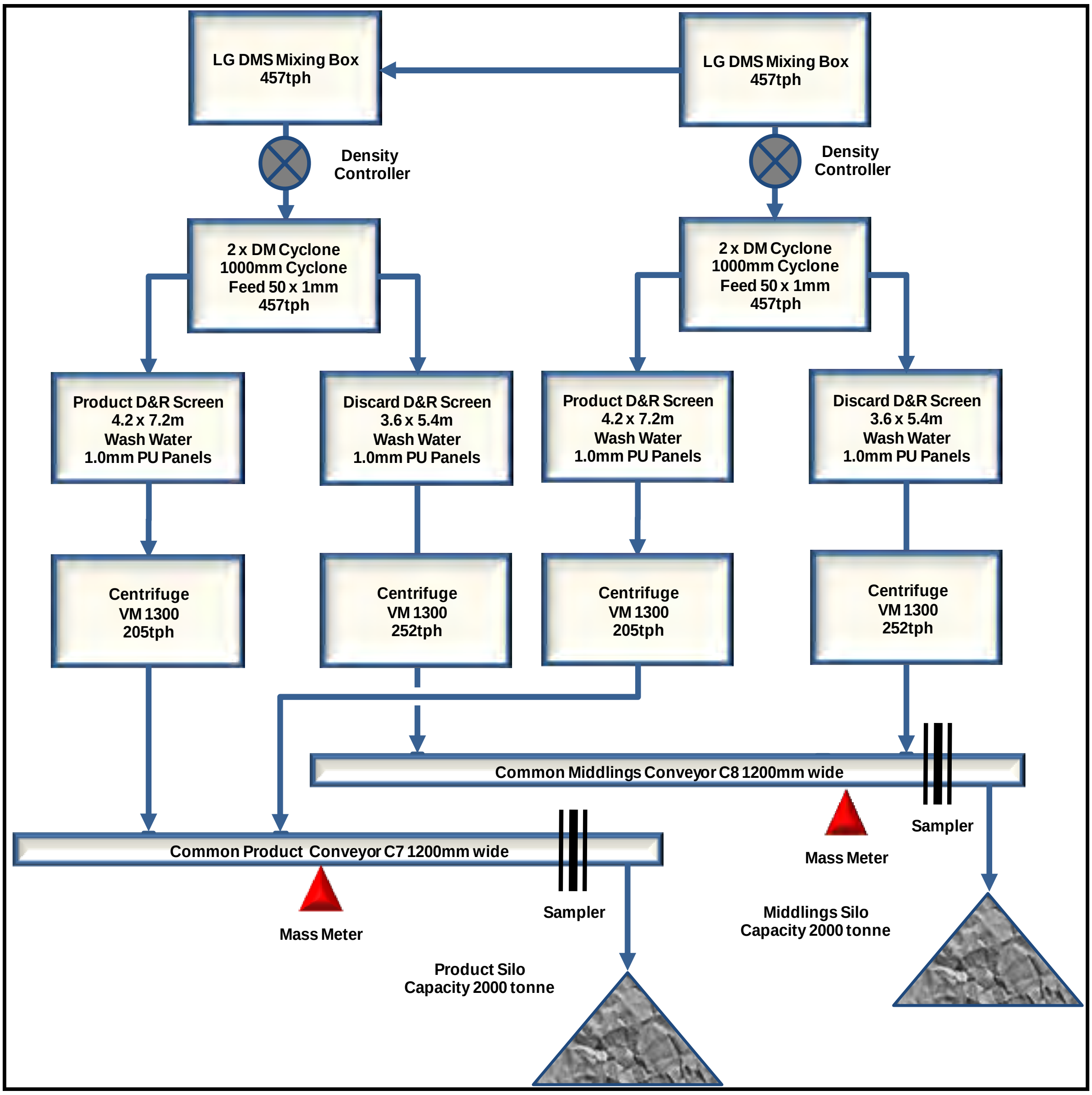


Figure 72: Wildebeesthoek Section – block flow diagram LG DMS

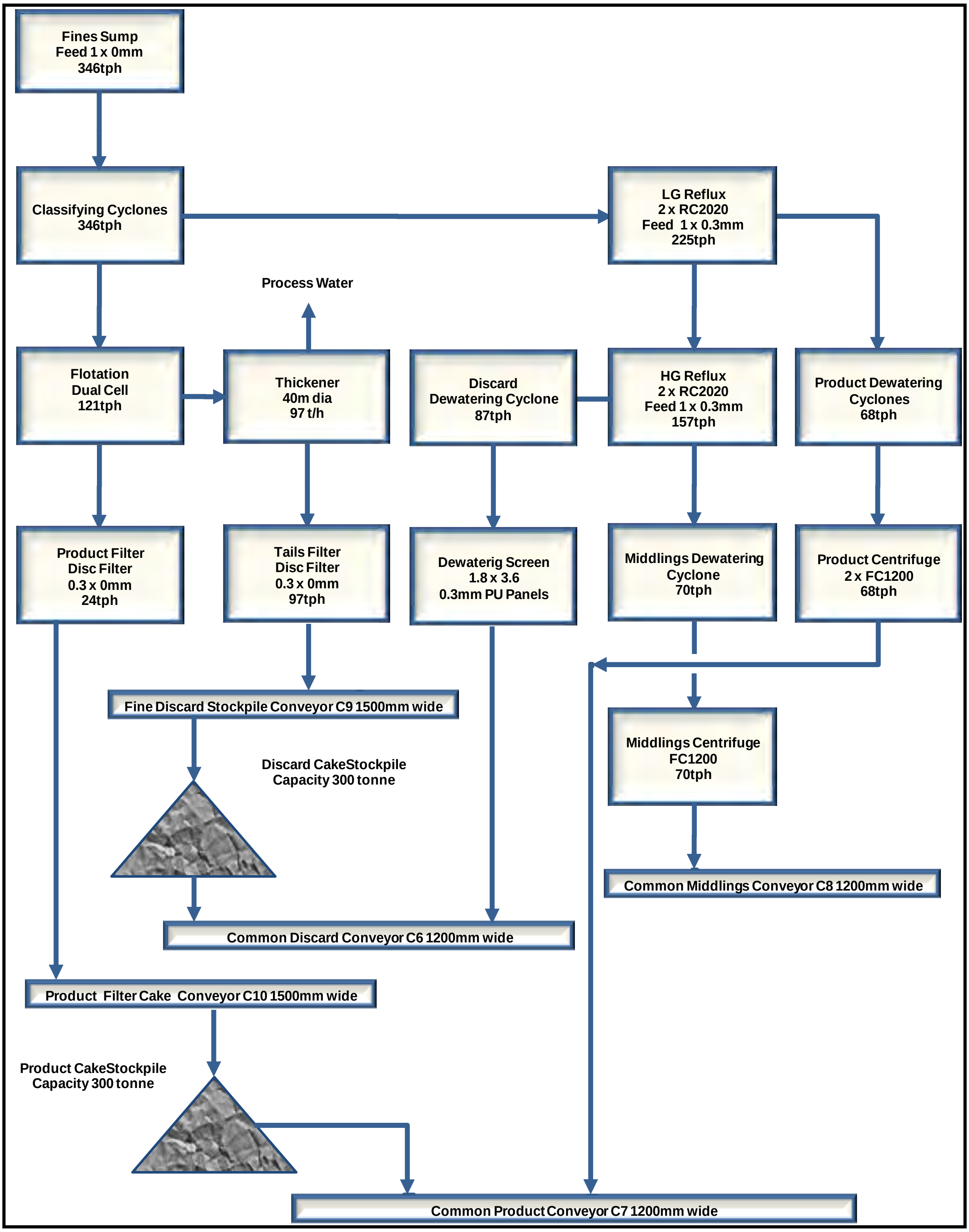


Figure 73: Wildebeesthoek Section – block flow diagram Fines Plant

2.3.4 MINE INFRASTRUCTURE

The mine infrastructure areas (MIA) comprise all the facilities, roads, services and systems required for the mine to operate optimally. The individual mining sections will be provided with workshops and other necessary infrastructure required for the mining operation. The centrally located infrastructure will comprise a coal beneficiation plant, personnel support structures, vehicle support structures, water management structures and management and monitoring systems. Buildings will include management offices, production offices, change house, medical and fire fighting facility, shift changing facility, security and access control, training centre, control room and contractors accommodation camp.

The major infrastructure items were designed and positioned to accommodate mining layouts at both pits, access to stockpiles, location of the beneficiation plants, and environmental requirements (including the management of dirty and clean water and protection of water courses and rivers).

2.3.4.1 Wildebeesthoek Section

The Wildebeesthoek Section support infrastructure is located centrally between the east and the west extremities of the pit on the farm Mountain View 706 MS.

2.3.4.1.1 Access Road

Access to the Wildebeesthoek Section is by way of the N1 towards Musina, turning west onto a new proposed intersection with the N1 where the D745 intersects east towards the Nzhelele Dam.

The main entrance to the Wildebeesthoek Section is approximately 12 km along the new route following the Mutamba River in a westerly direction from the N1 intersection. It is envisaged that a more appropriate route may be from the R523, this will be investigated during the feasibility phase. This road will have a gravel wearing surface.

2.3.4.1.2 Mining Roads

Haul roads link the west, central and the east sides of the Wildebeesthoek pits, the stockpile areas and the infrastructure areas on the east and west sides of the mining pits respectively. Haul roads have been planned to be 30m wide with gravel surfaces to meet the requirements of the hauling fleet.

Service roads will be constructed gravel roads and provide ease of access to remote areas for light mining vehicles. These roads are separate from the haul roads in order to separate light mine traffic from the heavy traffic (haul trucks) as a site safety measure.

2.3.4.2 Chapudi and Chapudi West Sections

The Chapudi and Chapudi West Sections will require dedicated infrastructure areas, which will be centrally located between the east and west extremities of the open pits on the farms Woodlands 701 MS and Albert 686 MS.

2.3.4.2.1 <u>Access Road</u>

Access to the Chapudi Section site is by way of the N1 towards Musina, turning west onto the R523. The main entrance to the Chapudi Section is approximately 15 km along this route and crosses the Mutamba River along the way. The access road to the mining site will have a gravel wearing surface.

From the farm Princess Hill 704 MS towards the west the R523 needs to be rerouted. During the feasibility phase a significant road study will be commissioned to evaluate this. The new road will be a surfaced road to Provincial Standards. The mine entrance should be located on the relocated R523.

2.3.4.2.2 <u>Mining Roads</u>

Haul roads link the central and the east sides of the Chapudi pits, the stockpile areas and the infrastructure areas on the north and south sides of the mining pits respectively.

At Chapudi West the pits are also linked to the mine infrastructure and plant areas by means of haul roads. However, in this instance the infrastructure is located on the northern side of the pits due to a lack of space on the southern side.

Haul roads have been planned to be 30m wide with gravel surfaces to meet the requirements of the hauling fleet.

Service roads will be constructed gravel roads and provide ease of access to remote areas for light mining vehicles. These roads are separate from the haul roads in order to separate light mine traffic from the heavy traffic (haul trucks) as a site safety measure.

2.3.4.3 Storm Water Management

Water is a scarce commodity and every effort has been made in the design of the water management systems to conserve and reuse as much water as possible. A water management strategy will be implemented on the Chapudi Project to address the following salient issues:

- Water uses and users, with a particular focus on consumption rates;
- Engineering design basis for the water reticulation and distribution systems required to provide water to all the infrastructure, mining and beneficiation operations;
- Effluent management, including sewage treatment and disposal;
- Engineering design basis for the clean water diversion system; and
- Engineering design basis for the dirty water collection and management systems, including flood protection.

Clean storm water run-off along the various small water courses will be diverted around the proposed infrastructure, the mining pits and dump areas. These storm water drains and deflection berms have been positioned along the southern boundaries of the proposed mining pits to collect and convey clean water into the closest natural river course. Dirty water such as storm water run-off from the various terraces and plant area is captured and conveyed along lined channels towards the various dirty water dams positioned around the site. All water polluted on site as well as run-off from the carbonaceous dumps as well as seepage under carbonaceous dumps is retained and recycled on site. A detail water management strategy will be developed and implemented for the Chapudi Project.

2.3.4.3.1 Clean Water Run-off

Clean storm water run-off along the various small watercourses will be diverted around the proposed infrastructure, the mining pits and dump areas. These storm water drains and deflection berms have been positioned along the southern boundaries of the proposed mining pits to collect and convey clean water into the closest natural river course.

2.3.4.3.2 Dirty Water Run-off

Dirty water such as storm water run-off from the various terraces and plant area is captured and conveyed along lined channels towards the various dirty water dams positioned around the site. All water polluted on site as well as run-off from the carbonaceous stockpiles and seepage under carbonaceous stockpiles is retained and re-cycled on site.

2.3.5 BULK POWER SUPPLY

The lengthy Eskom Tabor and Spencer 132 kV Distribution networks stretching 200 km from Polokwane to 50 km away from the Musina border-post result in low voltages and thermal constraints during transformation and line contingencies. The expected Tabor and Spencer 132 kV load growth is located 100 km north of Tabor and 70 km from Spencer - generally the area in which the Chapudi Project resides - therefore, the Transmission outreach constraint will cap load growth.

The Polokwane Customer Load Network (CLN), including the Tabor and Spencer power corridor, remains susceptible to voltage instability and is the weakest part of the Northern Grid network due to being operated beyond its reliability power transfer limit. Eskom Transmission Division plan to strengthen the Northern Grid in the areas north of the Soutpansberg with a new 400 kV power line between the Tabor Main Transmission Substation and the newly approved Bokmakirie (Nzhelele) Substation.

Eskom is accordingly establishing additional Distribution and Transmission assets to cater for load north of the Soutpansberg, including the Bokmakirie Distribution Station and the 4x250 MVA 400/132 kV Nzhelele Main Transmission Station (MTS). The proposed network solution meets the 10 year Distribution load requirements in the Tabor and Spencer network area and it is also informed by the 20 year Transmission and Distribution load forecast in meeting the Transmission 20 year plan.

The Chapudi Project requires an electrical supply capability of 60 MVA:

Operation	Electrical Capacity (MVA)	Year
Wildebeesthoek	20	2018
Chapudi	20	2033
Chapudi West	20	2040
Total	60	

An Eskom connection can only be established once the Nzhelele / Bokmakirie 400/132 kV Main transmission Station has been commissioned - this is planned for 2017/8.

The Chapudi Project electrical supply will be taken from the 132 kV network and transformed to 11kV/550/400/230V. The exact supply configuration is yet to be determined and the least environmental impact solution will be followed. The project team has evaluated the possible supply options and has identified a direct supply from Nzhelele / Bokmakirie 400/132 kV Main transmission Station.

A 132/11 kV substation will be established at each of the mining operations. Power factor correction equipment will be installed at each of the 132/11kV substations to reduce the amount of reactive power required from Eskom and to improve the voltage regulation over the 11kV/550/400/230V distribution networks.

2.3.6 BULK WATER

The water requirement estimate for the Chapudi Project indicates that a maximum of 11 000 m^3/day of water is required at the mining peak.

The water supply to the mine will come from the following sources:

- Groundwater (boreholes and seepage into the mining pits;
- Storm water run-off impounded on site;
- An external water source piped to site;
- Sewage effluent release from Makhado; and
- Abstraction from the Sand River.

Storm water run-off on site is seasonal and, although it will be utilised, it is not a constant water supply and cannot be included in the water-supply chain.

The investigation into the most cost-effective source for water supply to the Chapudi Project has yet to be completed. This will be finalized during the Feasibility Phase of the project.

2.3.7 LOGISTICS

The primary domestic destination for coking coal is located at ArcelorMittal, Vanderbijlpark. The intent is to export an initial 1 Mtpa (million tonnes per annum) of coking coal, and transport 2.1 Mtpa to ArcelorMittal. Up to 3.6 Mtpa of middlings will be railed to local destinations from the proposed Chapudi Project in the Limpopo Province. The volumes increase later when other mines come into production with export growing to 1.6 Mtpa of coking coal, 3.8 Mtpa coking coal to ArcelorMittal and 8 Mtpa of middlings coal to local destinations. The primary domestic location for middlings coal is Eskom's Tutuka, Majuba, Camden and Grootvlei Power Stations in Mpumalanga Province.

The Chapudi Project is close to the railway line running southwards from Beitbridge / Musina and is an important link to the main hub of the Transnet Freight Rail (TFR) network connecting at Pyramid

South, near Pretoria. An important junction occurs at Groenbult, where a connecting line joins the Hoedspruit – Kaapmuiden – Komatipoort export channel avoiding the Pretoria complex.

From Pyramid South links are available to Richards Bay Coal Terminal (RBCT), Maputo or Durban. The export route through Mozambique to the Port of Maputo is in the process of being upgraded for the planned increase in volumes. Through agreements reached to expand the port facility as well as on-going negotiations with Transnet Freight Rail, the Port of Maputo is the export port of destination. These upgrades have been driven by the current tonnage being railed from the Vele Mine.

Private sidings with RLT facilities and railway links on the farms Bushy Rise 702 MS, Woodlands 701 MS and Sandpan 687 MS railway links has proven to be the preferred solution on the basis of repeated review and iterative evaluations of option, within this highly dynamic phase of project development. Factors influencing this conclusion include the low long term operational cost for coal transport from plant to port, lower environmental impact and the lessening of community impact (lower road traffic, congestion and pollution). A rail link provides a seamless transition from the loading siding to a direct link to TFR mainline network.

The rail links originates at the turn-outs at kilometre points 123.11 for Chapudi West, 125.11 for Chapudi and 127.11 for Wildebeesthoek on the Waterpoort – Huntleigh mainline section. The total rail lengths for the private sidings including their load out stations are 13.2 km for Chapudi West, 10.8 km for Chapudi and 10.7 km for Wildebeesthoek.

Three RLT's are planned on the balloon lines on the farms Bushy Rise 702 MS, Woodlands 701 MS and Sandpan 687 MS. The balloon layouts allow for continuous loading of rail wagons, without un-coupling the TFR locomotives. The balloons are designed to cater ultimately for 100 CCL wagon trains. The TFR train consist (locomotives and wagons) will enter the siding via the 1:12 turnout on the main line. The train pulls clear of the main line and stops at the permanent stop sign. Siding personnel will provide permission to enter the siding.

The train then pulls into the siding, travels to the RLT. The locomotive will pull the wagons at a constant speed underneath the rail load-out station while the wagons are loaded. Once all the wagons are loaded, the locomotive departs to the stop boards protecting the main line, where it will obtain permission from TFR's train control offices in Polokwane to depart.

In light of higher volumes the rail siding is designed to have 100 wagons waiting off the main line at the entrance of the RLT and once train in the RLT has completed loading the second train can be received in the RLT prior to the first loaded train departing.

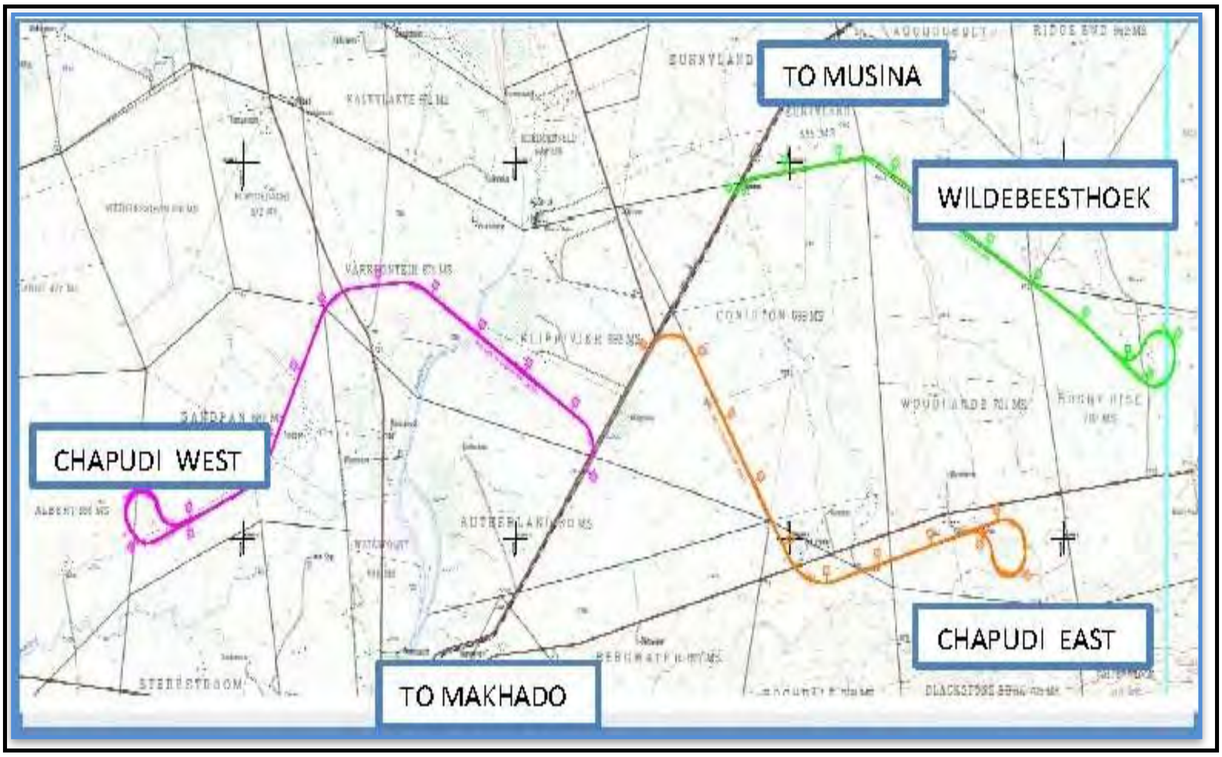


Figure 74: Wildebeesthoek, Chapudi and Chapudi West private sidings

2.4 MINE RESIDUE MANAGEMENT

2.4.1 MINING (INDUSTRIAL) WASTE

Mine residue stockpiles are required to accommodate mining overburden, partings and plant discards on the mine surface. Mine residue stockpiles are categorised as topsoil stockpiles, non-carbonaceous stockpiles and carbonaceous stockpiles.

2.4.1.1 Carbonaceous and Non-Carbonaceous Stockpiles

Design philosophy is based on the requirement to minimise the volume and surface area required for stockpiling by starting in-pit backfilling as soon as possible during the mining operation as double handling of the material is costly. It is envisaged that the dumping of material on the surface will be required for a period of three years after which the material mined from the pit and discards from the plant will be returned to the pit minimising the fill material during the rehabilitation process.

2.4.1.2 Topsoil Stockpiles

Topsoil will be stripped from the pit mining areas, roads and terrace areas and will be placed as close as possible to the point of stripping. The topsoil will be used as fill material, for the construction of berms and also be placed between the discards to act as isolating material. Topsoil will also be used as capping material during final rehabilitation of the stockpiles.

2.4.2 NON-MINING WASTE

The following waste types will be generated during the course of the project:

- Domestic waste
- Hazardous waste
- Fluorescent tubes
- Glass
- 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. An approved, registered waste contractor will be appointed by the mine to manage the waste generation and safe disposal thereof. No landfill site will be established on the Chapudi Project site. The waste removed will be either treated through the composting station, recycled through the Waste Transfer Station (WTS) and the remainder will be disposed through landfill at appropriate registered landfill sites.

No waste will be disposed of or buried on site, or in any other location that is not a licensed waste disposal site.

2.4.3 SEWAGE EFFLUENT

Sewage effluent will be managed as follow:

- An appropriate sewage treatment plant will be designed and constructed for the Chapudi Project. The final treatment system will be selected during the Feasibility Phase and the necessary authorization applied for.
- As a minimum, treatment will adhere to the General Standards and chemical dosing will be applied for final effluent disinfection (chlorine contact basin).
- Treated effluent will be re-used in the processing plant.
- No sewage disposal will be allowed on site.

2.5 LIST OF MAIN MINING ACTIONS, ACTIVITIES OR PROCESSES

Below a summary of the main activities / processes and their associated activities.

Main activities / processes	Associated activities
Opencast mining	Mining pits - Wildebeesthoek Section - Chapudi Section - Chapudi West Section ROM crushers In-pit water management - sumps - pumping systems
Processing plant & infrastructure	Process Infrastructure Area (PIA) - Plant stockpiles - Plant infrastructure - Clean water storage tanks - Dirty water holding dams - Silt traps / dirty water canals Mine Infrastructure Area (MIA) - Workshops - Wash-bay - Bulk hydrocarbon facilities Offices Communication Structures Explosive magazine Stores Waste Collection Area
On-site conveyance of ROM & product	Haul roads / service roads / conveyors - River crossings / culverts
Mine residue / waste management	Carbonaceous / discards stockpiles Non-carbonaceous stockpiles Topsoil stockpiles / berms In-pit disposal Waste management (general / hazardous)
Off-site product transport	Rapid Load-out Terminal (RLT) Balloon railway siding
On Mine water	Dirty and Clean Storm Water systems - Dirty water surge dams - Diversion and protection berms and channels - River diversions / storm water berms and channels Potable water plant Dirty and potable water pipelines Sewage treatment plant

2.6 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. 7 of 2003: Limpopo Environmental Management Act (LEMA)
- 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, R.545 and R.546 of 18 June 2010: NEMA: EIA Regulations
- GN No. 718 of 3 July 2009: 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

It is important to note that the approach for the Chapudi Project is to first apply for a NOMR and follow the required Regulations in conducting the EIA and compile an EMP in terms of the MPRDA. Once this process is completed and the applicant has obtained further detail in respect of its planned development, the applications for environmental authorisation in terms of the NEMA and an IWUL in terms of the NWA will be conducted as separate processes. Refer to Table 38 for a high-level assessment of the listed activities (NEMA) and water uses (NWA) that may potentially be triggered by the Chapudi Project.

The purpose of this document is to address the requirements of the MPRDA only. However, it is important to note that the construction and mining activities cannot commence without compliance to all the legislative requirements and before all the necessary permits / licenses are issued by the regulating authorities.

Table 38: Activity-based legal requirement assessment (high-level) for Chapudi Project

ACTIVITY	NEMA/NEMWA	NWA
Opencast Mining		
- Wildebeesthoek Section - Chapudi Section - Chapudi West Section	GNR 545 – A15: *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.*	S21(c)&(i) – impeding / altering of water courses S21(g) – dust suppression
- In-pit water management - {sumps / pumping}		S21(a)&(j) – Dewatering of pits S21(g) – Disposing of waste / water containing waste
- Storm water management - {river diversions / berms}	GN544 – A11: *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.*	S21(c)&(i) – impeding / altering of water courses
Beneficiation plant and infrastructure areas		
- Access / haul roads	GN544 – A22: *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.*	S21(g) – dust suppression
- Stream crossings - {bridges, pipelines, roads}	GN544 – A11: *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.*	S21(c)&(i) – impeding / altering of water courses
	GN544 – A18: *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-*	S21(c)&(i) – impeding / altering of water courses

ACTIVITY	NEMA/NEMWA	NWA
	water mark of the sea or an estuary, whichever distance is the greater.	
- Infrastructure area, workshops	GNR 545 – A15: *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.*	S21(g) – Disposing of waste / water containing waste
- Plant stockpiles		S21(g) – Disposing of waste / water containing waste
- Clean water storage tanks	*GN546 – A2: The construction of reservoirs for bulk water supply with a capacity of more than 250 cubic metres.*	S21(b) – Storage of water
- Dirty water dams	GNR 545 – A19: *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.*	S21(a)&(g) – Disposing of waste / water containing waste
- Bulk hydrocarbon facilities	GN545 – A3: *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.*	
- Sewage plant (effluent)	*GN718 – Category B(7): The treatment of effluent, wastewater or sewage with an annual throughput capacity of 15,000 cubic meters or more.*	S21(e) – controlled activities (irrigation with waste water) S21(g) – Disposing of waste / water containing waste
Conveyance of ROM & product (on site)		
- Haul / service roads	GNR 544 – A22: *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.*	S21(g) – dust suppression
- Stream crossings / culverts - {roads, pipelines, conveyors}	GNR 544 – A11: *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.*	S21(c)&(i) – impeding / altering of water courses
Mine residue management		
- Overburden stockpiles - Discards stockpile	GNR 545 – A15: *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.*	S21(g) – Disposing of waste / water containing waste

ACTIVITY	NEMA/NEMWA	NWA
- In-pit disposal / rehabilitation		S21(g) – Disposing of waste / water containing waste
- General / hazardous waste	N/A – off-site disposal	
Product transport		
- Rail loop and siding, RLT - {stream crossings, storm water management / dams}	GN545 – A11: *The construction of railway lines, stations or shunting yards, excluding (i) railway lines, shunting yards and railway stations in industrial complexes or zones; (ii) underground railway lines in a mining area; and (iii) additional railway lines within the reserve of an existing railway line.*	S21(g) – Disposing of waste / water containing waste
	GNR 545 – A15: *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.*	S21(c)&(i) – impeding / altering of water courses
	GN544 – A11: 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.*	
	GN544 – A18: *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.*	S21(c)&(i) – impeding / altering of water courses

2.7 IMPLEMENTATION SCHEDULE

From the date of granting of the mining right (anticipated to be in 2015) further prospecting, feasibility studies and final design studies will be undertaken. Construction will only commence in 2018.

The current planning is that construction and mining will commence at the Wildebeesthoek Section first where the coking coal yields are the highest. It is expected that mining operations at the Chapudi Sections will only commence much later (in terms of current data towards 2033) by which time the Transnet infrastructure will be have been enhanced to cope with the greater annual production of coal from the Project.

The Wildebeesthoek Section will be mined at 12.5 Mtpa, whilst the Chapudi and Chapudi West Sections combined will be mined at 12.5 Mtpa and the life of mine (LOM) is expected to exceed 30 years.

The project schedule over the next 10 years is shown in Figure 75.

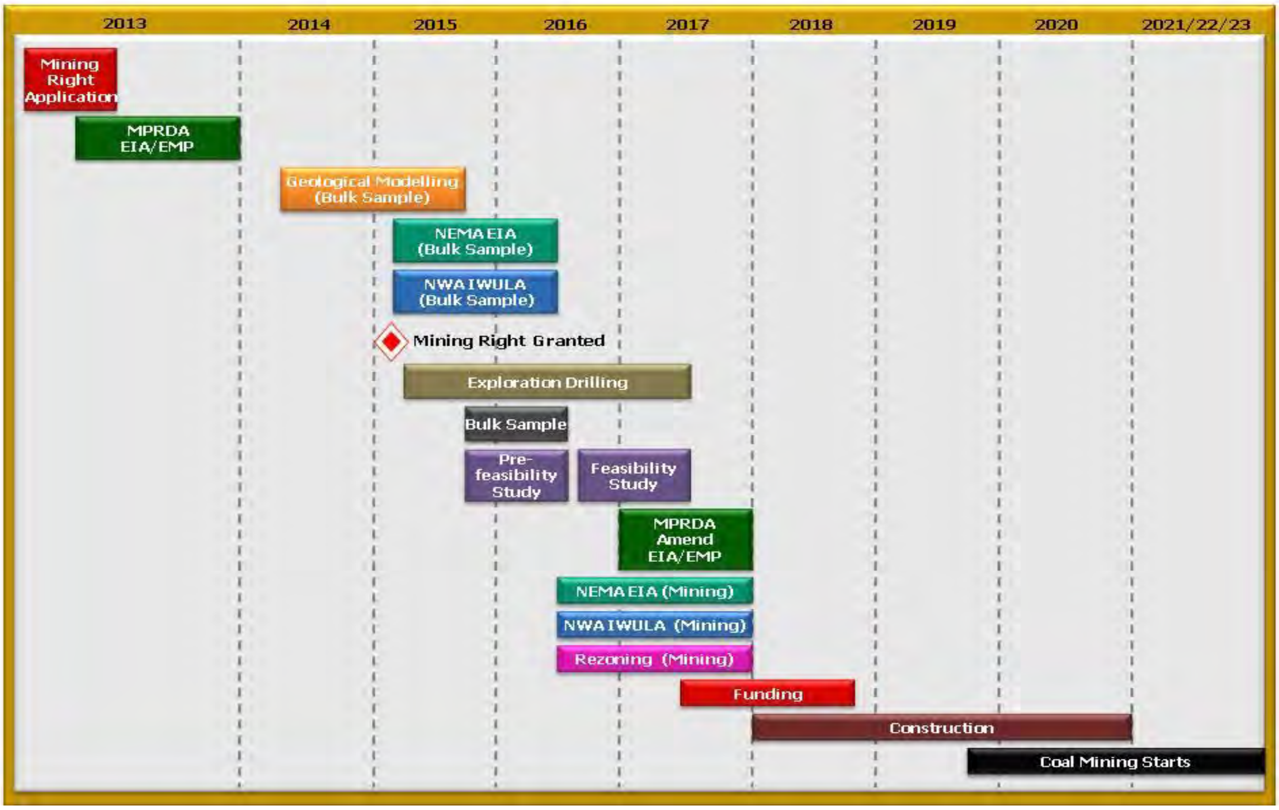


Figure 75: Project schedule for Chapudi Project over the next 10 years

3 DESCRIPTION OF POTENTIAL IMPACTS ASSOCIATED WITH ACTIVITY

3.1 LIST OF POTENTIAL IMPACTS

Table 39 lists the potential environmental impacts for each of the main mining activities, processes and activities associated with the Chapudi Project. These are described in more detail in the following sections.

Table 39: List of potential environmental impacts for the Chapudi Project

Activity	Environmental Aspect	Potential Impact
All activities	**Biodiversity / Land Use & Capability**	Surface disturbance of approximately 7,600 hectares for the purpose of mining and infrastructure development over the LOM will lead to impacts on the soil, land use and land capability, natural vegetation and fauna
All activities	**Waste management**	Poor waste management could lead to environmental impacts
		Poor sewage management could impact on water resources
All activities	**Bulk water**	Impact on water stressed catchment - fully allocated
All activities	**Bulk electricity**	Further impact on over-allocated electricity reticulation system
All activities	**Heritage resources**	Destruction of heritage & cultural resources as a result of mining and associated infrastructure (including linear activities)
All activities	**Sense of place**	Impact on conservation value of the region
Opencast mining	**Soils / Land Use & Capability**	Potential hard setting of soils post-reclamation
		Subsidence of rehabilitated areas
Opencast mining	**Surface water**	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff
		Impact on 1:100 year flood-line of the Sand and Mutamba Rivers
		Impact on wetland areas and aquatic ecosystems
		Increased sedimentation into the river systems due to uncontrolled surface run-off
		Potential impact on in-stream habitat and riverine vegetation as a result of decrease in runoff
		Impact of long-term decant on water quality
Opencast mining	**Groundwater**	Dewatering of aquifer as a result of mining, resulting in drying up of boreholes and springs
		Impact on surrounding vegetation (springs and seeps) as a result of dewatering and subsequent recovery
		Decrease in regional water quality due to seepage from rehabilitated pits
		Mixing of fresh and saline aquifers due to the disturbance of aquitards during mining
		Migration of pollution plume after full recovery of groundwater levels (prior to decant)
Opencast mining	**Air Quality**	Dust impact caused by vehicle movement
		Dust impact caused by blasting activities
		Dust impact caused by materials handling
		Methane emissions leading to air quality impacts

Activity	Environmental Aspect	Potential Impact
Opencast mining	**Noise**	Elevated noise levels caused by mining operation, dewatering (pumping) and blasting activities
Opencast mining	**Visual / Aesthetics**	The mining will have a negative on the aesthetics / sense of place
Opencast mining	**Blasting**	Impact on the communities and sensitive receptors as a result of blasting
Processing plant / infrastructure areas	**Soils / Land Use & Capability**	Soil impacts as a result of poor hydrocarbon management and spillages
		Surface disturbance caused by infrastructure
Processing plant / infrastructure areas	**Surface water**	Water quantity impact due to decreased surface runoff
		Water quality impact on Sand and Mutamba Rivers
		Water quality impacts as a result of poor hydrocarbon management and spillages
		Impact on wetland areas and aquatic ecosystems
Processing plant / infrastructure areas	**Groundwater**	Water quality impacts due to infiltration of dirty water from the plant and infrastructure areas
Processing plant / infrastructure areas	**Air quality**	Air quality impacts associated with processing activities and movement of vehicles
		Dust impact caused by crushing and screening operations
Processing plant / infrastructure areas	**Noise**	Elevated noise levels caused by crushing and processing activities
Processing plant / infrastructure areas	**Visual / aesthetics**	Processing plant will have a visual impact as a result of high buildings
Processing plant / infrastructure areas	**Lighting**	Sky glow effect will have an impact on the sense of place at night
		Impact on invertebrates
On-site conveyance of ROM and product	**Air Quality**	On-site conveyance will increase the ambient air quality
On-site conveyance of ROM and product	**Surface water**	Stream crossings (road and conveyor) could potentially impact on the stream flow and lead to stream flow reductions downstream
		Spillages along conveyors/roads could impact on water quality
On-site conveyance of ROM and product	**Noise**	Elevated noise levels caused by trucking and conveying activities
On-site conveyance of ROM and product	**Soils / Land Use & Capability**	Surface disturbance caused by infrastructure
Mine residue stockpiles	**Groundwater**	Impact of carbonaceous stockpiles on groundwater resources
Mine residue stockpiles	**Surface water**	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff
		Impact on wetland areas and aquatic ecosystems
		Increased sedimentation in drainage lines due to uncontrolled surface run-off and erosion
		Water quality impacts as a result of dirty water runoff / seepage from carbonaceous stockpiles
Mine residue stockpiles	**Visual / Aesthetics**	Large stockpiles will impact on the landscape
Mine residue stockpiles	**Air quality**	Increase dust emissions as a result of stockpiles
Mine residue stockpiles	**Noise**	Noise from stockpile construction leading to the main contributing factors to the noise at the sensitive receptors, especially at night-time
Rail link to main TFR railway line	**Safety**	Road / rail crossings could lead to safety risks to road users
Rail link to main TFR railway line	**Surface water**	Stream crossings where culverts may concentrate flow, leading to enhanced flow velocities and associated erosion problems

Activity	Environmental Aspect	Potential Impact
Rail link to main TFR railway line	**Surface water**	Potential for water quality impacts due to dirty runoff and spillages along the rail link
Rail link to main TFR railway line	**Noise**	Increase of ambient noise levels along the rail route
Rail link to main TFR railway line	**Air quality**	Increase of dust emissions along the rail link
Rail link to main TFR railway line	**Biodiversity**	Land units will be divided into smaller units which may not be ecologically viable
		Potential impact on protected flora species identified along the route
		Creation of additional corridors which could lead to increased poaching
		Killing of animals crossing the rail line
Off-site conveyance of product by truck (in emergencies)	**Safety**	Road transport of product will impact on the traffic along the route, safety risk to road users
Off-site conveyance of product by truck (in emergencies)	**Biodiversity**	Killing of animals and avifauna on the roads, especially nocturnal animals/birds
Off-site conveyance of product by truck (in emergencies)	**Surface water**	Potential for water quality impacts due to spillages and dirty runoff into the streams
Off-site conveyance of product by truck (in emergencies)	**Air quality**	Material and product loss from trucks
Off-site conveyance of product by truck (in emergencies)	**Noise**	Increase of ambient noise levels along the route

3.1.1 SOILS, LAND USE AND LAND CAPABILITY

The impacts identified for the soils, land capability and land use are considered collectively as all of these facets are inter-related and inter-dependant, and so the impact to the soil depth and land capability distribution includes all other facets e.g. opencast, plant infrastructure areas and stockpile areas will be the same.

Opencast mining results in total destruction (before mitigation) of the various facets of the following:

- Soils (i.e. slope, depth, order of horizons, organic carbon, microbial activity, fertility, perched water table, hydrology and relative compaction);
- Land capability (i.e. capability class and distribution) – land capability is downgraded; and
- Land use.

Areas that will be totally to largely altered by mining related activities include the sites of the various features/facilities in the infrastructure areas, the overburden stockpiles and the haul/access roads.

Areas that will only be partially altered by mining related activities include the conveyors, power lines, gravel service roads and temporary 'topsoil' stockpiles.

3.1.1.1 Post-Mining Land Capability

Post-mining land capability may be considered from two different perspectives, namely according to:

- The Chamber of Mines post-mining land capability requirements; and
- The land capability potential (i.e. potential land-use).

3.1.1.1.1 __Land capability requirements__

Rehabilitate to the Chamber of Mines (and Government Regulation R537) post-mining capability class standards. This scenario must represent at least equivalent (or increased) post-mining arable and grazing capability class percentages, relative to the pre-mining state. The aforementioned indicates a commitment by the mine to rehabilitate the post-mining land capability to the recommended standard.

3.1.1.1.2 __Land capability potential (i.e. potential land use)__

Soil is a living ecological entity, therefore it is unlikely that rehabilitated post-mining arable capability class areas in the totally and totally - largely altered (and rehabilitated) areas may be successfully cultivated in the post-mining state, this being due to both a lowered production potential of the soils.

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 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.

3.1.1.2 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.

3.1.2 BIODIVERSITY

3.1.2.1 Vegetation

The following impacts to vegetation and flora are expected as a result of the proposed mining activity, although additional impacts may be identified during future site assessments:

- Loss of vegetation
- Loss of floral species of special concern
- Increased risk of alien invasion
- Increased risk of soil erosion
- Disruptions to ecological corridors and loss of biodiversity conservation areas
- Aridification of the area as a result of mine de-watering

3.1.2.1.1 ***Loss of vegetation and habitat***

The mining activity will result in the removal of vegetation from the mining footprint. This could result in permanent or temporary loss of habitat for both dependant and localised floral and faunal species. Furthermore, it could result in loss of intact vegetation and habitat for populations of localised and endemic species.

The riverine forest and floodplains are important dry season refuge areas for many faunal species in their natural state. It is also a centre of floral diversity. Some of these areas, however, are degraded and overgrazed. The SandRiver does provide a source of water, while the deeper alluvial soils may provide better forage than areas inland of the riparian zone. Any impacts on the sensitive aquatic ecosystems, regardless of the source, need to be avoided.

Impacts on this system include erosion, deforestation through flooding, habitat loss and degradation and the associated impacts on faunal and floral diversity, dewatering, water abstraction as well as increased sedimentation. Continued impacts on the riverine ecosystems may also ultimately reduce the capacity of this system to absorb dramatic flooding events.

3.1.2.1.2 ***Loss of floral and faunal species of special concern***

Removal of natural vegetation in the areas where opencast mining will take place will influence various listed protected species. Listed protected species will be damaged or destroyed during construction or operation of the mine, which could have an impact on the population and survival of the species.

There are potentially 70 listed and legally protected species that could occur in the area, and whose habitat will be affected by the various mining activities. Many of these may not be present, and due to seasonal sampling constraints, confirmation thereof was problematic, especially herbaceous and bulbous species. Flora species that were noted to be present include, amongst other the following:

- *Acacia erioloba* (Camel Thorn)
- *Adansonia digitata* (Baobab)
- *Adenium multiflorum* (Impala Lily)
- *Boscia albitrunca* (Shepherd’s Tree)
- *Combretum imberbe* (Leadwood Tree)
- *Euphorbia aeruginosa*
- *Philenoptera violacea* (Apple-leaf)
- *Sclerocarya birrea subsp. caffra* (Marula)
- *Spirostachys africana* (Tamboti)

Different species, or categories of species, have different legal requirements in terms of actions that need to be taken and permit requirements will determine the actions that need to be taken in order to protect such species.

Potential impacts include:

- Destroy or damage of protected species.
- Influence on specific species population numbers and survival.

3.1.2.1.3 Increased risk of alien invasion

Disturbances relating to mining activities and post mining rehabilitation may increase the risk of localised infestations of alien species in disturbed areas. This could either be in the form of introduced new species or the spread of existing species. Measures to reduce this risk will be assessed and appropriate recommended provided

3.1.2.1.4 Increased risk of soil erosion

Disturbances relating to mining activities and post mining rehabilitation may increase the risk of soil erosion in disturbed areas. This could both be as a result of loss of vegetation cover, or altered drainage patterns and storm-water runoff. Measures to reduce this risk will be assessed and appropriate recommended provided

3.1.2.1.5 Disruption of ecological corridors and loss of biodiversity conservation areas

Large scale mining activities may result in the permanent or temporary disruption of important faunal and floral ecological corridors. Important faunal movement corridors may be disrupted, which could affect the population and survival of these species, as well as associated floral species as a result of disrupted pollination and seed dispersal mechanisms.

3.1.2.1.6 Aridification of the area as a result of mine dewatering

Mining at Chapudi will involve open cast mining along extended open cuts down to 200m below surface. A Multiple layered aquifer system is thought to occur in the Chapudi west area where aquifers of different quality overly each other. These aquifers are separated by shale aquitards. An example is the saline alluvial aquifer which overlies fresh aquifers associated with the coal seams and the faults. Mining will disturb the aquitards allowing for mixing of these aquifers resulting in the fresh water aquifers becoming more saline.

Groundwater flow will be intersected by the pits when below the water table. The water flowing into the pits will need to be pumped out (dewatered) for safe mining operations to continue. The water pumped from the pits will be used on the mine for process water in the plant and dust suppression.The dewatering will result in a lowering of the water table (cone of depression) around the mine pits, extending for more than to 25 kilometres northwards of Chapudi at the life of mine. This is because water is taken mostly from aquifer storage, as recharge in the area is low and unable to sustain the dewatering. The east-west striking faults such as the Tshipise, Senotwane and Phareng faults are far more transmissive resulting that the cone of depression is elongated along their axis.

Impacts of mining could be significant. These, in order of significance, include:

- Reductions in water available for abstraction and discharge i.e. lower borehole yields or drying up of boreholes and springs along the foot of the Soutpansberg Mountains within the radius of influence.
- Cross contamination of aquifers due to the disturbance of aquitard layers and the down gradient contamination due to seepage from the rehabilitated pits, discard dumps, stockpiles and dirty water dams.
- A reduction in water available for evapotranspiration. Groundwater dependant floral species around springs and seeps could be affected as the water table drops. Riverine vegetation is mostly sustained from surface flows and water stored in the alluvial deposits, however shallow groundwater may be important during extended dry periods.

3.1.2.2 Fauna

In relation to the proposed mine development, certain impacts have been identified within the study area. After looking at the habitats and the associated faunal communities, the impacts have been rated both with and without recommended mitigation and management measures. Impacts are rated for the full life cycle of the proposed mine and cumulative effects have been taken into account. T he following impacts were identified:

- Limited Food availability for Cape Vulture
- Habitat destruction
- Fragmentation of habitats
- Faunal mortality through mining operations
- Habitat creation (negative)

3.1.2.2.1 __Limited food availability for Cape Vulture__

The Blouberg Mountains (extension of the Soutpansberg Mountain Range) is home to the largest breeding colony of Cape Vultures in the world. Furthermore 'Vulture Mountain' on the farm Buffelspoort 222 IS is in close proximity to the South. They are attracted to this area due to the height and topography of the mountain, together with the food offered by the surrounding game farms. Cape vultures may have a 300 km foraging area surrounding their roosting sites.

The Cape Vulture is a scavenger of animal carcasses, and relies on leftover food from kills made by large predators (lions, leopards, etc). This bird also feeds off animals that have died from natural causes. Thus vultures are natures' way of controlling animal carcasses. This bird has adapted to a life of flying extensive distances for food. As the proposed mining area falls within the birds feeding grounds, the large game will be removed due to the selling of the farms they inhabit. This will result in a decrease of food for the Cape Vulture.

3.1.2.2.2 __Habitat destruction__

Mining activities involve permanently disturbing the terrestrial faunal environment. The top soil will be removed together with the vegetation habitats, thus destroying the entire area which is subjected to the mining operation. The mining activities will destroy existing habitats. Habitat destruction leads to the displacement of fauna.

3.1.2.2.3 __Fragmentation of habitats__

Even though certain areas will remain unaffected by the proposed mining operations, these small habitats may become isolated. Thus the ecological continuity will be disrupted by the proposed mining activities. Individual faunal species (within the proposed mining site) are generally familiar with their surroundings.

For example, tortoises know their home ranges, and other animals (such as caracal) are familiar with their territories and feeding grounds. Certain amphibian species may only make use of water sources for breeding (tadpoles) and spend the rest of their life-cycle away from water. During breeding times, these amphibians could be prevented from gaining access to water. Precocial bird species (such as guinea fowl) could be affected due to the disruption in the continuity of the ecological corridor, up until the flight feathers are fully developed. Precocial chicks are flightless and vulnerable to predators and mining (such as trenches and piled rocks) may trap chicks when being pursued chase, thus increasing chick mortality unnaturally.

Mining activities (such as stock piling between faunal habitats) may alter critical behaviours, traits and survival technique, due to alteration, manipulation or destruction of the numerous corridors present within the proposed mining site. Certain faunal species may utilize specific corridors to gain for flight (escape) and to gain access to foraging and breeding areas. Since animals are creatures of habit, they are likely to get trapped or killed by new structures place inside their habitats if they are not familiar with the placement thereof.

3.1.2.2.4 __Faunal mortality through mining operations__

Frequent truck/vehicle road activity (in the proposed site) will result in mortality of vertebrates and invertebrates. Reptiles frequent open sandy/rocky areas to searching for food, bask in the sun during the day, or simply traversing through. Amphibians may cross over the mining area to reach wetlands from aestivation areas. Rain is a key factor influencing amphibians, as (in times of rainfall) amphibians are at their most mobile and vulnerable. These factors all contribute to the above fauna being subjected to this impact.

Working machinery, blasting and conveyer belts, are additional factors which may contribute to faunal mortalities. It is likely that large birds (during flight) will collide into erected power lines/electrical cables or be electrocuted while roosting on said cables.

3.1.2.2.5 __Habitat creation (negative)__

Mining activities not only leads to habitat destruction, but can often create alternative habitats. However, habitat creation may indirectly lead to negative impacts. In this case, the creation of habitats often alters the natural balance for certain faunal species. Small crevices between rocks in stockpiles may lead to chambers which make excellent micro habitats for bees to set up a hive, bats to roost and reptiles to take up residence.

Loosely compacted rubble and stones stockpiled within the site may indirectly provide habitats for reptiles. Lizards and diurnal snakes will bask on the warm ground surface and retreat into this man-made habitat. Thus due to this artificial habitat, there will likely be an increase of reptiles near roads and stock piles, however temporary. Snakes are likely to use these artificial habitats as breeding grounds and lay their eggs between the stored materials (for example, the Natal Green Snake). Although not gregarious, this species is often found in large numbers within a relatively small area.

Temporary water accumulation after rains may occur in mined areas, and this offers temporary habitats for frogs and toad. These animals may be harmed by vehicle and machinery activity.

Birds such as swifts and swallows build mud nests under structures (such as bridges), thus if bridges are constructed, potential habitats are created. Large non-vegetated rock faces (mine pits) are likely to be created as a result of the proposed mining activities, which could offer breeding habitats for bee-eaters and certain owls. This can result in the harming of birds.

3.1.3 AQUATIC ENVIRONMENT

3.1.3.1 Loss of In-stream Flow, Aquatic Refugia and Flow Dependent Taxa

The Sand River, Mutamba River and to a lesser degree the other systems in the vicinity of the proposed Chapudi Project are water stressed. The systems are extensively utilised for the abstraction of water for the production of crops such as peppers, squash and tomatoes. These water uses lead to the lower sections of the Sand River being dry for significant lengths and few refuge pools for aquatic biota occur in these lower areas. Any impact on in-stream flow will therefore be significant and can have a significant impact on the Sand and Mutamba Rivers ecology. It is also important to note that the Sand River is designated as a Freshwater Ecosystem Priority Area (FEPA) and therefore impacts on fish ecology are considered to be particularly significant. It is also important to note that the system is considered important as an upstream management area in support of downstream fish FEPA areas.

In terms of aquatic and riparian zone ecology in the vicinity of the project area the Sand and Mutamba Rivers are the most significant and requires the most attention when considering impacts on reduced in-stream flow and aquatic refugia and the loss of flow dependant taxa.

The remainder of the project area is very dry and no other systems were identified in which aquatic biota occurred. The perennial pools within the Blackstone Edge wetland GSPC W1 support low abundances of tolerant aquatic taxa and wetland vegetation. In addition many of the drainage lines in the area have well established riparian zones. In particular mention is made of the Moleletsane River as well as some smaller systems.

Mean annual run-off (MAR) from the Project site into the Sand River 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 evaporated in dirty water dams, thereby decreasing the MAR reaching the Sand River system;

- 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 run-off 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 to discharge to tributaries and into the Sand River;
- Concentration of flow when run-off 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 Sand 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. Stream flow regulation and recharge and a change in flow rates will however occur.

A substantial increase to the peak flow of flood events in the Sand River 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 Sand River 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%) as compared to the natural surface (typically 60-70%), resulting in more surface run-off following storms and consequently higher peak flow rates.
- Capture of run-off and capture of rainfall in the 'dirty' area would lower in-stream flow in the receiving environment.
- Canalisation of run-off. Intercepting run-off 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 Sand 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 lower flow velocities.

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

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 water courses of water along their reach between the point of interception and the Sand River.

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, leading to altered surface and subterranean hydrology.

All the above factors are likely to lead to altered riverine recharge flood peaks and a general loss of runoff volumes successfully reaching the Sand and Mutamba River systems as well as the other major drainage systems in the area which in turn lead to the loss of aquatic biota such as fish and aquatic macro-invertebrates which rely on the presence of surface water as well as the riparian zone which relies on base flows as well as recharge by larger rainfall events.

3.1.3.2 Impacts on Water Quality Affecting Aquatic Ecology

3.1.3.2.1 __Increased sediment load in the Sand River__

In the natural state of the project site, vegetation cover causes friction to rainfall run-off, 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 of disturbed surfaces means that the run-off contains a higher silt or sediment load, which is discharged to the Sand 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. Severe sediment deposition in the Sand River could lead to reduced surface flows in the system with a larger volume of water moving through a thickened sand layer. 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 run-off volumes, including roads, buildings and paved areas;
- Canalisation of run-off, particularly if canals do not discharge directly into the Sand River; and
- Construction activities that loosen the ground surface.

Furthermore, if run-off from the stockpiles is uncontrolled, such run-off 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 Sand River will increase as a result of mining activities associated with this Project.

*3.1.3.2.2 **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 run-off of pollutants from the process plant area following rainfall, due to the activities within that area.

*3.1.3.2.3 **Impaired water quality due to pollutants in run-off from stockpiles***

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

*3.1.3.2.4 **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.

*3.1.3.2.5 **Impaired water quality due to petrochemical spills***

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

*3.1.3.2.6 **Heavy metal contamination***

Increase in metal concentrations is commonly associated with tillage and blasting of the upper crust of the earth's surface. This releases metals into the associated surface and ground water systems (NSS, 2009). Under alkaline conditions, most of the metals remain biologically unavailable, however in the presence of acid mine drainage the metal-speciation changes and they become available (Bonta et al., 1993). This may alter the species composition of the aquatic biota inhabiting the river, in the vicinity of and downstream of the proposed development.

3.1.3.3 Loss of Aquatic Habitat

Habitat destruction is the alteration of a natural habitat to the point that it is rendered unfit to support the species dependent upon it as their home territory. Many organisms previously using the area are displaced or destroyed, reducing biodiversity. Globally modification of habitats for agriculture is the chief cause of such habitat loss. Other causes of habitat destruction include surface mining, deforestation, slash-and-burn practices and urban development. Habitat destruction is presently ranked as the most significant cause of species extinction worldwide. Additional causes of habitat destruction include water pollution, introduction of alien species, overgrazing and overfishing.

Riverine systems and particularly ephemeral riverine systems or river systems that have very low flows as part of their annual hydrological cycles are particularly susceptible to changes in habitat condition. The proposed mining activity of the Chapudi Project has significant potential to lead to habitat loss and/or alteration of the aquatic and riparian resources on the study area.

3.1.3.4 Loss of Aquatic Biodiversity and Sensitive Taxa

Aquatic resources in the area can be considered scarce and in addition to being scarce are generally exposed to significant water stress. The aquatic resource in the area do however support, or potentially support, an aquatic community of significant diversity and sensitivity. This statement is considered particularly pertinent to aquatic macro-invertebrates and the fish community. On a national scale the system is also considered to be of importance and the lower sections of the Sand River are considered a FEPA system and a Fish FEPA support system

The aquatic ecology of the area can potentially be impacted by further reductions in in-stream flow, altered water quality and habitat loss.

3.1.3.5 Loss of Wetland and Riparian Habitat

The main land use constitutes game farming and to a lesser extent crop cultivation. As a result, overall landscape and vegetation transformation in the vicinity of water courses and depressions, within the study area, are considered to be low. Consequently, all features presently provide niche habitat for wetland and aquatic faunal and floral species within a water stressed region.

The ephemeral nature of smaller drainage lines does limit the ability for these features to provide optimum conditions for the formation of an extensive riparian zone. Therefore, larger tree species with root systems that can subtract water from deeper within the soil during winter months such as *Faedherbia albida* and *Xanthocercis zambesiaca* (Nyala) and fig species were restricted to river systems such as the Mutamba River. None the less, the smaller drainage lines do provide habitat for species such as *Combretum imberbe* (leadwood) (protected in accordance to the National Forest Act (Act No 84 of 1998 as amended September 2008).

Surface water that would provide habitat for aquatic species as well as drinking water for terrestrial wildlife was also concentrated on the Sand and Mutamba Rivers. The permanently inundated wetland depressions in the Blackstone Edge GSPC W1 wetland however also retains water for longer periods increasing these features importance in terms of niche habitat as well as drinking water for wildlife and habitat for waterfowl. Some of the more ephemeral pans in the area are also likely to be of some importance in surface water provision to the faunal communities of the area

Loss or impact on wetland and riparian habitat would result in loss of niche habitat for various faunal and floral species within a water stressed region. Due to the sandy nature of the soil it is doubtful that wetland and riparian habitat could be rehabilitated to resemble these unique habitat units presently within the study area.

3.1.3.6 Changes to Wetland Ecological and Sociocultural Service Provision

To determine feature specific importance in terms of function and service provision, the Sand River, Mutamba River, Moleletsane Stream, Banff Stream, smaller drainage lines as well as pans and wetland depressions were assessed separately. Following the assessment, all features are considered of intermediate importance in terms of function and service provision, with the highest scores calculated for biodiversity, tourism and recreation.

Loss or impact on wetland and riparian habitat would reduce a features importance in terms of function and service provision. Although deemed possible to reduce impact in terms of changes to ecological and sociocultural service provision it is doubtful that the level of importance could be reinstated after mine closure, unless all allocated 100m buffer zones are kept strictly off limits to any mining related activity, including general infrastructure and that water abstraction are kept to a minimum and there is no formation of a cone of dewatering which may be created through the opencast mining methods which affects the baseflows in the aquifers of the Sand and Mutamba river systems.

3.1.4 SURFACE WATER

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

- Impacts on surface water quantity
- Impacts on surface water quality

It should however 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.

3.1.4.1 Impacts on quantity

3.1.4.1.1 Impact on mean annual run-off to major rivers

Mean annual run-off (MAR) from the Project site into the major rivers 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 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 from the sides of the stockpile. Any run-off 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 to discharge to tributaries and into the major rivers.
- Concentration of flow when run-off 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, 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.
- Rainwater falling on the open portions of the pits will be collected as dirty water and be re-used. Likewise, seepage and surface water runoff from the carbonaceous dumps will be collected as dirty water.

The total reduction in runoff shown in Table 40 and Table 41 for the Sand River and Mutamba Rivers respectively is for the worst case scenario at the end of the life of the mine, assuming that no rehabilitation of the pits has been done and the carbonaceous dumps and plant areas retain polluted runoff.

For the Sand River Basin, the cumulated impact has a reduction in annual runoff of 318 427 m^3/annum, or 0.33% of the MAR of the downstream quaternary catchment A71J. The theoretical impact on runoff in the Sand River just downstream of the mining activities based on the naturalized runoff estimates amounts to 0.56%. With the actual cumulated runoff in the Sand River expected to be smaller than the naturalized runoff due to upstream water use, the actual impact would be a larger percentage.

Table 40: Estimated impact* on surface water runoff in quaternary catchment area A71J

DESCRIPTION	AFFECTED AREA (ha)	% OF SITE AREA	RUNOFF INTERCEPTED** (m^3/a)	% OF MAR of A71J	% OF MAR IN SAND RIVER***
Opencast mining (all pits)	861	12.4	83 398	0.09	
Plant dirty water area, plus haul roads	2051	29.4	198 738	0.21	
Carbonaceous dump area	375	5.4	36 291	0.04	
TOTAL FOR SITE	3 286	47.2	318 427	0.33	0.56

* Based on worst case scenario with no rehabilitation in place
** Based on 9.69 mm runoff, the average for A71J
*** MAR = 57.13 million m^3/a

For the Mutamba River, the cumulated impact has a reduction in annual runoff of 283 530 m^3/annum, or 0.41% of the MAR of the downstream quaternary catchment A80F. The impact on the naturalized runoff in the Mutamba River is a low 0.41% and similar to the discussion above for the Sand River Basin, the actual impact in terms of percentage of the runoff may be higher. In the absence of flow gauges in the river, a more reliable estimate cannot be made of this quantity.

Table 41: Estimated impact* on surface water runoff in quaternary catchment area A80F

DESCRIPTION	AFFECTED AREA (ha)	% OF SITE AREA	RUNOFF INTERCEPTED** (m^3/a)	% OF MAR of A80F
Opencast mining (all pits)	1187	17.0	81418	0.12
Plant dirty water area, plus haul roads	2525	36.2	173186	0.25
Carbonaceous dump area	422	6.1	28 925	0.04
TOTAL FOR SITE	4133	59.3	283530	0.41

* Based on worst case scenario with no rehabilitation in place

**Based on 6.86 mm runoff, the average for A80F

3.1.4.1.2 Change to peak flow rates in the major rivers during flood conditions

A substantial increase to the peak flow of flood events in the rivers 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 receiving rivers 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 somewhat less infiltration into the soil, resulting in more surface run-off following storms and consequently higher local peak flow rates.
- Capture of run-off. Capture of rainfall in the 'dirty' area would lower peak flow rates.
- Canalisation of run-off. Intercepting run-off 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 major rivers. 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 lower flow velocities. In technical terms, the time of concentration would be reduced, reducing the time of concentration results in higher peak flow rates. This effect is dependent on the design of the canalisation system, as increasing the length of flow paths, and implementing other detention measures, could negate this effect.

3.1.4.1.3 Drying up of tributaries and establishment of new watercourse due to canalisation

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 water courses of water along their reach between the point of interception and the major rivers.

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 more clayey, usually structured subsoil.

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 major rivers, impacting on water quality.

3.1.4.1.4 ***Impact of pit dewatering***

In general, the impact of pit dewatering would be to lower the surrounding water table. In the case of Chapudi Project, the drawdown may be in the order of 100 m. This would reduce the contribution of groundwater to surface flow on the one hand and, on the other, directly reduce surface water flow by inducing a drawdown on surface water levels.

3.1.4.2 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 major rivers 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 major rivers cannot be relied upon.

3.1.4.2.1 ***Increased sediment load in the major rivers***

In the natural state of the project site, vegetation cover causes friction to rainfall run-off, 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 run-off contains a higher silt or sediment load, which is discharged to the major rivers. 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, viz. 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 run-off volumes, including roads, buildings and paved areas;
- Canalisation of run-off, particularly if canals do not discharge directly into the major rivers; and
- Construction activities that loosen the ground surface.

Furthermore, if run-off from the stockpiles is uncontrolled, such run-off 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 major rivers will increase as a result of mining activities associated with this Project.

3.1.4.2.2 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 run-off of pollutants from the process plant area following rainfall, due to the activities within that area.

3.1.4.2.3 Impaired water quality due to pollutants run-off from stockpiles

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

3.1.4.2.4 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.

3.1.4.2.5 Impaired water quality due to petrochemical spills

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

3.1.4.3 Generalized mitigation measures

- Diversion of streams and drainage lines: The water quality of re-routed streams should be maintained by preventing scour of bed material, thereby minimising turbidity during flood conditions. Lining of the canals and/or energy dissipating structures may be required at steep slopes.
- Impact of the proposed mining development on surface water runoff quantity: The area of the open pits should be kept as small as possible to minimize the reduction in runoff.

- Impact of the proposed mining development on surface water runoff quality: By adhering to the requirements of GN 704 and implementing a design along the guidelines provided in the Best Practice Guidelines, the water quality will not be polluted by mining activities. However, care should be taken in the mining development phase to restrict the clearing of land to the minimum required. In this phase, while erosion control measures are being implemented, the highest risk of erosion damage occurs. This will lead to high turbidity levels and increased sediment in the drainage lines and streams.
- In the event of major floods causing failure of the system, the dilution effect may minimise the impact.
- Other types of failures should be prevented by proper management and maintenance of the system.
- Impact of the dirty water areas on water quality: By adhering to the requirements of GN 704 and following the best practice guidelines, as would be required in the licensing application, dirty water is contained and water available after evaporation losses will be re-used.
- In case of accidental spillages, especially of hydro carbons and of coal, specialized equipment should be available on site to mop up the pollutants before irreversible damage is caused. Else, specialized contractors may be used to fulfill this function.
- Off-setting the loss of wetlands: The creation of small impoundments at the head of stream diversions, where appropriate, may be considered. These low structures (earth or gabion embankments) will lower the approach velocity and contain sediment, thereby delivering relatively clean water at acceptable velocities into the canal system. In time wetlands will be formed behind the embankments.
- Impact of surface water use: At this stage of the investigations, the large-scale development of a surface water source for use by the mine does not appear feasible. Therefore surface water use would be limited to the direct rainfall on open pits, increased evaporation loss and a small quantity to be stored for use in the dirty water area control dam.
- Limiting erosion at drainage structures, e.g. design and install appropriate outlet structures to retard the flow velocity.

The Storm Water Management Plan described in the EMP (Section 2) Paragraph 2.3 describes the expected localized impacts and mitigation requirements at the Chapudi Project to ensure that the surface water impacts are minimized.

3.1.5 GROUNDWATER

Mining 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.

A numerical model was generated in order to quantify the impact of the proposed mine on the groundwater in the study area, and to determine inflows into the mine workings. Since many mines will be operated in conjunction, it was necessary to model a large area to determine cumulative impacts. The Makhado Colliery will be in operation before the Mopane Project, and will impact on water levels. In addition, the Chapudi and Generaal Projects will overlap with the Mopane Project, hence all the projects must be considered in conjunction.

The USGS MODFLOW2000 Finite Difference groundwater model was used in the US Department of Defense GMS 9.0 (Groundwater Modelling System) interface to simulate and plot groundwater flow.

The construction and calibration of the regional numerical model is discussed in detail in the Groundwater Specialist Report (ANNEX-3, WSM Leshika 2013) and is not repeated here.

3.1.5.1 Groundwater Inflows

The impacts of mining on the regional water balance are shown in Figure 76.

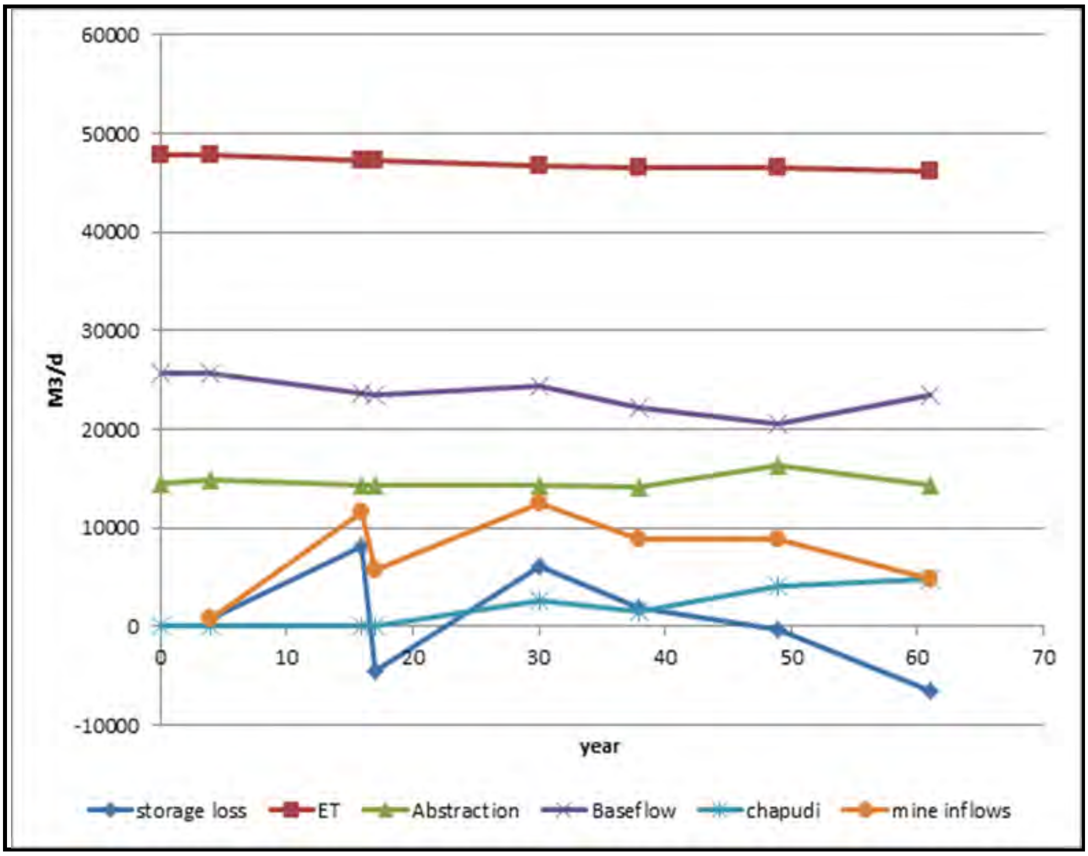


Figure 76: Mine abstraction and impact on the aquifer

Evapotranspiration from riverine areas is impacted and decreases from 47.8 Ml/d to 46.4 Ml/d. This reduction occurs largely along the river channels and the springs and seeps along the foot of the Soutpansberg Mountains, where drawdown of the water level reduces the availability of shallow groundwater.

Abstraction of groundwater for existing users is reduced from 14.5 Ml/d to a minimum of 14.1. Due to the way that the model has been set up i.e. 2 layers of 200m thickness each, losses from abstraction may be significantly more, as in the model, boreholes can abstract water down to 200m, which is not the real situation.

The bulk of inflows into the pits and to boreholes originate from storage losses from the aquifer, which rises to 8.1 Ml/day by the end of the life of mine of Makhado. They subsequently decline due to the refilling of Makhado and the closure of Mount Stuart underground mine and Wildebeesthoek

Section. Inflows into mines peak at 12.4 Ml/d when all mines except Makhado are in operation, then decline to 8.7 Ml/d by the end of the life of Mopane. During the peak inflows (Year 30), 2.7 Ml/d are inflows into the Chapudi open pits. Inflows into Chapudi Project open pits rise to 6.2 Ml/d by year 59, thereafter falling to 4.8 Ml/d at year 61 (end of life of mine).

Mine inflows exclude direct rainfall into mine workings, and surface runoff which is not diverted. This is because such inflows are not part of the average daily inflow, and occur only during storm events, which are highly variable. Post mining, recharge to the pits is included in the water balance, since this volume will not be removed as storm water and will replenish the pits.

3.1.5.1.1 Inflows into Wildebeesthoek, Chapudi and Chapudi West Sections

Inflows into Wildebeesthoek Section increase to 2.9 Ml/d in mining year 34, 29 years after the pit starts, which were simulated assuming a progressive deepening of the pit. The first 18 years mining will be above the water table, hence no inflows due to the deep present water level (up to 70 mbgl).

Inflows into Chapudi Section, located close to the high recharge zone in the Soutpansberg, increase to 5.4 Ml/d by year 59. During the first 8 years mining will be above the water level and thus no inflows.

Inflows into Chapudi West Section increase to 0.8 Ml/d by year 59, before starting to decline. During the first 20 years mining will be above the water table and thus no inflows.

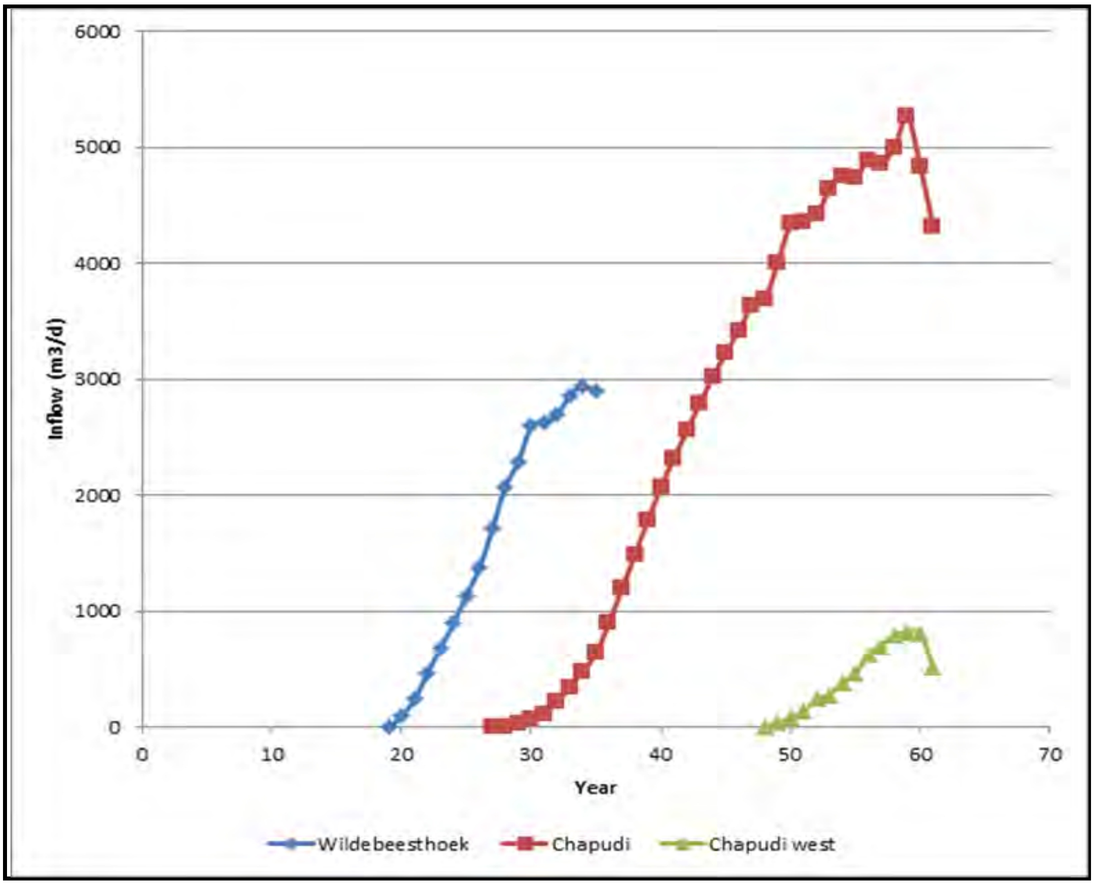


Figure 77: Inflows into the Chapudi open pits

3.1.5.2 Cumulative Drawdown

Drawdown is the measure of water level decline taken from a bases point, in this case prior to commencement of mining i.e. year 2013. Drawdown of the water level after mining commences is shown for various periods of time in Figure 78 to Figure 81.

Not much drawdown in water level occurs around Wildebeesthoek Section by year 16, 12 years after the start of Wildebeesthoek Section, due to the existing deep water levels already present in the area prior to mining. By mining year 38 and 49 significant drawdown occur around the Wildebeesthoek and Chapudi Sections but not much around Chapudi West Section due to existing deeper water levels as a result of irrigation. By mining year 61, the end of life of all mines, significant drawdown occurs northwards for more than 25 km as the impacts from the Chapudi, Generaal, Mopane and Makhado Projects are cumulative and overlap.

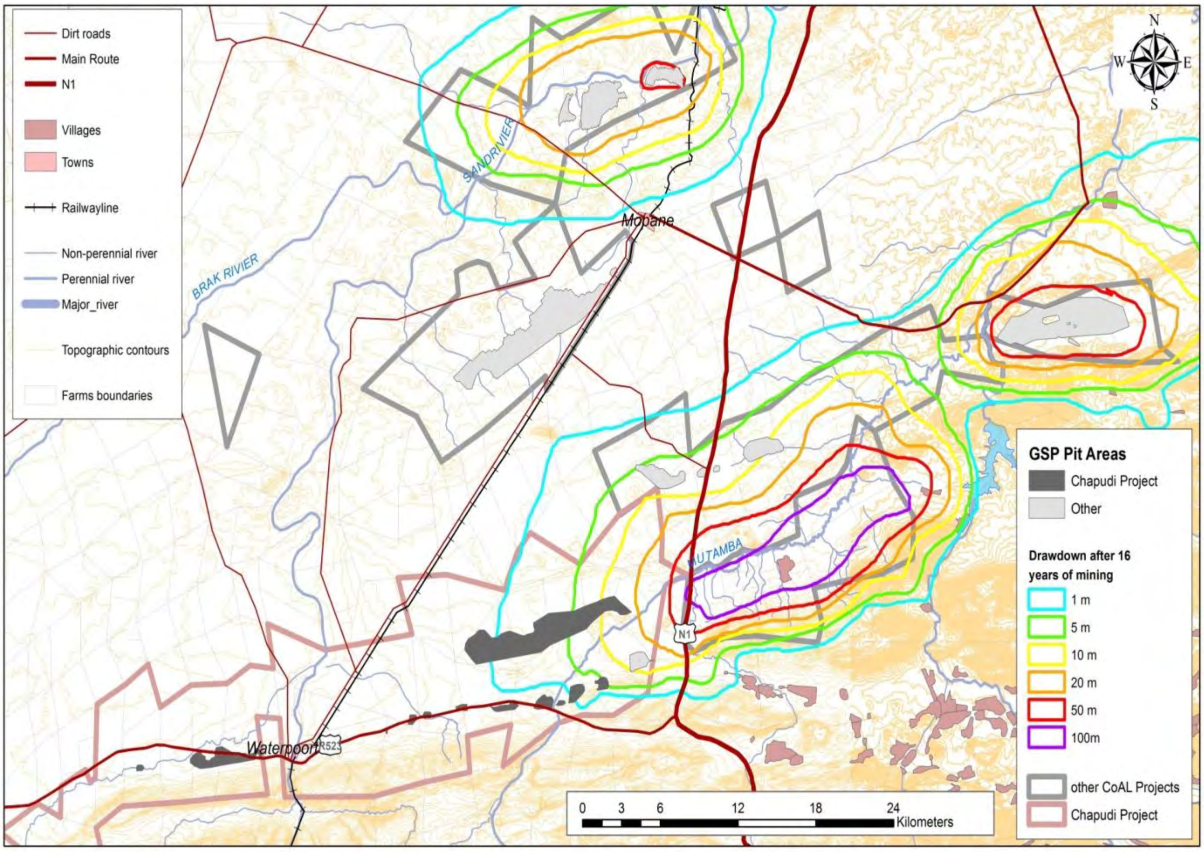


Figure 78: Cumulative drawdown in Year 16

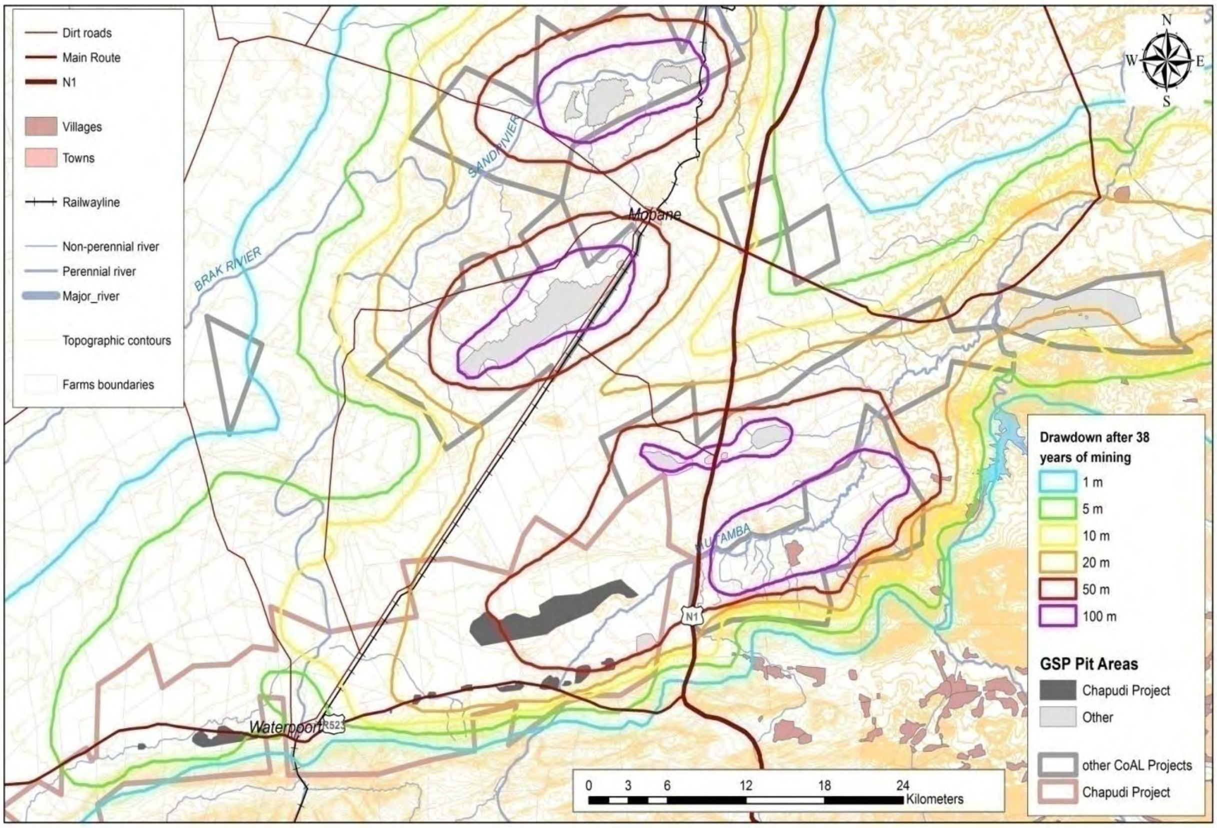


Figure 79: Cumulative drawdown in Year 38

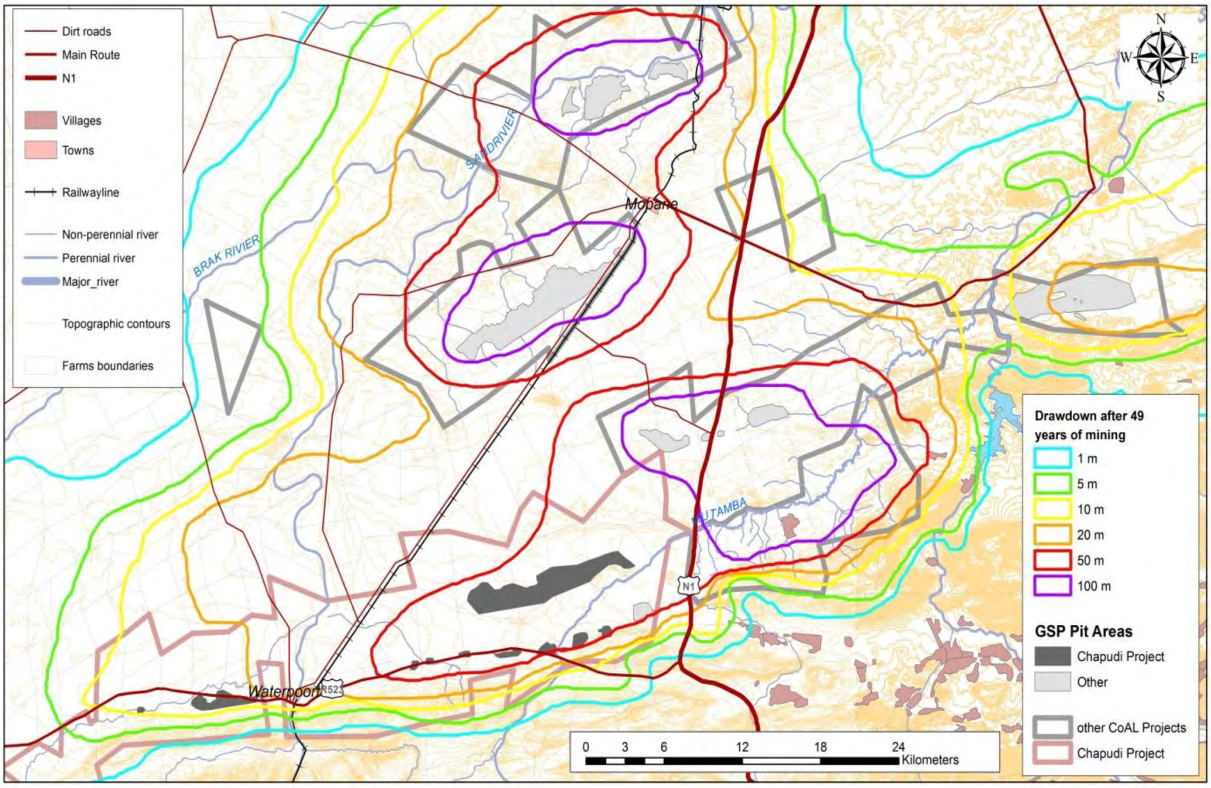


Figure 80: Cumulative drawdown in Year 49

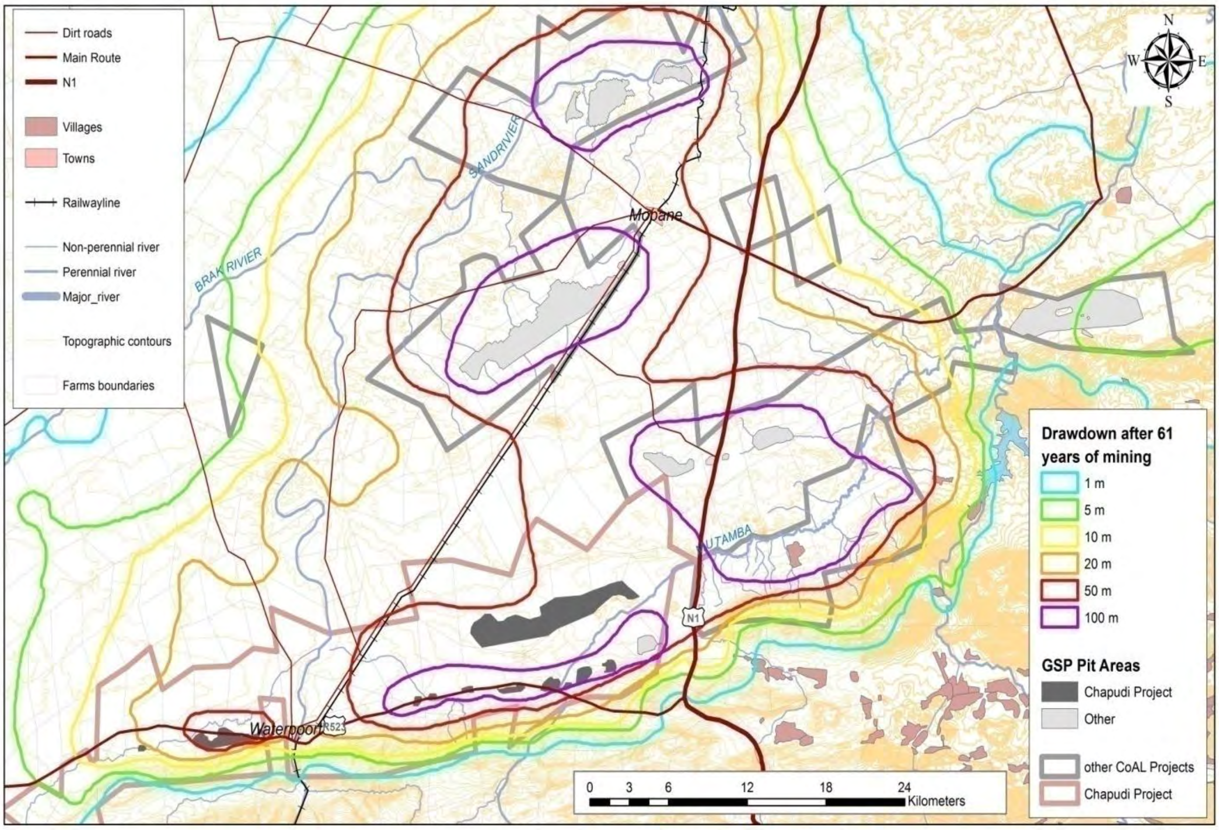


Figure 81: Cumulative drawdown in Year 61

3.1.5.3 Groundwater Impact Assessment for Chapudi Project

Mining at Chapudi will involve open cast mining along extended open cuts down to 200m below surface.

A multiple layered aquifer system is thought to occur in the Chapudi West area where aquifers of different quality overly each other. These aquifers are separated by shale aquitards. An example is the saline alluvial aquifer which overlies fresh aquifers associated with the coal seams and the faults. Mining will disturb the aquitards allowing for mixing of these aquifers resulting in the fresh water aquifers becoming more saline.

Groundwater flow will be intersected by the pits when below the water table. The water flowing into the pits will need to be pumped out (dewatered) for safe mining operations to continue. The water pumped from the pits will be used on the mine for process water in the plant and dust suppression. The dewatering will result in a lowering of the water table (cone of depression) around the mine pits, extending for more than to 25 km northwards of Chapudi at the life of mine. This is because water is taken mostly from aquifer storage, as recharge in the area is low and unable to sustain the dewatering. The east-west striking faults such as the Tshipise, Senotwane and Phareng faults are far more transmissive resulting that the cone of depression is elongated along their axis.

Impacts of mining could be significant. These, in order of significance, include:

- Reductions in water available for abstraction and discharge i.e. lower borehole yields or drying up of boreholes and springs along the foot of the Soutpansberg Mountains within the radius of influence.
- Cross contamination of aquifers due to the disturbance of aquitard layers and the down gradient contamination due to seepage from the rehabilitated pits, discard dumps, stockpiles and dirty water dams.
- A reduction in water available for evapotranspiration. Groundwater dependant floral species around springs and seeps could be affected as the water table drops. Riverine vegetation is mostly sustained from surface flows and water stored in the alluvial deposits, however shallow groundwater may be important during extended dry periods.

3.1.6 SENSITIVE LANDSCAPES

3.1.6.1 Conservation Initiatives / Protected Areas

The Chapudi Project falls within the boundary of the VBR, but not within or adjacent to any of the core areas. It does however border on a VBR buffer zone identified as the Limpopo Central Bushveld to the south. Because of the large scale of a biosphere, various developments can be accommodated in the biosphere concept and the development of a coalmine within the borders of a biosphere can be accommodated. The sensitivity of environments and zone will determine the allowable activities in the VBR, which will determine if the mine is in compliance with VBR stipulations.

Protected areas in the vicinity of the site include:

- Bergtop Nature Reserve to the South;
- Goro Game Reserve to the South;
- Studholme Nature Reserve to the South;
- Hangklip State Forest to the South;
- Happy Rest Nature Reserve to the South;
- Roodewal State Forest to the South;
- Entabeni State Forest to the South; and
- Langjan Nature reserve to the West.

Protected areas that is situated (partly) within the MRA area or that are directly adjacent to the site include Bergtop Nature Reserve and Goro Game Reserve.

The Chapudi Project area further borders on Priority Area 1 {North Eastern Escarpment} for conservation as determined by the National Biodiversity Assessment (NBA) as contemplated in the National Protected Area Expansion Strategy (LEDET, 2008). The study area also falls within the following important biodiversity areas:

- Soutpansberg centre of endemism;
- key vegetation community (Soutpansberg);

- delineation of the Soutpansberg escarpment; and
- special habitat for crested guinea fowl.

Because of the remoteness of the areas, the main impacts will probably be through aspects such as ambience and character of the environment and wilderness quality (sense of place) through visibility, noise, air quality (dust), light etc. In addition, species that occur within the protected areas, but not restricted to its boundaries through fences (e.g. birds), might be influenced through a loss in habitat for feeding, nesting, etc.

Potential impacts can be summarized as follow:

- Impact on protected species (fauna and flora).
- Loss in habitat and habitat quality for certain (migration) species.
- Change the ambience and character of the environment.
- Decrease the experience of the Soutpansberg and the VBR as an eco-tourist destination.
- Direct and indirect impact on protected areas, VBR buffer zone and NBA Priority Areas.

3.2 CUMULATIVE IMPACTS

The Chapudi Project forms part of the Greater Soutpansberg Project (GSP) situated to the north of the Soutpansberg in the Limpopo Province. Figure 1 depicts the locality of the various GSP projects, from which it is evident that they are within close vicinity of each other, all situated within the A80F and A71J, K & L quaternary catchments. Future operations planned for the Greater Soutpansberg area (MbeuYashu / CoAL only) are:

- Makhado Colliery (in decision-making phase)
- Mopane Project (NOMR application submitted)
- Chapudi Project (NOMR application submitted)
- Generaal Project (NOMR application submitted)

The total surface area associated with these NOMR applications is approximately 100 500 hectares.

The cumulative impacts of the high risk environmental aspects associated with the Greater Soutpansberg Project are summarized below.

Aspect	Unit of measurement	Makhado	Mopane	Chapudi	Generaal	Total
NOMR application area	hectares	7 635	24 703	40 792	27 306	100 436
Surface disturbance / vegetation clearance (over 60 years of mining, ignoring continuous rehabilitation)	hectares	3 800	3 500	7 575	1 672	16 547
% of NOMR application area	%	50	14	19	6	16.5

Aspect	Unit of measurement	Makhado	Mopane	Chapudi	Generaal	Total
Maximum bulk water requirements (make-up water at full production in 2035 at current mining schedule)	m^3/day	5 200	7 600	11 000	11 000	34 800
Groundwater Impact - area of drawdown influence	km^2	300	inclusive	inclusive	inclusive	3 600
Direct employment opportunities (at full production, inclusive of all sections)	persons	1 106	917	1 834	905	4 762
Impact on existing employment (estimate)	persons	370	128	412	TBD	TBD

TBD: Still under investigation as part of the Generaal EIA specialist investigations.

The most significant cumulative impact is associated with the groundwater drawdown. The groundwater modeling indicate that the impacts from the Makhado, Mopane, Generaal and Chapudi Projects are cumulative and overlap, and drawdown occurs for a radius of up to 25 km at the end of the life of the mines. The area of drawdown influence is in the order of 3 600 km^2.

The Sand River is an extremely important system with the system providing potable water as well as large volumes of water for the irrigation of crops to the north of the Soutpansberg mountain range. The irrigation of the crops is critical to their success and the crops produced can be considered to be of high significance as the crops are produced in winter when areas further to the south cannot produce food for the South African consumer. Prior to any large scale mining in the area the system can already be considered to be stressed from a water supply point of view. It is also important to note that no reserve determination has been undertaken for the Sand River. In addition the system has been identified as a FEPA river system and an upstream support area for a fish FEPA and is therefore considered important in fish conservation. For these reasons extreme caution must be used in decision making in the area with regards to any activity which may affect water supply.

The activities of the Generaal Project are unlikely to contribute to the cumulative impact on the Sand River although some very small impacts on the Limpopo River system may occur. There will however be a significant cumulative impact on the Sand River system from both the Chapudi and the Mopane Projects with both systems likely to have similar types of impacts on the Sand River system. The combined impact of both these projects is likely to significantly affect the water supply and possibly the water quality in the Sand River which in turn will affect the habitat available in the system as well as the availability of refuge pools in periods of low flow and an impact on aquatic and riparian community diversity sensitivity and abundance is likely to occur. In addition these projects have the potential to affect downstream socio-cultural service provision of the Sand River system.

For these reasons extreme caution and care should take place throughout the entire life cycle of these two projects, should they proceed, in order to ensure that the impact on the Sand River system and other ephemeral systems in the area with riparian vegetation is minimised to levels which would ensure an ongoing acceptable level of functioning and biodiversity in these systems.

The socio-economic cumulative impacts have been addressed in detail in the SEIA (Naledi, 2013) and are not repeated here. Refer to ANNEX-9.

The main conclusion arising from the SEIA assessment is that should all the Greater Soutpansberg Projects and other planned mining developments in the region be implemented at the same time and development cannot be staggered, the following cumulative socio-economic impacts and benefits are envisaged:

- Cumulative socio-economic impacts:
  - Additional influx of people into the area, thereby adding to congestion and pressure on local infrastructure and services.
  - Compounded impact on the area's sense of place, this in turn may cause a decline in tourism and hunting related activities in the surrounding area.
  - Impact on land use and availability for ecotourism and hunting.
- Cumulative socio-economic benefits:
  - Combined increased in local economic growth and employment.
  - Combined increase in local procurement opportunities causing local business to expand to fill the demand for goods and services.
  - Additional contribution to government tax, balance of payments and national growth.

Given the scale of mining planned in the region and if there is a lack of a concerted action by key stakeholders including government, local stakeholders and industry, there is a high likelihood that significant environmental and socio-economic impacts will occur in the area. It is therefore recommended that development be staggered in the area to optimise the sustainability of the long-term benefits and mitigate the environmental and socio-economic impacts.

3.3 POTENTIAL FOR ACID MINE DRAINAGE

No geochemical testing has been done during the current EIA. This brief evaluation is based on the results of tests done previously for the Chapudi Project (SRK report Chapudi Project: Environmental baseline study, September 2009). The results of tests done on this project indicated the following:

- The overburden material stripped to access the coal seams are unlikely to generate acidity and in fact show strongly neutralising potential. There is however a possibility that they will produce salts which may negatively impact on the environment.
- The coal seams may or may not generate acidity and it will be necessary to conduct long term tests to confirm this. If it is assumed that acidity will be generated mobilisation of manganese, iron, barium and nickel and in some instances cobalt and strontium could occur.
- The inter-seam mudstones and dolerites are unlikely to be acid generating although there may be salt produced which may impact the environment

All the above conclusions can only be fully confirmed with the completion of detailed testing including long-term kinetic test work.

The risks therefore include:

- Potential acid generation from coal / carbonaceous stockpiles which will need to be managed.
- Salinity generated from overburden stockpiles in the form of alkalinity mainly sulphate with the major cations being sodium, calcium, potassium and magnesium, depending on the lithologies.

4 ALTERNATIVE LAND USE OR DEVELOPMENTS THAT MAY BE AFFECTED

4.1 CURRENT LAND USE

The current land uses / economic activities in the region include:

- Live Stock Farming
  - Commercial Cattle
- Game Farming
  - Live Sales
  - Hunting, sub-divided into "Trophy" and "Biltong"
    - Trophy hunting including services like professional hunter, skinner, tracker, etc.
    - Biltong hunting including the services of trackers, skinners, etc.
  - Hunting Accommodation
- Eco-Tourism
- Irrigation

Refer to Section 1.2.4 and Section 7 of this report for more detail in this regard.

4.2 ALTERNATIVE LAND USE OPTIONS

From the specialist field surveys and other available information it can be stated that large areas of the proposed Chapudi Project area have arable soils. However, as a result of low rainfall, high temperatures (high evapotranspiration), susceptibility to compaction, present erosion and potential erosion susceptibility of the soils in the area, the soils are not always optimal for rain fed crop production. Therefore, soils classified as arable land fall into Classes III to IV according to the agricultural classification system.

Only 2 236 ha in the project area are presently under cultivation (1 699 ha dry land and 537 ha irrigated). These areas generally have deep soils and are suitable for crop production especially under irrigation when sufficient amount of good quality irrigation water is available.

Water quality for irrigation purposes varies across the project area. The boreholes situated near the hills in the southern parts of the project area are highly suited for irrigation purposes, with absolutely no restrictions to irrigation.

Some of the water samples only have minor suitability constraints and can be used for irrigation if it is well managed. The quality of water of some of the boreholes further north in the study area, is less suitable for irrigation purposes with restrictions specifically to sensitive crops.

Shallow soils and surface rock are dominant in large areas. Areas classified for grazing have presently low basal grass cover and are dominated by Mopane shrub field. Generally the soils are sandy and susceptible to erosion (water and wind) and should be permanently covered with vegetation to prevent erosion and top soil loss. Uncovered areas are also susceptible to water erosion in times of high intensity storms.

The majority of the Chapudi Project area is presently covered with low density woody species and used for grazing purposes for either cattle or game farming; however, carrying capacity is questionable due to poor soil fertility (potential erosion susceptibility, shallow soils, and surface rock) and poor climatic conditions.

Refer to Section 1.2.3 of this report as well as the Soil Specialist report (ANNEX-1) for detail description of the land capability of the project area.

4.3 DEVELOPMENT ALTERNATIVES – CONCEPT STUDY

A number of alternative options have been evaluated during the mine design. A high-level qualitative risk assessment was performed to determine the most preferred option from an environmental perspective. The final positions and alternatives will be influenced by the EIA and stakeholder engagement process, and will be revisited during the Feasibility Phase of the Chapudi Project development.

4.3.1 MINE INFRASTRUCTURE

The Chapudi Project footprint is in an environmental and ecological sensitive area and therefore the necessary diligence will be exercised when considering the final location, placement and orientation of the mine infrastructure and coal beneficiation plant.

Due to the close proximity of the mines, the infrastructure comprises of elements that could be shared by all three mines. The first layout that was prepared for the Wildebeest, Chapudi and Chapudi West mines allowed for a single processing plant for all three mines. More options were developed with a final option showing all three mines with individual infrastructure layouts necessary for the mine development requirements. As the individual layouts is not restrictive in terms of shared facilities and do not depend on the timing and sequencing of the other mines, this was then regarded as the more favourable option and taken forward to the costing and submission stage.

The following factors were taken into considerations during the process where the alternatives were compared:

- Distance of product to be transported to the nearest rail link;
- Mode of transport i.e. rail versus conveyor (for environmental reasons road transport was not considered);
- Topography and water courses;
- Sharing of facilities amongst the three mining pits;
- Positioning of carbonaceous and non-carbonaceous dumps, discards and topsoil dumps in relation to the mining pits;
- Discard dumps in relation to the plant/infrastructure position and layout;
- Positioning and orientation of infrastructure and layouts of haul roads, access roads, rail access routes and conveyor routes;
- Traffic movement around the plant and mine infrastructure areas; and

- Natural streams and drainage channels for discharge of clean and capture of polluted storm water run-off.

The following salient factors will be considered during the final design and placement of the facilities:

- Energy efficiency;
- Impacts of environmental conditions such as prevailing winds, dust and sun with respect to infrastructure placement;
- Flood and rainfall immunity levels;
- Human settlement planning and design; and
- Water recycling and reuse.

4.3.1.1 Option 1: Central Processing Plant

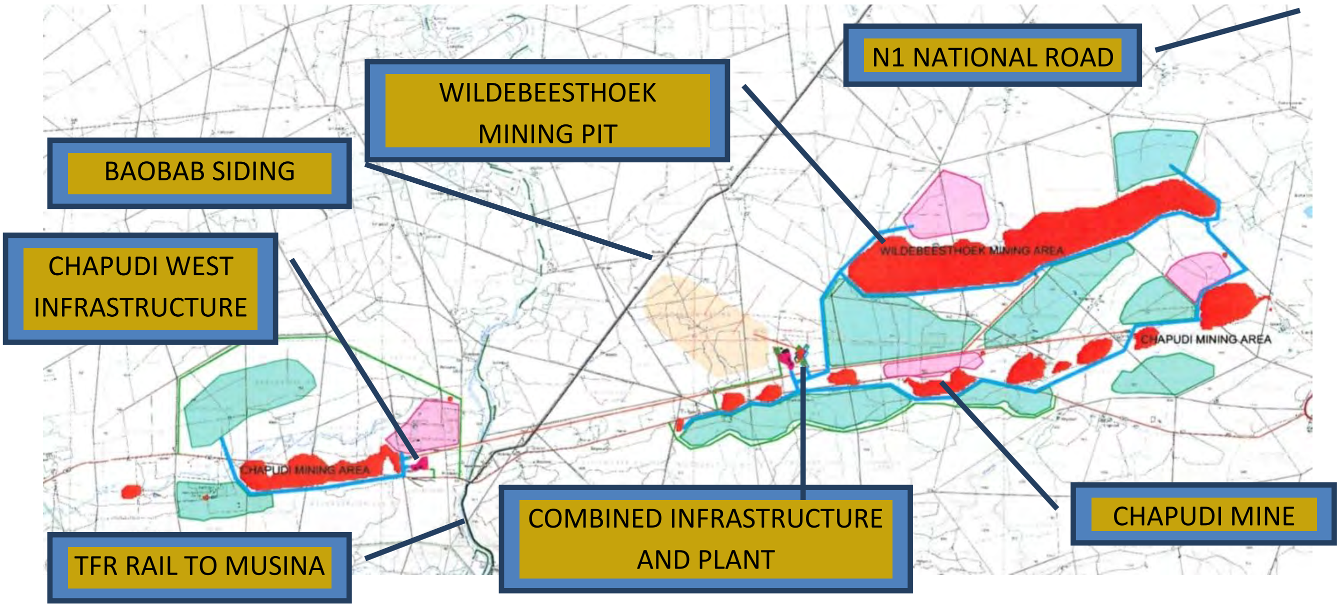


Figure 82: Option 1 - Central Processing Plant

This Option considered a centrally located processing plant to cater for the processing of coal from all three mines. The plant is located close to the Wildebeesthoek and Chapudi pits as the larger part of the coal reserves lies in this area. These two mines will also share common mine infrastructure located adjacent to the processing plant. Chapudi West however has been provided with mine infrastructure of its own due to the long travel distance to the East Infrastructure. Common to all three mines is a RoM tip and conveyor to the processing plant.

The coal seams all dip in a northerly direction. Ideally the dumps should be placed to the south of the pits in order to minimise the hauling distance. This is however not possible in all instances due to the Soutpansberg mountain range south of the pits creating space constraints. The dumps have therefore been positioned as close as possible to the southern edge of the pit but some dumps have of necessity been placed on the east and west but also on the northern side of the mining pits.

The position of the plant and infrastructure area was chosen in order to be accessible by road and rail. The main TFR line runs to the west of Wildebeest pit and the rail loop and rapid load out is positioned such that the product can be transported over a short distance to the loading point. From here the rail runs in a north-westerly direction along the border of Woodland farm to the Baobab Siding. Access to the mining site is provided by an intersection on the N1 national road.

Access to the Plant site is by way of the N1 towards Musina, turning west onto the R523. Chapudi West access is off the same road (R523) further to the west.

Advantages and disadvantages

The main advantage of this option is that only one processing plant is required. The disadvantage is that the product from Chapudi West will have to be hauled or conveyed over a considerable distance, which increases the cost and environmental impacts in respect of dust and noise.

4.3.1.2 Option 2: Chapudi and Wildebeesthoek combined

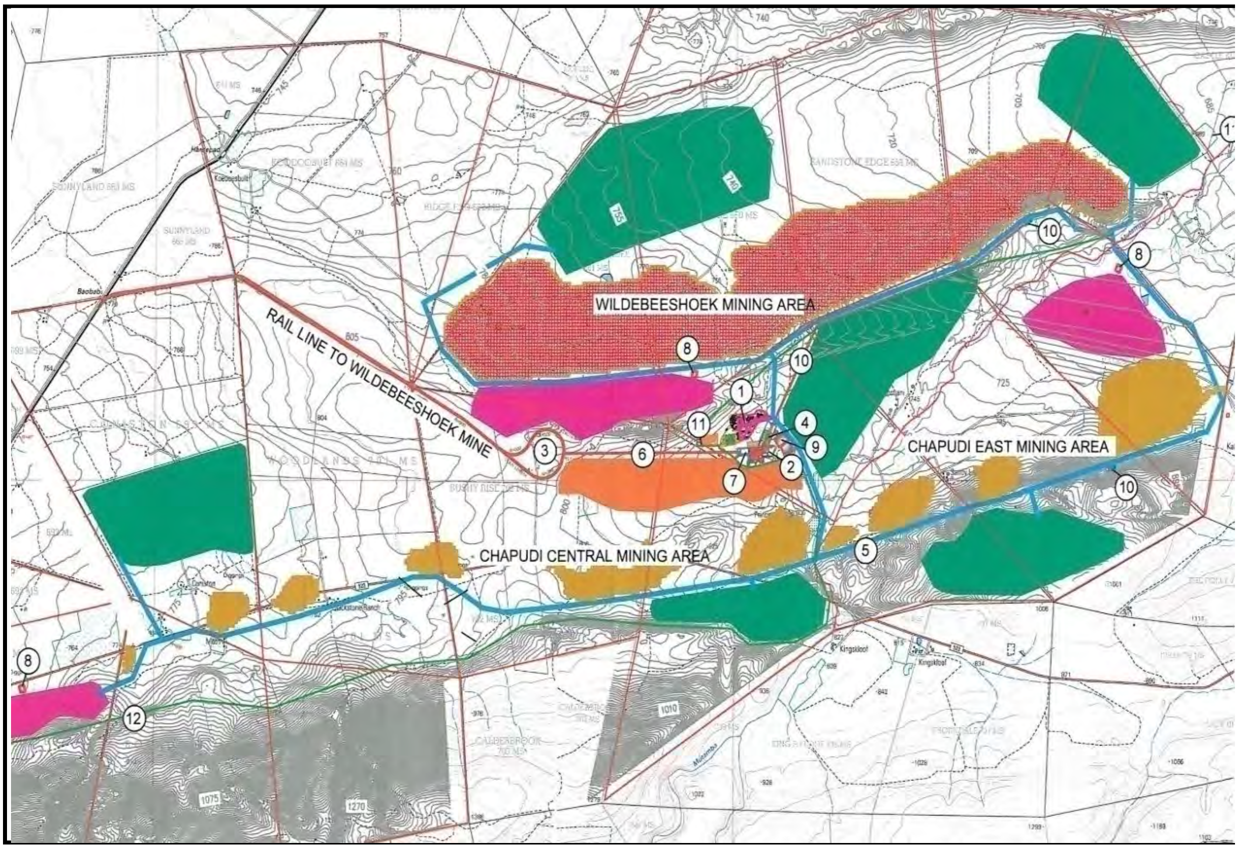


Figure 83: Option 2 – Chapudi and Wildebeesthoek Combined Layout

The combined mining option, as opposed to individual mining options explored the advantages of the two mining pits sharing common facilities such as:

- Processing plant;
- Infrastructure such as change house, managers offices etc;
- Single load out facility;
- Balancing coal production between the two pits;
- Explosives magazine etc.

In this option the Wildebeesthoek and Chapudi Mines will share plant and infrastructure facilities located adjacent to the Wildebeesthoek pit. Chapudi West will be provided both with plant and infrastructure separately.

Access to the mining sites will be from the R523 as before, first to Chapudi and from there proceeding in a northerly direction to the Wildebeesthoek infrastructure and mining area. Haul roads will be positioned along the pits from where RoM will be transported to the Wildebeesthoek RoM tip by truck haulers and from the Chapudi RoM tip by means of a conveyor. RoM and discards will be transferred to the plant and discards stockpile by means of conveyors.

The coal washing plant is located centrally in-between the two mining pits in order to limit hauling distance as much as possible. Product from the coal processing plant will be transferred by conveyor to the rail loop and RLT from where it will be railed to the Baobab Rail Siding on the main TFR line.

Advantages and Disadvantages

The main advantage of this option is that facilities can be shared.

The main disadvantage of this option is that Chapudi West is too far to share the common facilities provided for the other two mines.

4.3.1.3 Option 3: Individual Infrastructure for Mines

This option allows for separate infrastructure for all three mines. This option allows flexibility in terms of the individual mining development as individual mines are not dependant or linked to the other mines timelines. As such this option was selected for the costing exercise of the three mines.

The individual mining layouts for the three mines are discussed below.

4.3.1.3.1 Wildebeesthoek Section

The Wildebeesthoek Section lies in-between the TFR rail line and the N1 National road to the north of Chapudi Section and the Soutpansberg mountain range. The mining layout is shown in Figure 84. The infrastructure and washing plant lies on the south side and more or less in the middle of the pit footprint. The non-carbonaceous stockpiles (dumps) have been positioned to the south, the east and also on the north side of the pit due to lack of space on the southern side of the pit. The discards stockpile (shown in magenta) has been positioned close to the processing plant.

This layout is essentially the same as the combined Chapudi layout with the exception that a shorter access road from the N1 National Highway will be provided. Following the N1 towards Musina a new intersection with the N1 where the D745 intersects east towards the Makhado Mine and the Nzhelele Dam will be provided. The road is approximately 12 km long following the Mutamba River in a westerly direction up to the mining pit from where it follows the pit perimeter towards the mining infrastructure. It is envisaged that a more appropriate route may be from the R523, this will be investigated during the feasibility phase.

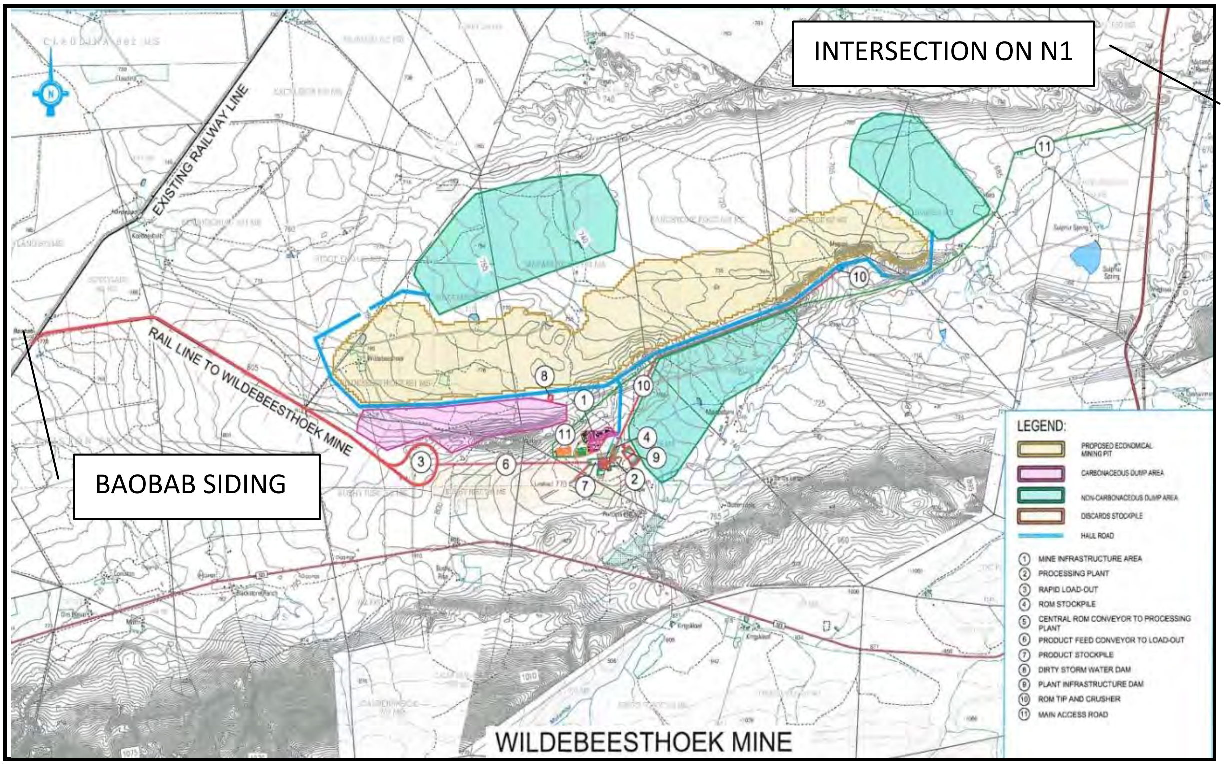


Figure 84: Option 3 - Wildebeesthoek Section layout

From the plant area a conveyor will transport the product to the rail loop and RLT to the west of the plant from where a new rail line will run in a north-westerly direction to link up with the TFR rail at the Baobab Siding.

4.3.1.3.2 <u>Chapudi Section</u>

The Chapudi mining pits are strung out along the northern edge of the Soutpansberg mountain range (refer Figure 85). The position of the infrastructure and washing plant is largely determined by the available space and has therefore been positioned on the south–eastern corner of the farm Woodlands 701 MS. Infrastructure for supporting the mining activities has been laid out and engineered so as to best suit the topography and mining pit layouts.

The discards stockpile lies adjacent and to the west of the washing plant with the mining infrastructure south of the plant. Other stockpiles have been positioned as close as possible to the pits.

Access to the mine site is off the R523 which currently passes to the north of the mine layout area. From the farm Princess Hill 704 MS towards the west the R523 needs to be rerouted. During the feasibility phase a significant road study will be commissioned to evaluate this.

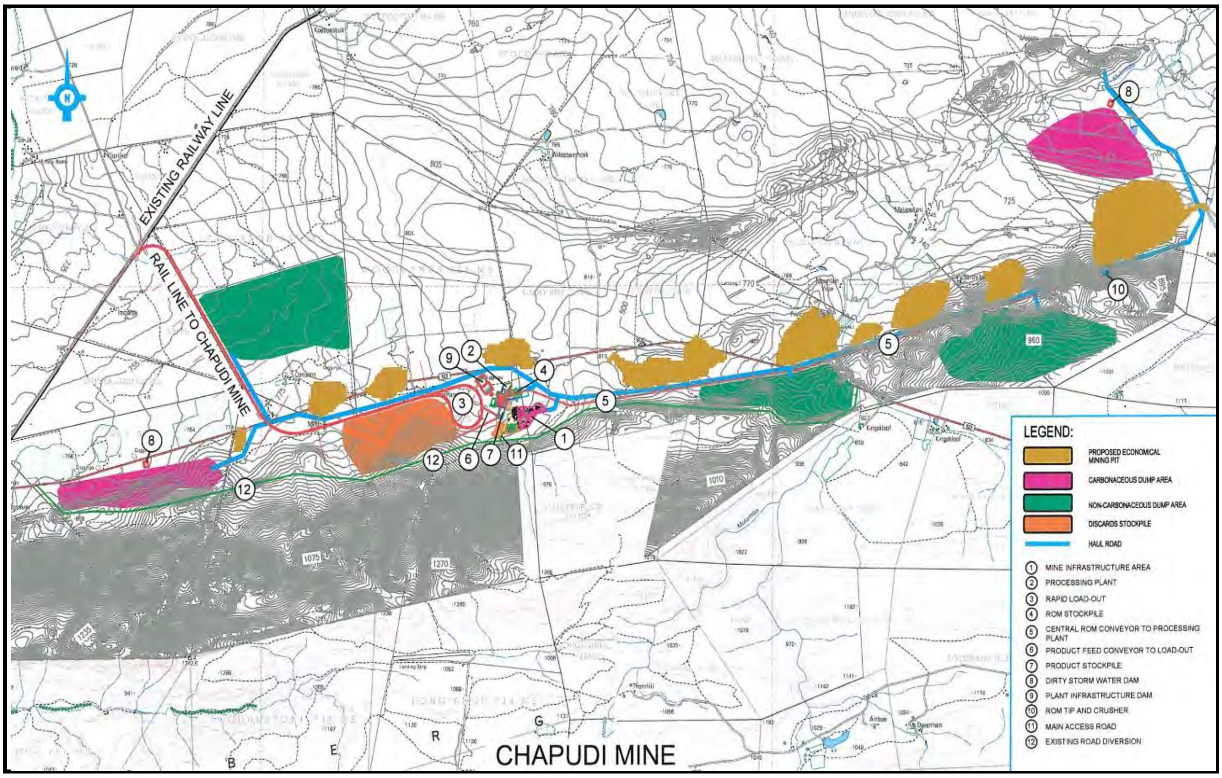


Figure 85: Option 3 - Chapudi Section layout

A conveyor will be utilised to transport the run of mine (ROM) from the pits on the eastern side to the processing plant at Chapudi due to the long hauling distance. Haul roads will also be used to transport RoM to the plant on shorter haul distances. The rail loop and RLT is adjacent to the plant from where product will be loaded onto the rail wagons. The new rail line then proceeds to join the TFR rail over a distance of approximately 8km.

4.3.1.3.3 Chapudi West Section

Access to the Chapudi West site is along the R523 as for Chapudi but approximately 11.5 km west of the rail line (refer to Figure 86). The R523 will be relocated as it crosses the mining pit once more over a distance of approximately 10 km. The mine access road take-off is at the position where the relocated road joins the existing R523 at the western extremity of the mining pits

Mine residue dumps have all been positioned to the north of the pit due to space constraints on the south side. These consist of non-carbonaceous as well as a discards stockpile. The infrastructure comprises of haul roads, a processing plant and vehicle maintenance facilities on the mining area. Water will be derived from the sand aquifer in the Sand River.

A tip and crusher is provided at the mining pit and RoM will be transported with a conveyor to the processing plant from where product will be loaded by means of a RLT onto the rail. The rail from the loop at the plant runs in a north-easterly direction and crosses the Sand River before it links up to the existing TFR line over a distance of approximately 9 km. A new siding will have to be constructed on the TFR line for the mine.

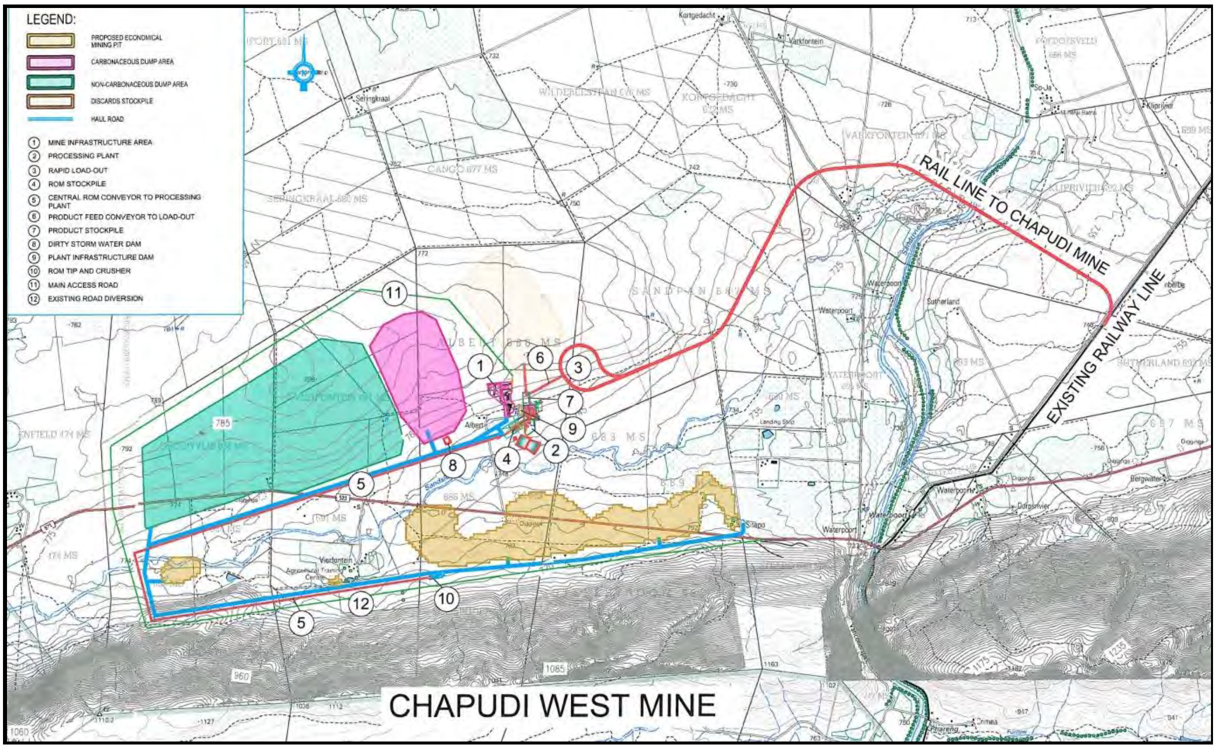


Figure 86: Option 3 - Chapudi West Section layout

4.3.2 PRODUCT TRANSPORT

Private sidings with RLT facilities and railway links on the farms Bushy Rise 702 MS, Woodlands 701 MS and Sandpan 687 MS railway links has proven to be the preferred solution on the basis of repeated review and iterative evaluations of option, within this highly dynamic phase of project development. Factors influencing this conclusion include the low long term operational cost for coal transport from plant to port, lower environmental impact and the lessening of community impact (lower road traffic, congestion and pollution). A rail link provides a seamless transition from the loading siding to a direct link to TFR mainline network.

Factors underpinning this decision include:

- Long term rail costs are significantly lower than road costs, when upgrading and ongoing maintenance costs are taken into account;
- A railway has a lower environmental impact when measured against a road haul option, under prevailing road and rural community conditions;
- A railway option largely internalizes the externalities associated with transport in the form of congestion, accidents, air pollution, carbon footprint, noise (the marginal difference between road and rail) and nuisance, which are not passed on to the community at large;

- The effect of approximately 757 x 34 t road vehicle trips per day (empty and loaded leg) is effectively removed as a source of ongoing community conflict, significant traffic hazard, noise and nuisance in a very confined rural environment;
- While a railway line will not be without its impacts, the dramatically lower level of intrusion into the fabric of public life allows due attention to be paid to those issues which do indeed materialize; and
- Better environmental management of loading activities is possible, due to the provision of a RLT.

4.3.3 MINE RESIDUE MANAGEMENT

4.3.3.1 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.

4.3.3.2 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 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 combination of surface and in-pit disposal will be employed at the Chapudi Project.

4.4 DEVELOPMENT ALTERNATIVES – FEASIBILITY STUDY

The following alternative options were proposed by stakeholders during the various engagement sessions and will be investigated further during the Feasibility Phase of the project:

- Diversion of R523 to allow mining of the Chapudi West Section:
  - Diversion to the north, from the Alldays road.
  - Upgrading of old road along the mountain to the south of the MRA area.
- Mining layout:
  - Combining the Wildebeesthoek and Chapudi Sections, utilizing the same mining and processing infrastructure.
  - Repositioning of the stockpiles and infrastructure at Wildebeesthoek Section to avoid the Mutamba River and associated wetland areas.
- Consideration of creating a Community Trust Fund for all potentially impacted landowners and farm workers as a compensation mechanism.
- Preferential lease back agreements with landowners in the case of land purchase.

Based on the outcome of the EIA, the following will be further investigated during the Feasibility Phase:

- The re-positioning / re-alignment of the mine infrastructure and stockpiles will be investigated to facilitate the following:
  - No activities (mining or ancillary) should take place within 100m from the edge of the 1:100 year flood-line of the major drainage lines, i.e. Sand River, Moleletsane River and Mutamba River.
  - No activities (mining or ancillary) should take place on the farms Blackstone Edge 705 MS and Woodlands 701 MS (south of the R523) in order to protect the highly sensitive GSPC W1 wetland system.
- The mining schedule will be optimized (phased-in / staggered) in order to mininmise the impact on groundwater drawdown on a regional basis.

5 POTENTIAL SOCIAL AND CULTURAL IMPACTS

5.1 SOCIO-ECONOMIC ENVIRONMENT

5.1.1 AIR QUALITY

Dispersion modelling simulations were undertaken by Royal Haskoning DHV (ANNEX-7) to determine the potential air quality impacts associated with the proposed activities. These impacts are reflected as isopleths plots. The isopleths plots reflect the gridded contours (lines of equal concentration) of zones of impact at various distances from the contributing sources. The patterns generated by the contours are representative of the maximum predicted ground level concentrations for the averaging period being represented.

5.1.1.1 Construction impacts

The major impact associated with construction activities is the high potential for dust generation which may have a substantial impact on the local air quality.

Emissions released during the construction of a mine are associated with land clearing activities, drilling and blasting, ground excavation and construction of mining facilities. Dust emissions will vary from day to day and will depend on the duration, the type of activity and the prevailing wind conditions (USEPA, 1996). However the majority of dust impacts are generated by construction vehicles and equipment over unpaved roads (USEPA, 1996).

The temporary nature of construction activities is what distinguishes it from other fugitive sources present within the locality. Emissions from construction activities are expected to have a definitive start and end period and will vary depending on the various construction phases. In contrast to other fugitive sources, here the emissions occur in a steady state or follow a discernible pattern.

The impact on air quality and air pollution of fugitive dust is dependent on the quantity and drift potential of the dust particles (USEPA, 1996). Large particles settle out near the source causing a local nuisance problem. Fine particles can be dispersed over much greater distances. Fugitive dust may have significant adverse impacts such as reduced visibility, soiling of buildings and materials, reduced growth and production in vegetation and may affect sensitive areas and aesthetics. Fugitive dust can also adversely affect human health.

The following components of the environment which may be impacted upon during the Chapudi Project construction phase:

- The ambient air quality;
- Local residents, farms and neighbouring communities;
- Mine employees; and
- The surrounding environment and possible the fauna and flora.

A quantitative assessment of the construction impacts was based on the activities carried out in the respective mining pits. Emission rates were calculated based on the USEPA heavy construction emission factors. Wildebeesthoek, Chapudi West and Chapudi Sections were modelling simultaneously.

Figure 87 and Figure 88 illustrates the maximum predicted daily and annual ground level concentration of PM_{10} from construction activities respectively. The predicted PM_{10} concentration falls below the respective daily and annual standards (Table 42). The PM_{10} construction impacts are highest from the Wildebeesthoek and Chapudi Sections. The resultant impacts arising from construction activities of all three mines are minimal.

Table 42: Maximum predicted ambient ground level concentration (µg/m^3) of Particulate Matter during the construction phase

Source	Maximum predicted ground level Concentration of PM_{10} (µg/m^3)	Ambient air quality standard	Fraction of the standard (%)
Daily			
Cumulative construction impacts	0.20	120	0.17
Annual			
Cumulative construction impacts	0.07	50	0.14

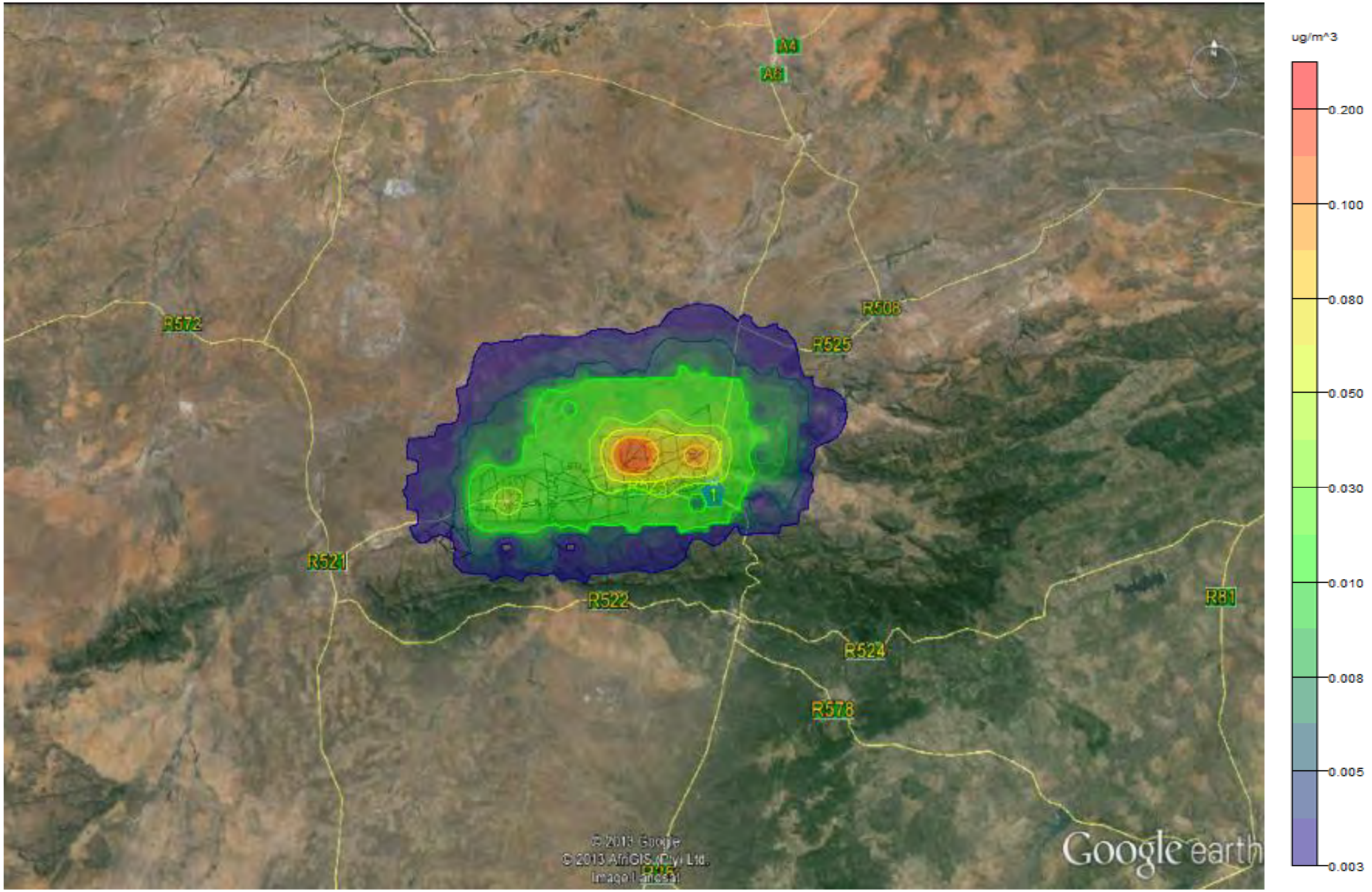


Figure 87: Maximum predicted daily concentration (µg/m^3) of PM_{10} during construction activities

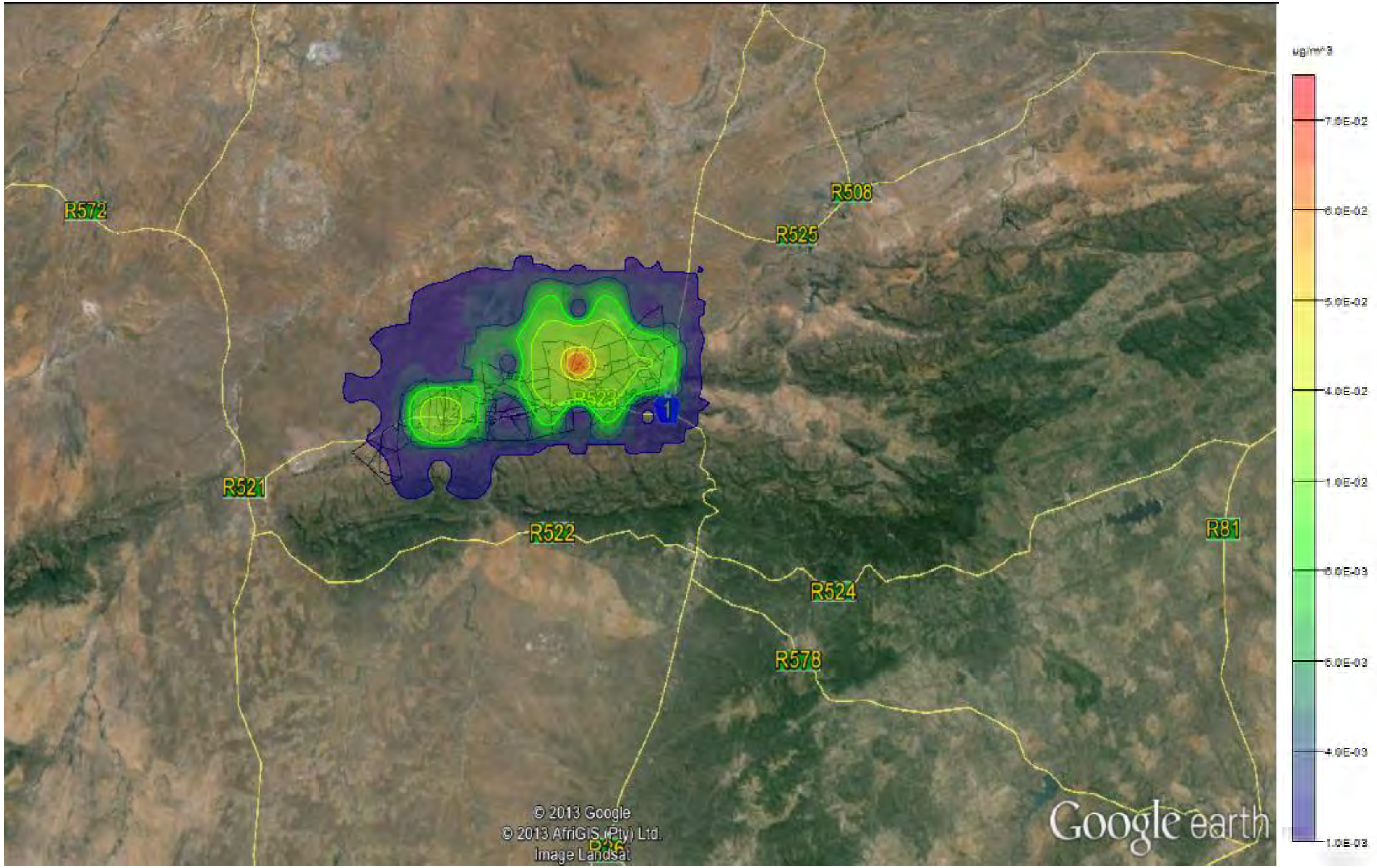


Figure 88: Maximum predicted daily concentration (µg/m^3) of PM_{10} during construction activities

5.1.1.2 Operational Impacts

The details regarding the source characteristics were extrapolated from site layout plans. Sources that were included in this impact assessment are:

- Coal processing (storage piles, crushing and screening activities);
- Open cast mining and in – pit activities (drilling, blasting, bulldozing and tipping); and
- Wind erosion from exposed surfaces.

Table 43 below indicated the maximum predicted daily ground level concentration of PM_{10} during the operational phase at the Chapudi Project. The cumulative impact of 70 µg/m^3 falls below the daily South African standard of 120 µg/m^3 for PM_{10} (Figure 89). When compared against the standard to be implemented in 2015, the predicted concentration is just below the 75 µg/m^3 standard. Mitigation measures should be considered in order to maintain compliance with the 2015 PM_{10} standards.

The highest contributor to the PM_{10} concentration is activities carried out in the mining pit with emissions from stockpile being minimal.

Table 43: Maximum predicted daily ground level concentration for PM_{10} during the operation conditions

Source	Maximum predicted ground level Concentration of PM_{10} (µg/m^3)	Ambient air quality standard (µg/m^3)	Fraction of the standard (%)
Mining Pits	67.6	120	56
Wildebeesthoek Section	26.4	120	22
Chapudi West Section	30.9	120	26
Chapudi Section	61.2	120	51
Stockpiles	3.1E-02	120	0.02
Cumulative impacts	70.0	120	58

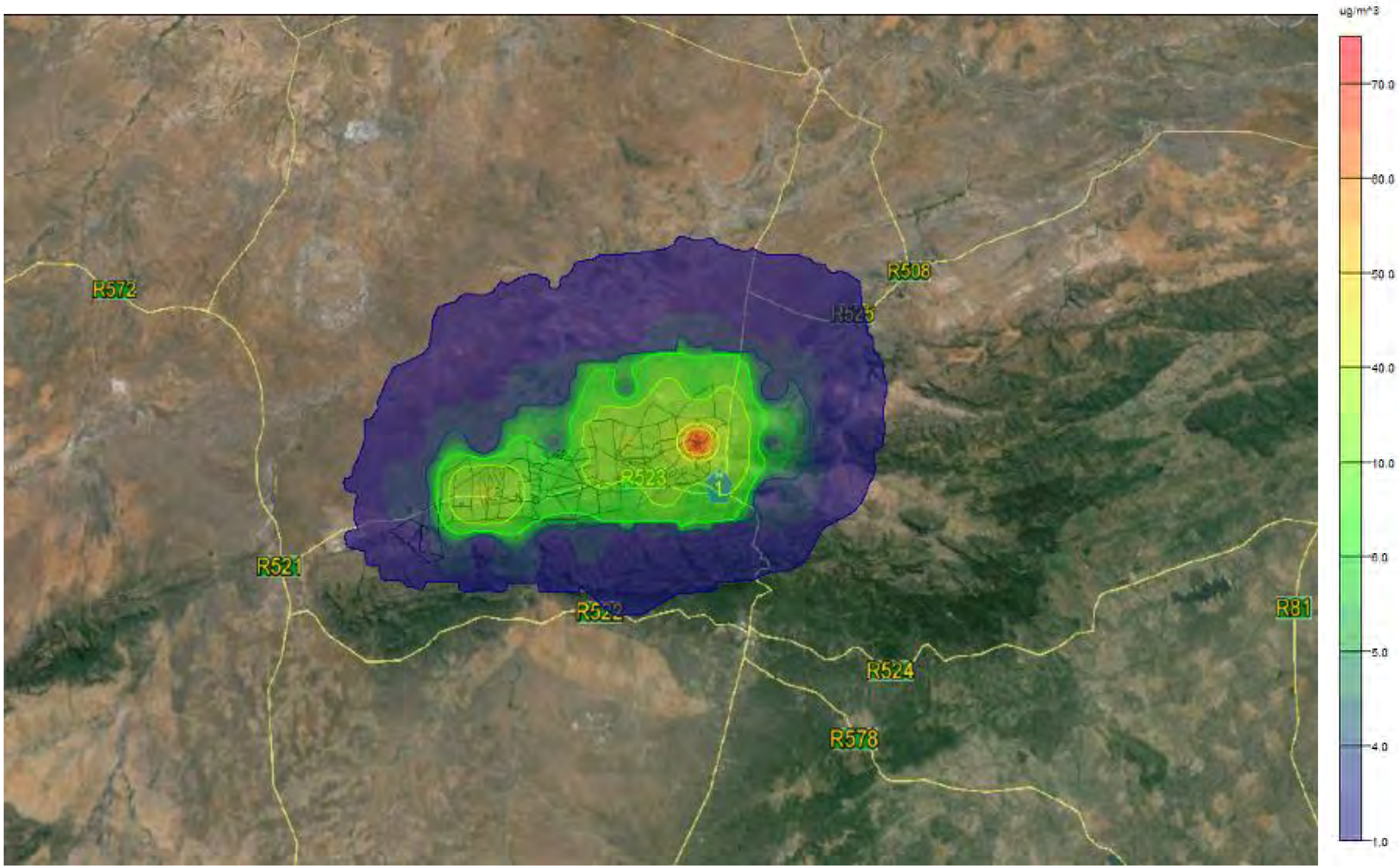


Figure 89: Maximum predicted daily ground level concentration (µg/m^3) of PM_{10} during operational phase at the Chapudi Project

Table 44 below indicated the maximum predicted annual ground level concentration of PM_{10} during the operation phase. The cumulative predicted impact of 20 µg/m^3 for PM_{10} (Figure 90) falls below the annual South African standard of 50 µg/m^3. The highest contributor to the predicted annual concentration is emissions from the mining pits, particularly Chapudi West Section with 11.8 µg/m^3.

Table 44: Maximum predicted annual ground level concentration for PM_{10} during the operation conditions

Source	Maximum predicted ground level Concentration of PM_{10} (µg/m^3)	Ambient air quality standard (µg/m^3)	Fraction of the standard (%)
Mining Pits	12.0	50	24
Wildebeesthoek Section	9.74	50	20
Chapudi West Section	11.8	50	24
Chapudi Section	7.36	50	15
Stockpiles	4.8E-03	50	<0.1
Cumulative impacts	20.0	50	40

The blasting impacts were modelled separately as blasting was modelled at an average of 3 times per week for intervals of approximately 10 minutes. Figure 91, Figure 92 and Figure 93 illustrate the hourly, daily and annual concentrations of particulate matter from blasting activities. The daily and annual standard of PM_{10} for blasting activities falls below the daily and annual South African standard of 120 µg/m^3 and 50 µg/m^3 respectively.

Blasting is not a continuous activity and is limited to a maximum of three times a week, thus the initial impact of blasting is relatively high with the annual concentration being minimum.

Figure 94 illustrates the dispersion potential of the predicted dust fallout impacts arising from the operational phase at the Chapudi Project. Dust fallout concentrations were highest at the Wildebeesthoek and Chapudi Section with 600 mg/m^2/day. There were no exceedances of the 1200 mg/m^2/day limit for a non residential site. The average concentration of dust fallout at the mine boundary is estimated at 300 mg/m^2/day.

When comparing the modelled result to monitored results of August 2010- April 2013, the average dust fallout results was 390 mg/m^2/day compared to the modelled data of 300 mg/m^2/day. Higher dust fallout rates are expected during the winter months of July – August. Increase in the activities will result in an increase in the dust fallout rate.

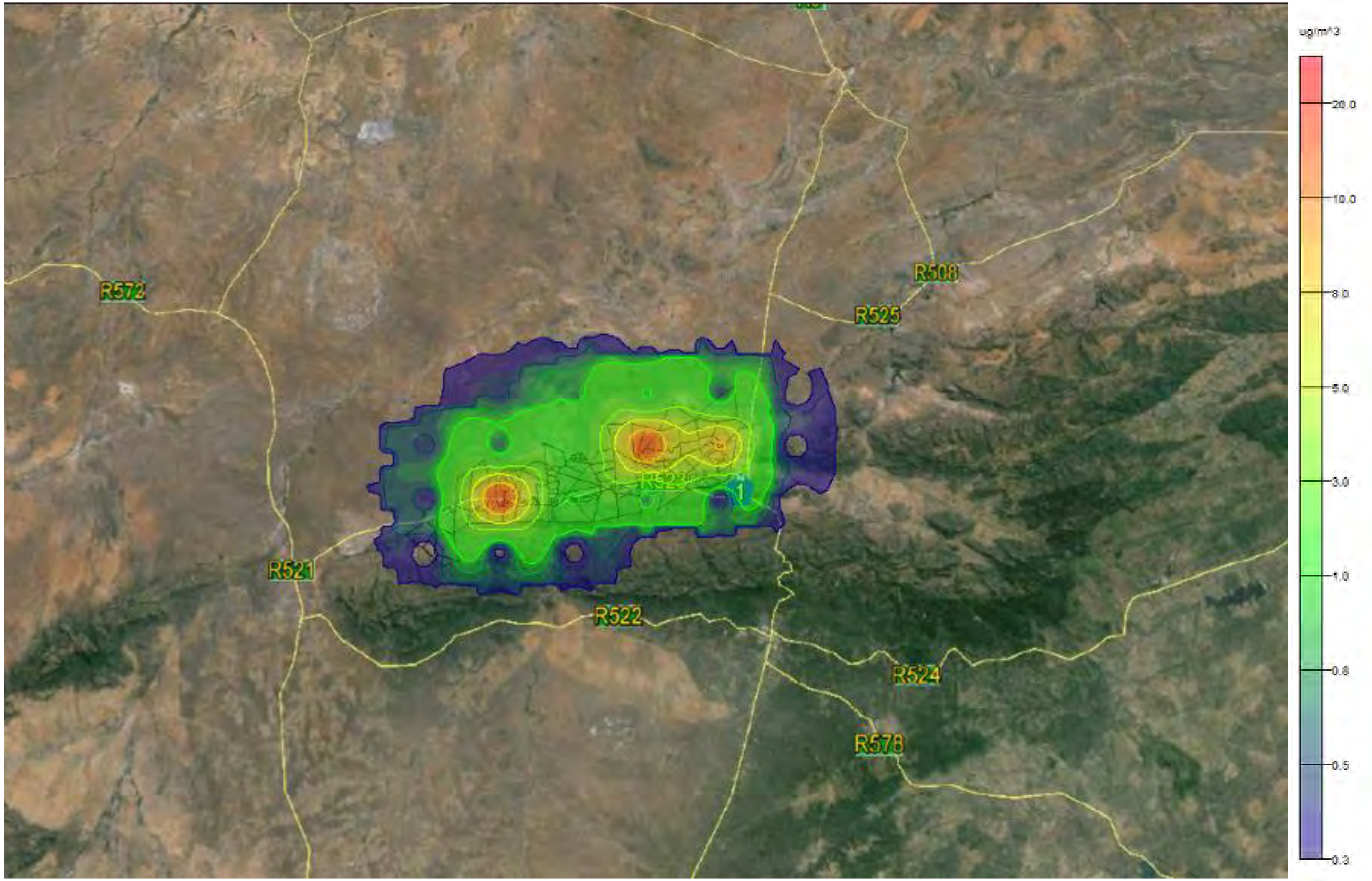


Figure 90: Maximum predicted annual ground level concentration (µg/m^3) of PM_{10} during operational phase at the Chapudi Project

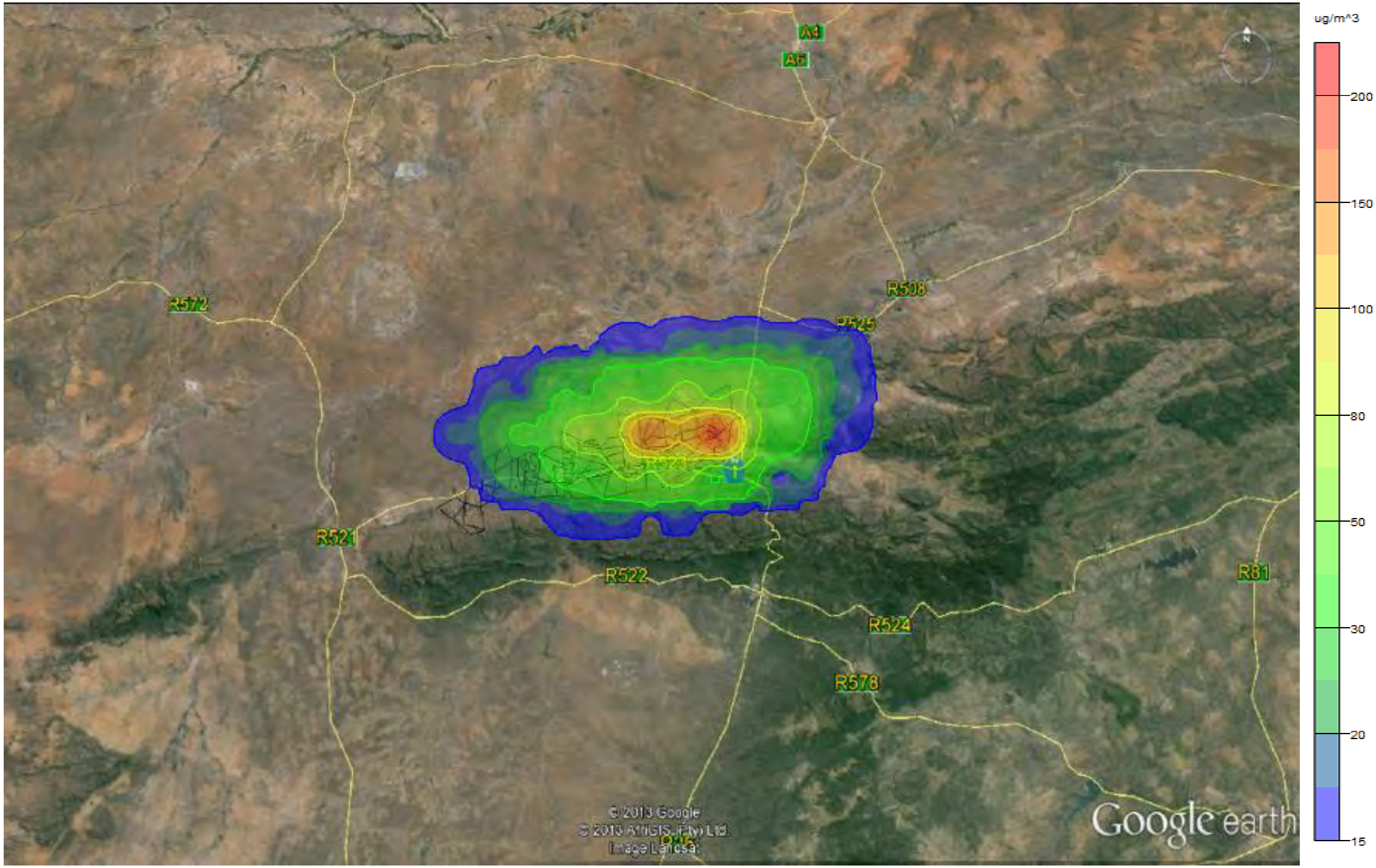


Figure 91: Maximum predicted hourly concentration (µg/m^3) of PM_{10} from blasting activities at the Chapudi Project

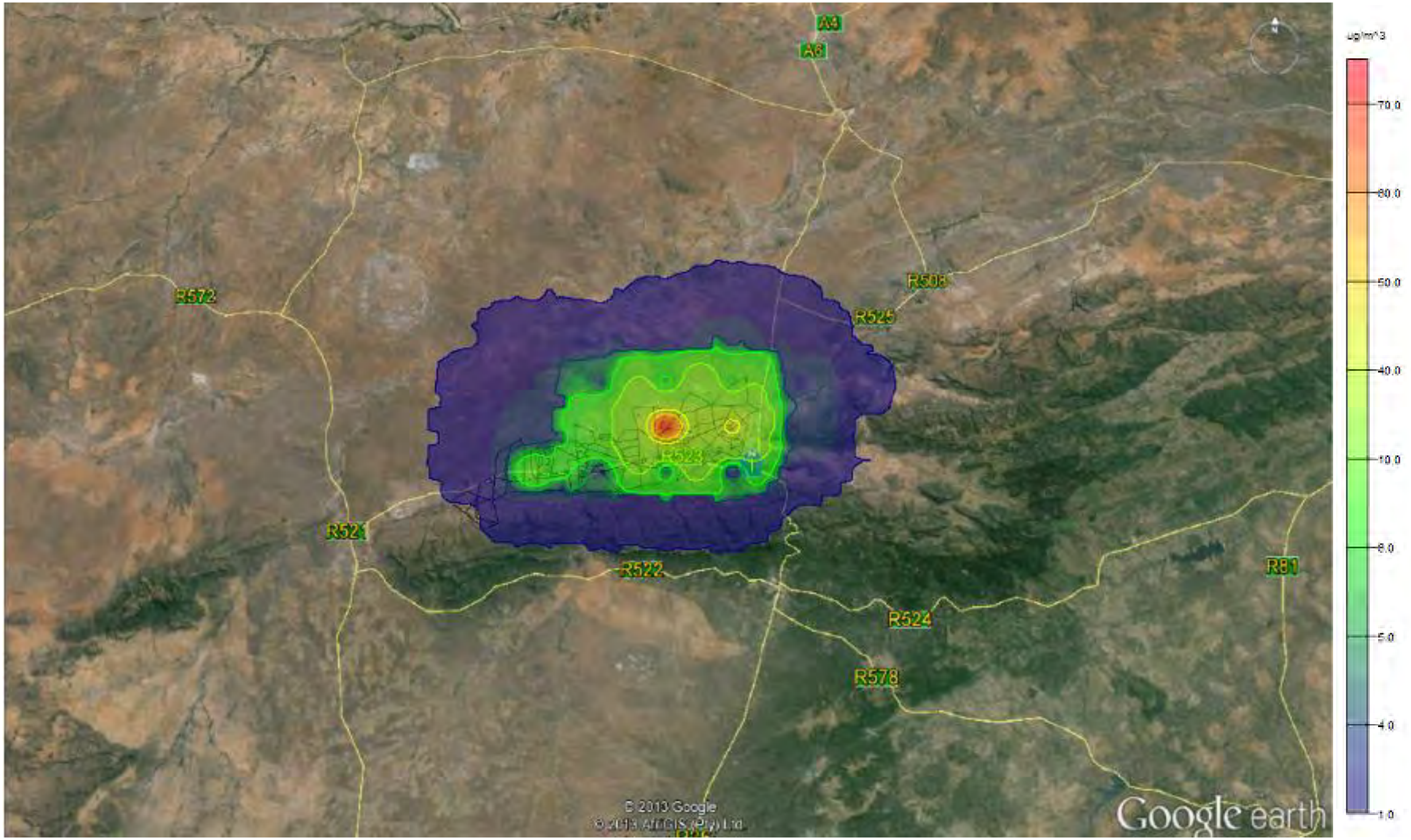


Figure 92: Maximum predicted daily concentration (µg/m^3) of PM_{10} from blasting activities at the Chapudi Project

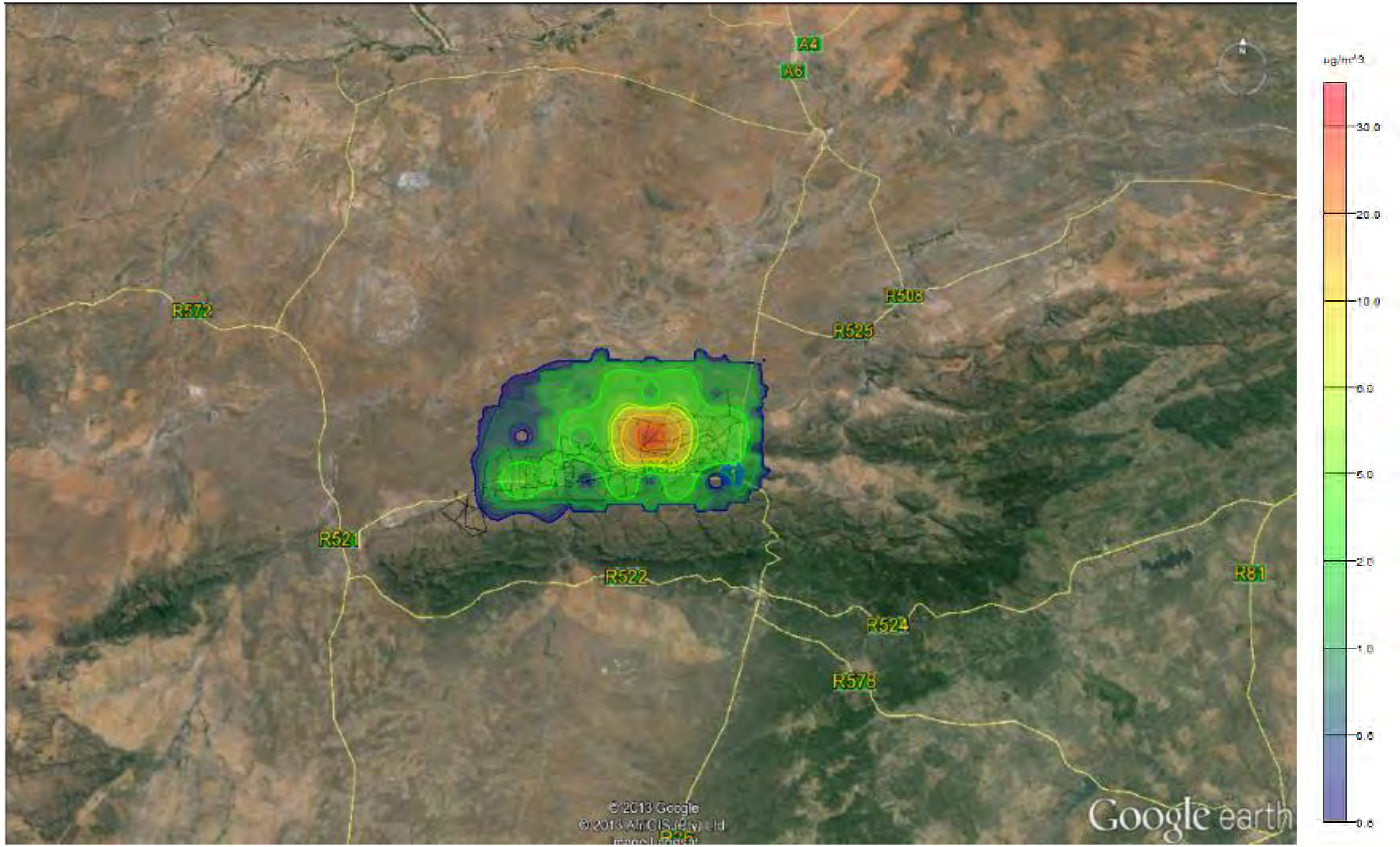


Figure 93: Maximum predicted annual concentration (µg/m^3) of PM_{10} from blasting activities at the Chapudi Project

Figure 94: Dust fallout impacts recorded during the operational phases of the Chapudi Project (Yellow: 300 mg/m^2/day, Green: 600 mg/m^2/day)

5.1.1.3 Decommissioning impacts

The decommissioning phase is associated with activities related to the demolition of infrastructure and the rehabilitation of disturbed areas. The total rehabilitation will ensure that the total area will be a free draining covered with topsoil and grassed. The following activities are associated with the decommissioning phase (US-EPA, 1996):

- Existing buildings and structures demolished, rubble removed and the area levelled;
- Remaining exposed excavated areas filled and levelled using overburden recovered from stockpiles;
- Topsoil replaced using topsoil recovered from stockpiles; and
- Land and permanent waste piles prepared for re-vegetation.

Possible sources of fugitive dust emission during the closure and post-closure phase include:

- Smoothing of stockpiles by bulldozer;
- Grading of sites;
- Transport and dumping of overburden for filling;
- Infrastructure demolition;
- Infrastructure rubble piles;
- Transport and dumping of building rubble;
- Transport and dumping of topsoil; and
- Preparation of soil for re-vegetation – ploughing and addition of fertiliser, compost etc.

Exposed soil is often prone to erosion by water. The erodability of soil depends on the amount of rainfall and its intensity, soil type and structure, slope of the terrain and the amount of vegetation cover (Brady, 1974). Re-vegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing wind and water erosion. Plants used for re-vegetation should be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and should easily be propagated by seed or cuttings.

The impacts from dust fallout and Particulate Matter can be reduced by implementing dust control measures. The highest intensity of the construction work should be carried out during the summer months and not over the harsh winter months as this can result in increased dispersion of fugitive dust. The Chapudi Project should ensure that unpaved roads are continuously watered and treated with dust-a-side products to reduce the volume of fugitive dust emitted from unpaved roads. The use of wind screens on open ground surfaces during periods of extreme windy conditions.

Overall the impacts arising from the mining activities on the surrounding environment are within the ambient air quality standards.

5.1.2 AMBIENT NOISE

The noise emissions from various sources, as defined by the project, were calculated in detail by Gudani Consulting (ANNEX-6) using the sound propagation models described by SANS 10357 and checked with the ISO 9613-2 model.

The following were considered:

- The octave band sound pressure emission levels of processes and equipment;
- The distance of the receivers from the noise sources;
- The impact of atmospheric absorption;
- The meteorological conditions in terms of Pasquill stability;
- The operational details of the proposed project, such as projected areas where activities will be taking place;
- A barrier where berms, high walls, spoil or discard dumps are expected around open cast or stockpile areas;
- Topographical layout; and
- Acoustical characteristics of the ground. 50% soft ground conditions were modelled, as the area where the mining activity would be taking place is well vegetated and sufficiently uneven to allow the consideration of soft ground conditions. This is because the use of hard ground conditions could represent a too precautionary situation.

5.1.2.1 Construction Phase

Daytime (06:00 – 22:00) and night-time (22:00 – 06:00) operations were assessed. Most critical investigational times would be the night-time hours when a quiet environment is desired (at night for sleeping, weekends etc.).

Only opencast and stockpile construction was assessed as other construction processes (road and plant infrastructure development) is relatively short-term in comparison to the lengthy opencast site clearance and box-cut development phase. As it is unsure if the developer intends on constructing the facility during the night-time hours, it is assumed that open cast site clearances will take place over the 24 hour day and night periods.

Calculations are based on a worst-case scenario and will not be relevant for all times during the construction phase and may only be relevant when construction activities occur near a receptor. Stockpiles, berms and barriers will be constructed during this phase. This material will be re-used to close the open pits for rehabilitation purpose after mining.

5.1.2.1.1 Investigated Worst-Case Construction Scenarios - Day and Night-times

Road Traffic: Traffic on the haul roads from open cast pits calculated as – 10 vehicles p/h on a single continuous non-paved road, heavy vehicles was calculated as 50 % of vehicles. Traffic calculated at constant speed of 60 km/h.

Construction of Opencast/Stockpile Areas: Construction processes assessed included:

- A worst-case scenario was assessed whereby the most significant noisy equipment during construction takes place as feasibly close as possible to receptors, while still remaining on the project footprint; and
- Site preparations and other construction processes at pits and stockpiles are defined in Section 2 of the noise impact specialist report (ANNEX-6), with construction localities illustrated in Figure 95.

Existing Ambient Contributors and Acoustical Factors: The following ambient soundscape factors were considered:

- Distance from receiver to noise source considered. Receptors are regarded at a 2 meters height in relation to the ground surface;
- The existing ambient soundscape as defined in Chapter 2 of this report;
- Intervening ground conditions of a medium ground nature, i.e. some flora etc. (50% hard ground conditions); and
- Activities functioning during wind-still conditions, in good sound propagation conditions (20^{o}C and 80% humidity).

5.1.2.1.2 Results

Figure 96 illustrates the resulting conceptual night-time worst-case peak noise climate around the proposed development and represents a worst-case scenario indicating the potential maximum equivalent (average) noise climate ($L_{Req,1\,h}$) the receptors could be exposed to during peak construction hours. The noise contours are illustrated from 40 dBA upwards (SANS 10103:2008 Rating level referencing), with contours illustrated in 5 dBA intervals. The figure indicate a $L_{Req,1\,h}$ value with no tone or impulse corrections. Only a night-time map is displayed.

Calculated levels will exceed the Equator Principle IFC guideline, SANS10103:2008 Rating or ambient soundscape by a measurable value during day and night time hours.

Activities at a receptor dwelling as well noise sources of significance (N1 and R523 road traffic) may however screen noise levels, thereby reducing the impact. Construction processes are normally short to medium term in operational period and the impact is considered to be moderate. The potential operations near buildings and facilities where a natural or quiet period is required, e.g. religious, educational and health care and hospitality facilities (game lodges) needs to be considered.

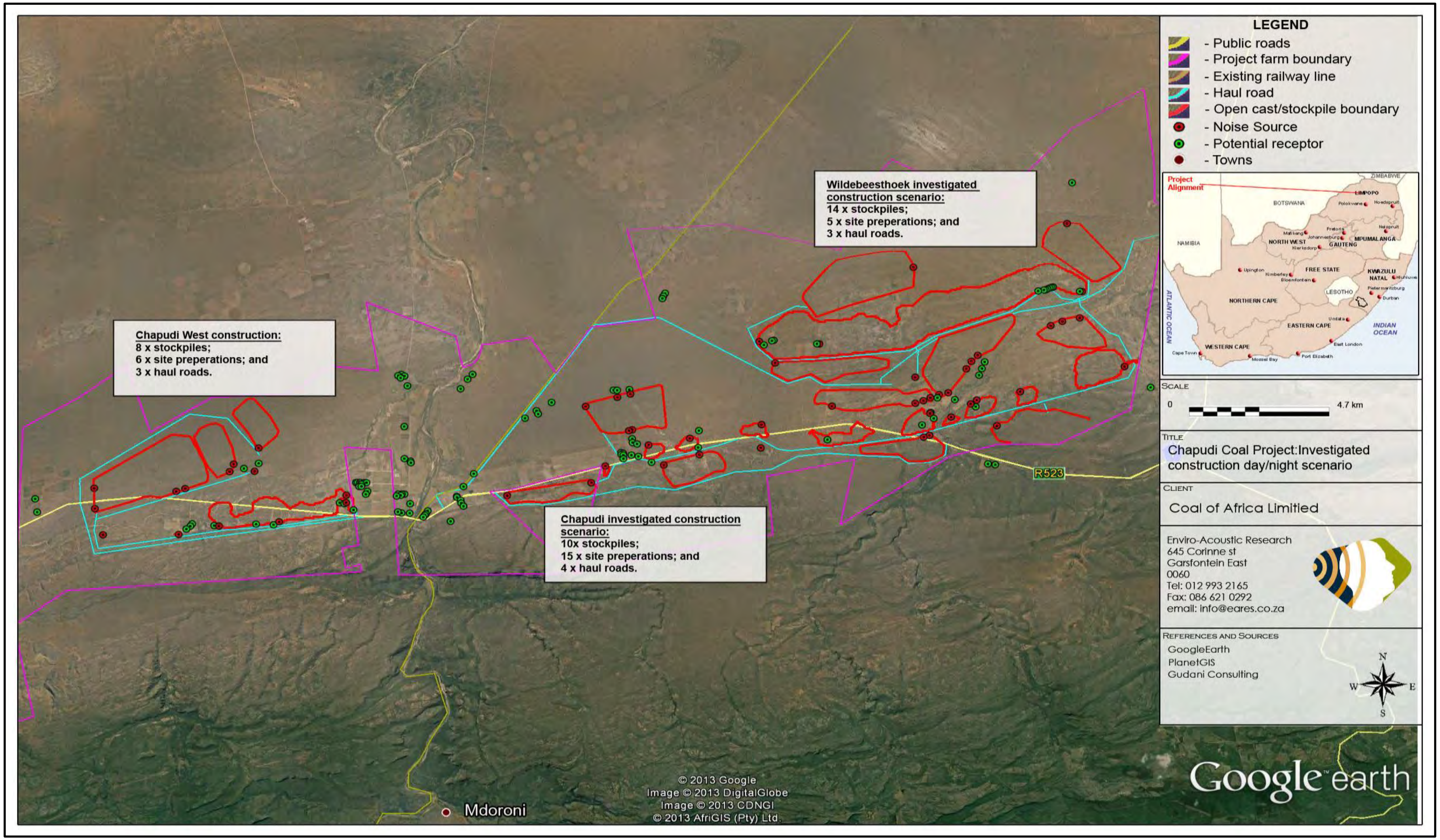


Figure 95: Investigated construction scenario as modelled for the day/night time period – worst case

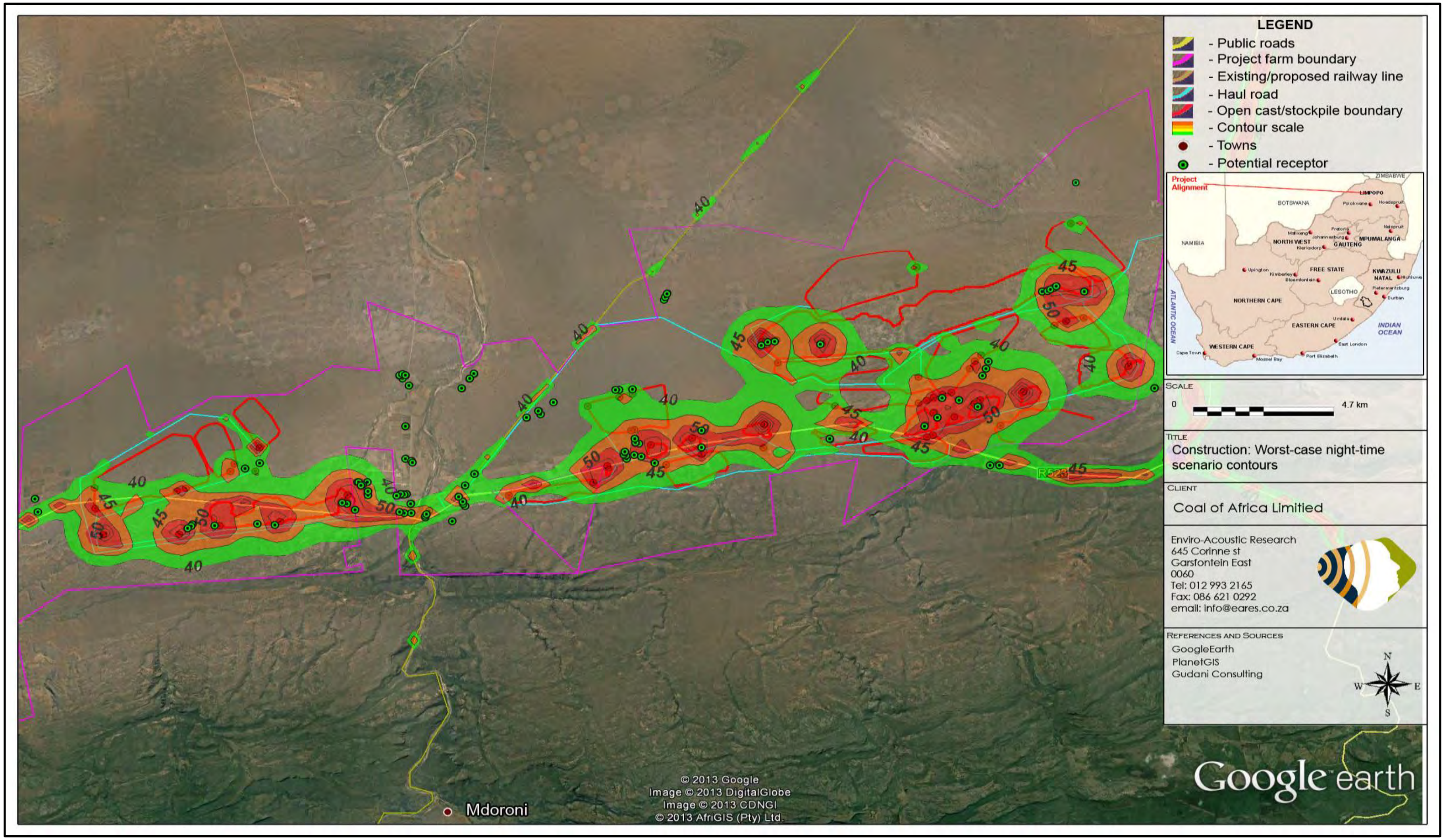


Figure 96: Projected Construction Noise Rating Levels in contours of equal sound levels

5.1.2.2 Operational Phase

Calculations for the operational phase are based on a worst-case scenario and will not be relevant for all times of the operation phase (not a moment in time, but the potential extent of noise rating levels during the operational phase). No screening corrections were considered (such as the cladding or enclosing of crushers and screens). Opencast pit operations took into consideration a conceptual 10 m berm/barrier around it.

5.1.2.2.1 <u>Investigated Worst-Case Operational scenarios - Day and Night-times</u>

Haul Road Traffic: Traffic on the haul roads calculated as – 174 vehicles p/h (delivering to stockpiles and dumps) travelling on a single non-paved continuous road, all heavy vehicles. Traffic calculated at constant speed of 60 km/h. The Articulated Dump Trucks (ADT) volumes used on haul roads was calculated from available information sourced in the specialist report.

Colliery Infrastructure: Colliery infrastructure and modus operandi is defined in the noise specialist report, with assessed scenario localities illustrated in

Figure 97: Investigated operational scenario as modelled for the day/night time period – worst case

Open Cast "truck and shovel" Method and Stockpile Management: It is expected that berms and barriers will be implemented during the construction phase from spoils, discards, hards, softs etc. Operations of the Open cast and stockpile areas took the following into account:

- A worst-case scenario was assessed whereby the most significant noisy equipment during operational phase takes place as close as feasibly possible to receptors, while still remaining on the project footprint;
- A conceptual 10 m barrier/berm constructed during the construction phase from overburden, interburden (hards, softs etc.) was considered as a screen completely enclosing open cast pits and stockpile areas; and
- Drilling, excavating, trucks, overburden removal, truck and shovel coal mining, stockpile management and other operational processes are defined in Section 4.3 of the noise specialist report, with assessed scenarios illustrated
- Figure 97: Investigated operational scenario as modelled for the day/night time period – worst case

Railway traffic: Based on available information, the operations were assessed taking into account the following acoustical corrections:

- Train lines were split into sections for various corrections. The daytime and night operations of 2 x Class 43 electric locomotives and 100 CCL 8 x 4-axle tread braked wagons per train with 1 (1 delivery, no return) trains a day and night, traveling at 40 km/h;
- Ballast correction (acoustics attenuation due to ballast effect) was considered;
- Intervening ground conditions of a medium ground nature, i.e. (50% hard ground conditions);
- Continuous welded rail (CWR) corrections were considered; and

- Assessment does not consider façade corrections or the row of houses acting as a screen when obstructing a direct line of sight to the railway line. Assessed calculations better illustrate potential noise rating levels at houses directly adjacent or with a direct line of sight to railway lines.

Existing Ambient Contributors and Acoustical Factors: The following ambient soundscape factors were considered:

- Distance from receiver to noise source considered. Receptors are regarded at a 2 meters height in relation to the surrounding environment;
- Existing ambient soundscape contributors as defined in Chapter 2 of this report;
- Intervening ground conditions of a medium ground nature, i.e. some flora etc. (50% hard ground conditions); and
- Activities functioning during wind-still conditions, in good sound propagation conditions (20^oC and 80% humidity).

5.1.2.2.2 Results

This impact assessment is quite precautious and a worst-case scenario represents the maximum equivalent (average) noise climate ($L_{Req,1\ h}$) the receptors could be exposed to during peak operational hours.

Figure 98 illustrates the resulting conceptual night-time worst-case peak noise climates for the Chapudi West Section, while Figure 99 illustrates the Chapudi and Wildebeesthoek Sections. The noise rating contours are illustrated from 40 dBA upwards (SANS 10103:2008 night-time Zone Sound Level for a suburban area), with contours illustrated in 5 dBA intervals. These figures indicate a $L_{Req,1\ h}$ value with no tone or impulse corrections. Only night-time maps are displayed as daytime projections would not be easily presented.

The layout as evaluated will provide a number of berms and stockpiles that will assist in the attenuation of noises from the mining activities and during the operational phase. Subsequently, the potential noise impact would be of a moderate to high significance during the operational phase.

Mitigation measures are proposed that could reduce the noise levels as experienced by the closest noise-sensitive developments (the magnitude of the reduction depending on the selection of the mitigation measures).

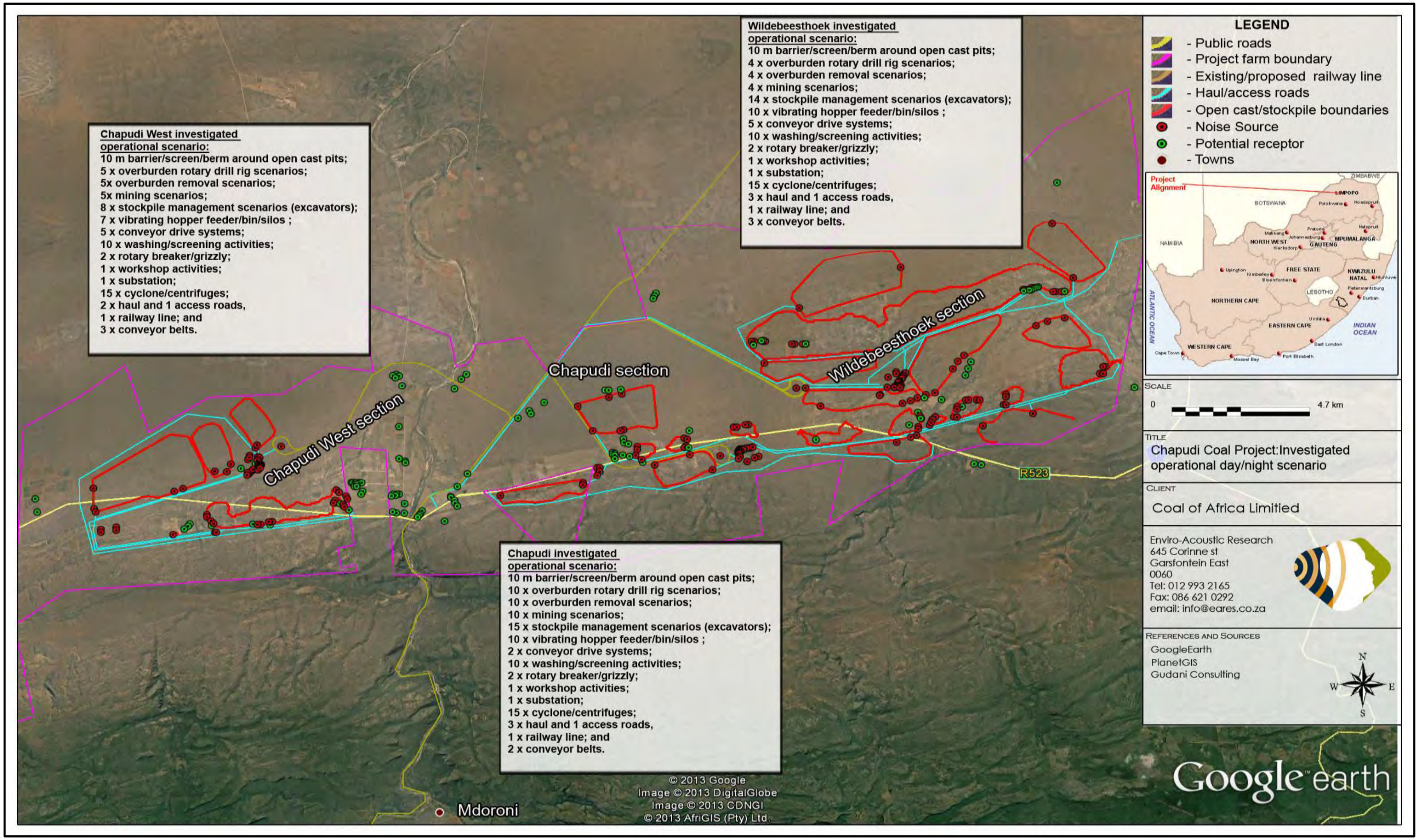


Figure 97: Investigated operational scenario as modelled for the day/night time period – worst case

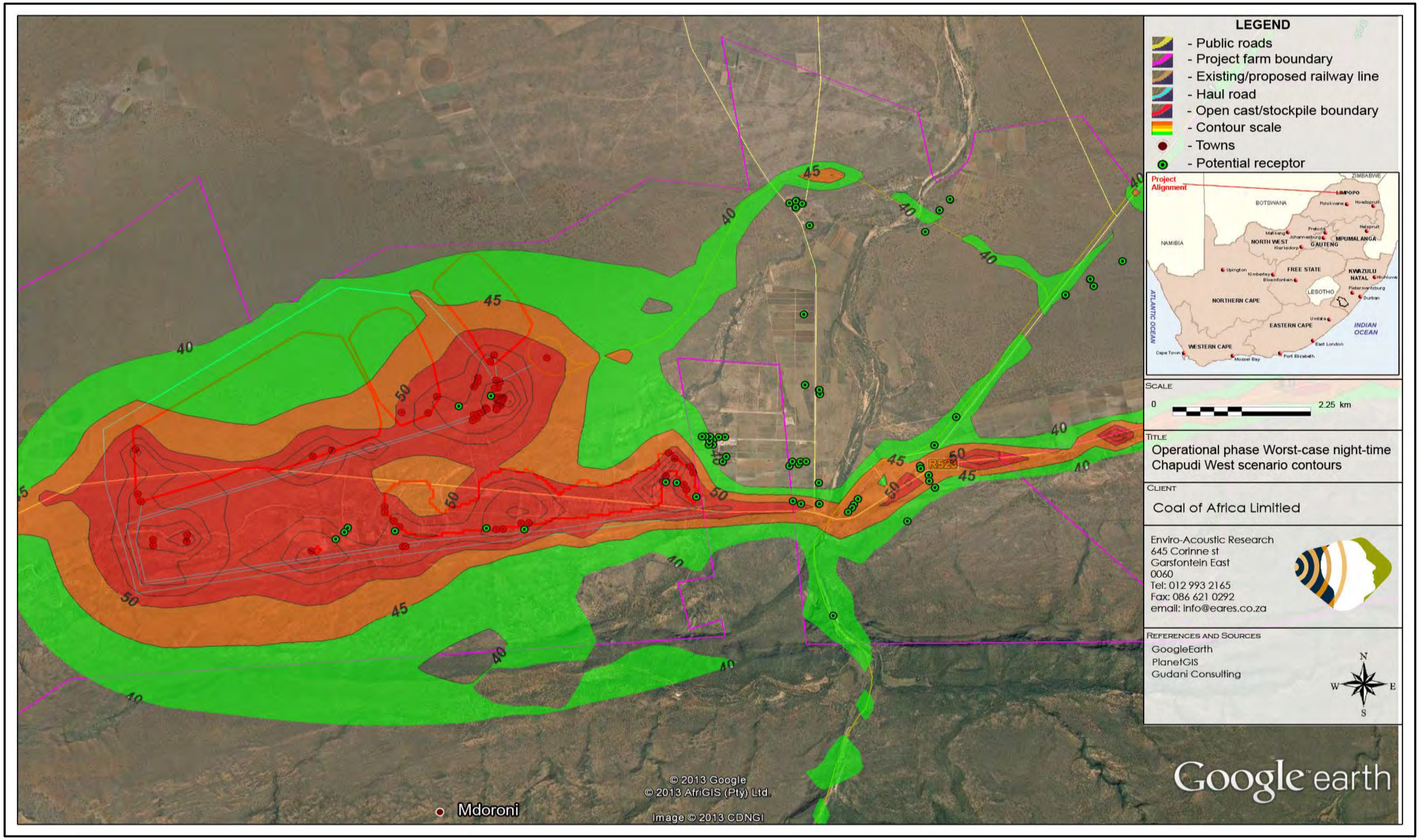


Figure 98: Night-time operations: Projected noise contours – Chapudi West Section

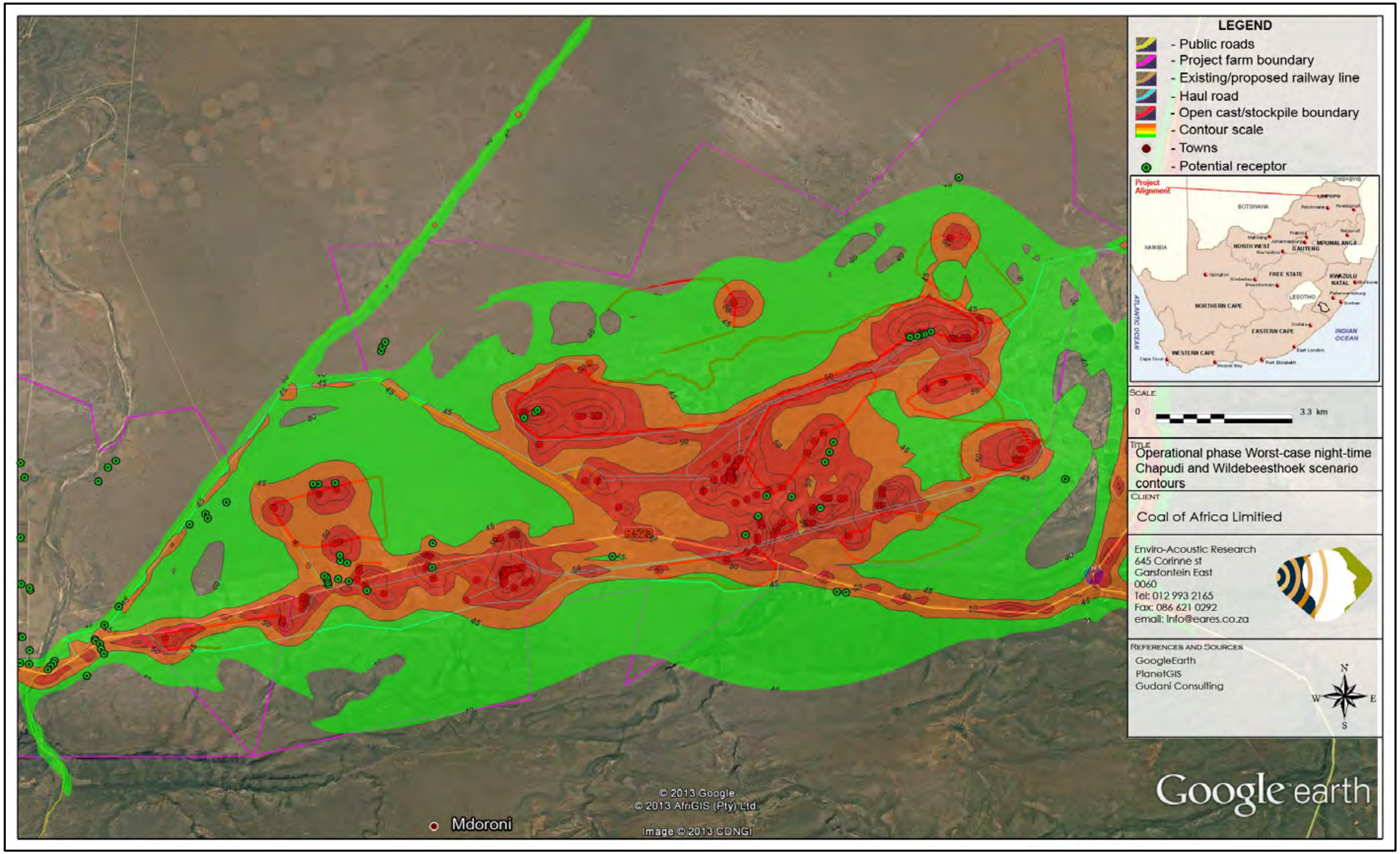


Figure 99: Night-time operations: Projected noise contours – Wildebeesthoek and Chapudi Sections

5.1.3 VISUAL AND AESTHETIC

The aim of the visual assessment is to identify systematically all the potential landscape and visual impacts associated with the mine development to predict and estimate their magnitude. The assessment will cover landscape impacts, which amount to changes in the fabric and character of the landscape and visual impacts, for example, changes in available views of the landscape and the effect the changes will have on sensitive receptors in the area.

The total extent of the mining operations will be extensive with an east-west span of approximately 35 km by 10 km (north-south span). The proposed operations are large and include various open pits and associated stockpiles, a conveyor system, a coal beneficiation plant, haul roads etc. Extensive vegetation clearance and topsoil stripping will affect the visual character and the development and will affect the immediate sense of place.

The main concerns in this regard are the following:

- The change of the topography by large scale (footprint and height) of the opencast areas, stockpiles and the beneficiation plant and related infrastructure;
- Reflective and bright infrastructure development will alter the visual character of the area;
- Dust pollution due to excessive vegetation and topsoil stripping;
- The dumping and exposure of calcareous materials, the color of which is in sharp contrast with the Soutpansberg mountain range;
- The introduction of industrial activity with associated light pollution;
- The introduction of additional coal transporting vehicles on local gravel roads with an increased rate of recurrence.

5.1.3.1 Visual Exposure

A viewshed analysis conducted from one point in the centre of the Chapudi Project area for a 50 m high structure reveals that the highest visual impact will be to the north of the MRA area. The impact of the infrastructure and stockpiles will create a visible impact on the surrounding environment for a radius reaching as far as 20 km with secondary impacts reaching further than 30 km. The visual impact is illustrated in Figure 100.

The higher altitude of the Soutpansberg provides a high degree of visual shielding to the south of the Chapudi Project area; however the mining operation will be highly visible from various points in the mountain range and will have a significant impact on the visual character of the area.

A full impact assessment will provide a clearer picture of the impacted areas and sensitive receptors that will be impacted on, by the development however it is anticipated that larger structures such as stockpiles and parts of the beneficiation plant will be highly visible. Due to the rural and agricultural focused nature of the area, visibility of the mine is expected to have an extremely negative visual impact if not mitigated.

5.1.3.2 Factors Impacting on the Sense of Place

Apart from visibility of static mine components such as 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:

Product Transport: The additional the RLT and rail loop (siding), and the increase in rail traffic, will increase the ambient noise levels which will impact on the sense of place and negatively influence sensitive receptors.

Road traffic: Additional transport on the roads in the vicinity of the mine. Apart from the N1, these roads mainy carry local traffic. The type of vehicles, which may be regarded as abnormal, invoke extremely negative perceptions from residents and other road users, especially where these are considered to be causing road deterioration, accidents, traffic congestion and dust pollution.

Lighting: It is expected that lighting associated with mining operations will introduce a large degree of light pollution in the rural area and onto the Soutpansberg Mountain range, especially since no other activities of this nature exist in the area. This is of particular concern for game farm and lodge owners who host tourists in close proximity to the mine area.

Dust: Dust is an inevitable result of opencast mining and the 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.

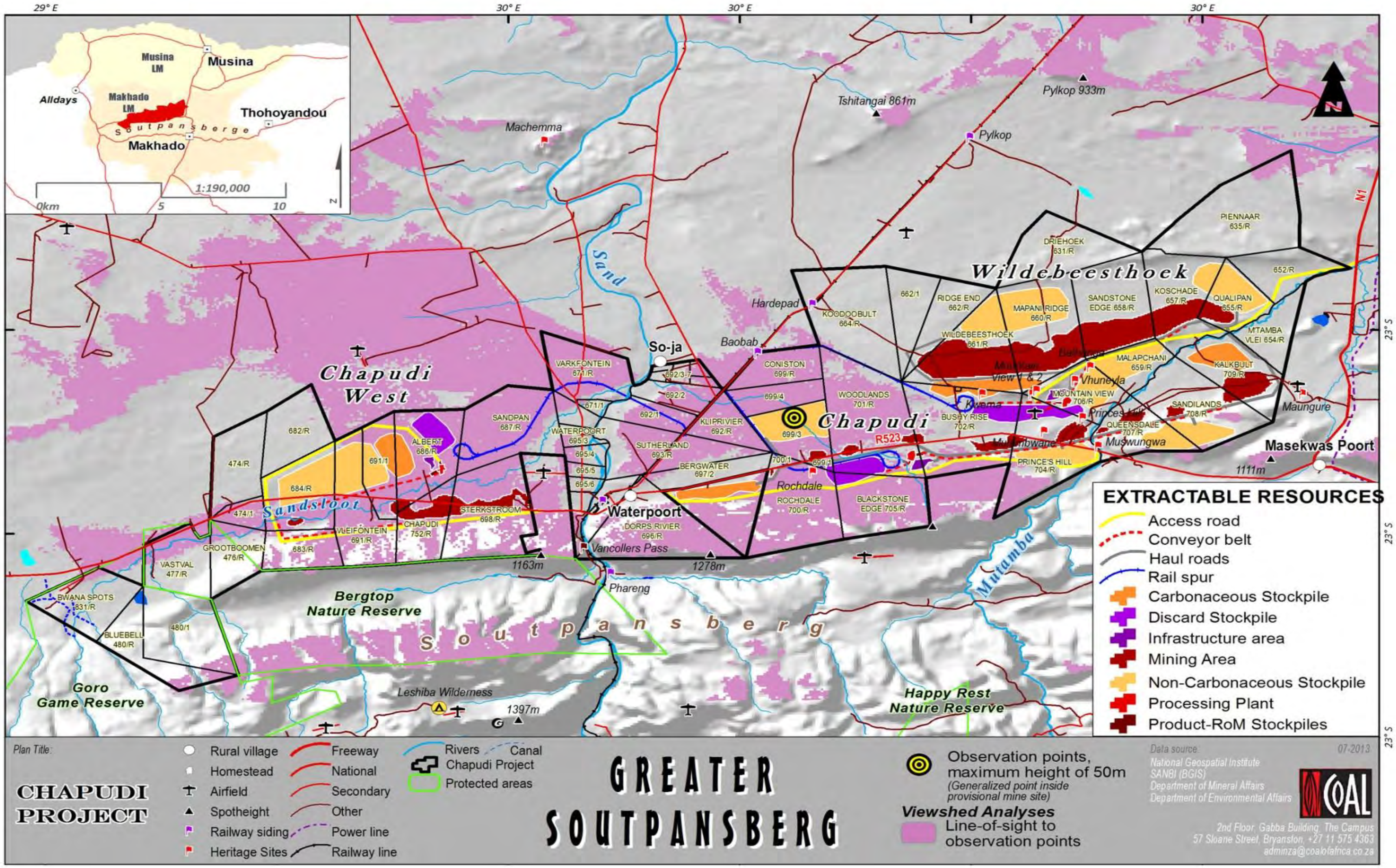


Figure 100: Viewshed analysis for the Chapudi Project area

5.1.4 SOCIAL IMPACTS

The anticipated socio-economic impacts of the proposed project are detailed in the SEIA (ANNEX-9) and are summarized below in table format.

Table 45: List of potential socio-economic impacts for the Chapudi Project

Social Aspect	Potential Impact
Demographic and Population Impacts	Influx of work seekers into the area
	Influx of construction labour with pressure on services and social structures
	Influx of operational workforce with pressure on services and social structures
	Influx of people and the development of spontaneous settlements near project facilities, in the Waterpoort Town and surrounding areas
	Conflicts arising at the end of construction due to the termination of job opportunities for contractors
Health and Social Wellbeing	Increased chances of the spread of communicable diseases such as HIV/AIDS and STDs linked to influx of predominantly male job-seekers and workers
	Safety and Risk Exposure through an increase in crime
	Safety and Risk Exposure due to an increase in poaching on neighbouring game farming properties
Quality of Living Environment	Change in "sense of place"
	Disruption of Social Networks and decrease in Social Capital
	Perceptions of and Feelings in relation to the project
Family and Community Impacts	Impacts on landowners and labourers
	Change processes and impacts related to daily movement patterns
	Conversion of land use
Institutional/Legal/Political/Equity Impacts	Challenge to local government capacity
	Participation and Consultation in process
	Impact equity
Socio-economic Wellbeing	Increase in South African GDP and Trade Balance
	Increase in provincial and local GDP
	Increase in government revenue
	Increase in employment, income and skills development
	Impact on existing businesses in surrounding areas
	Change in property values
	Decrease of visitors, tourists and hunting parties
	Equity Participation of the Local Communities
	Participation of local business in procurement opportunities
	Decline in South African GDP and Trade Balance at Decommissioning
	Decline in provincial and local GDP at decommissioning
	Decline in government revenue at Decommissioning
	Decline in employment, income and skills development at decommissioning
Vulnerable Group Impacts	Gendered Division of labour
	Potential Infringements on Historically Disadvantaged People's Human Rights

5.2 CULTURAL AND HERITAGE

The nature and scale of impacts of the proposed mining on heritage are summarised in the following table:

	ACTIVITY	POTENTIAL IMPACTS
1	Mineral extraction	Stripping of top soil and mineral extraction opencast methods will represent the most extensive excavation of the area and earthmoving. Total destruction of heritage sites.
2	Non-carbonaceous material dumps	Overlaying (and destruction) of heritage sites. Possible graves in the proposed.
3	Carbonaceous dump	Overlaying (and destruction) of heritage sites.
4	Stockpiles (topsoil & discards)	Overlaying (and destruction) of heritage sites.
5	Mine infrastructure/plant	Total destruction of heritage resources. Visuals impacts on cultural landscapes.
6	Main access road, conveyor belt	Total destruction and visual impacts.
7	Emulsion and explosion areas	Destruction, vibration, pollution.

A farm by farm distribution of operational activities is summarised in the table below, together with the number of heritage sites identified on the farms.

	Farm	Mining area	Carbonaceous material	Non-carbonaceous material	Stockpiles (topsoil & discards)	Mine Plant	Emulsion & explosion	Road Rail C- belt	Heritage sites
1	Sutherland								5
2	Coniston								12
3	Woodlands								5
4	Bushy Rise*								31
5	Malapchani**								40
6	Ekland								1
	TOTAL								**94**

*: Bushy Rise consists of Bushy Rise and Blackstone Edge farms.

**: Malapchani is a combination of several farms (Malapchani, Mapani Ridge, Sandstone Edge and Driehoek). It constitutes the largest area.

The area of high impact from mining is roughly a belt running in an East-West along the R523 Road. A number of heritage sites located along the mining belt will be directly affected by the mining operations. These include Later Iron Age ruins, graves and stands of Marula trees which require Phase II assessment. Salvage operations will be carried out in Phase II, and where possible locations of plants/dumps/discards may be reviewed.

Six (6) stonewalled sites lie to the North of the mining belt. They are considered to be safe, but may be affected by dust pollution. Furthermore as population is expected to increase in the mining area, inadvertent destruction may result from ignorance and other human factors. Educational programmes will be necessary.

The following is a summary of specific threats:

SITE NO[#]	HERITAGE TYPOLOGY	FARM	POTENTIAL THREATS
27	SA Site	Bushy Rise	No direct threats, outside operational areas
29	LIA Site	Bushy Rise	Mineral extraction
45	LIA Site	Coniston	Mineral extraction
2	Ruins	Bushy Rise	No direct threat. Potential dust pollution
5	Ruins	Bushy Rise	No direct threat. Potential dust pollution
6	Ruins	Bushy Rise	No direct threat. Potential dust pollution
21	Ruins	Bushy Rise	No direct threat. Potential dust pollution
24	Ruins	Bushy Rise	No direct threat. Potential dust pollution
25	Ruins	Bushy Rise	No direct threat. Potential dust pollution
10	Graves	Bushy Rise	Mineral extraction/Plant
12	Graves	Woodlands	Mineral extraction/Plant
37	Graves	Coniston	Non-carbonaceous dump
57, 60, 62, 68, 71, 73	Graves	Malapchani	Proximity of carbonaceous dump
16	Mopane Stand	Bushy Rise	Mineral extraction/Plant/Dump
35	Farmsteads	Woodlands	Mineral extraction/Plant/Dump
36	Farmsteads	Woodlands	Mineral extraction/Plant/Dump
47	Farmsteads	Coniston	Mineral extraction
48	Farmsteads	Coniston	Mineral extraction/Discards
93	Farmsteads	Sutherland	Carbonaceous dump
32	Marula stand	Woodlands	Mining
40	Marula Stand	Coniston	Non-carbonaceous dump
41	Marula Stand	Coniston	Non-carbonaceous dump

[#] Refer to Catalogue of heritage sites (Annexure II of the HIA)

5.3 QUANTIFICATION OF IMPACT ON DIRECTLY AFFECTED PERSONS

This will be affected by the final mining schedule and infrastructure layout plans to be developed during the Feasibility Phase, in line with the numerous recommendations made by the EIA specialists. The final quantification in monetary terms will only be undertaken after completion of the Feasibility Phase.

6 ASSESSMENT AND EVALUATION OF POTENTIAL IMPACTS

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 (probability) x S (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 positive and negative impacts were assessed on the basis of issues identified through the public participation process, interviews with key stakeholders and specialist opinion. Identified impacts were categorised in terms of the phase of the proposed project that is expected to give rise to the impacts. The following steps were followed in the assessment of the potential risks:

- Issues that may arise as a result of the proposed development, through planning, construction, operation and decommissioning phases.
- Potential impacts will be identified for each issue and assessed by considering criteria as outlined in the table below.
- Where the potential impacts are perceived as having a high risk or significance, alternatives, preventative and mitigation measures will be recommended.
- The significance of each impact will be determined "without mitigation" and "with mitigation", taking into consideration alternatives, preventative and mitigation measures.

Table 46: Impact Rating methodology

RISK IMPACT METHODOLOGY		
DURATION		
Short term	6 months	1
Construction	36 months	2
Life of project	50 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	Musina Local Municipality	3
Regional	Vhembe District Municipality	4
Provincial	Limpopo Province	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	4

RISK IMPACT METHODOLOGY		
	term loss in capabilities, off-site release with no detrimental effects, major financial implications	
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

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.

Table 47: Environmental Impact Risk Matrix

#ID Abbreviations: A – All activities, OC – Opencast mining, P – Processing plant / infrastructure areas (incl RLT / siding), ON – On-site conveyance of ROM and product, MR – Mine residue stockpiles, RL – Rail link to main TFR railway line, EM – Off-site conveyance of product by truck (in emergencies)

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
A1	Biodiversity / Land Use & Capability	Surface disturbance of approximately 7,600 hectares for the purpose of mining and infrastructure development over the LOM will lead to impacts on the soil, land use and land capability, natural vegetation and fauna	Negative	High Risk	Moderate Significance	• Development and implementation of a detailed Mine Rehabilitation and Reclamation Plan during the Feasibility Phase. • Concurrent rehabilitation and levelling of opencast pits in line with the Mine Rehabilitation and Reclamation Plan. • Monitoring, auditing and regular review (if required) of the Mine Rehabilitation and Reclamation Plan. • Rehabilitation of infrastructure and other disturbed areas post-mining. • Implementation of Flora Rescue and Relocation Plan prior to any surface disturbances. • Develop species rescue, relocation and re-introduction plan (fauna) with the assistance of specialists in this field. • Develop and implement Biodiversity Action Plan, including avifaunal plan. • Fencing of designated mining and infrastructure areas. • Implementation of biodiversity monitoring. • Close collaboration with the Vhembe Biosphere Reserve in respect of final end land use and sustainable mining. • Participation on a collaborative approach for the development of a Regional Strategic Environmental Impact Assessment (SEIA).	Moderate Risk	Moderate Significance
A2	Waste Management	Poor waste management could lead to environmental impacts	Negative	Moderate Risk	Low Significance	• Implementation and regular review of Waste Management Procedure. • Appoint an approved, registered waste contractor to manage the waste generation and safe disposal thereof. • No waste will be disposed of or buried on site, or in any other location that is not a licensed waste disposal site.	Low Risk	Low Significance
A3	Waste Management	Poor sewage management could impact on water resources	Negative	Moderate Risk	Moderate Significance	• Sewage effluent will be treated to General Standards and pumped to the Infrastructure Area storage dams for re-use in the process. No effluent will be discharged to the environment.	Low Risk	Low Significance

ID[#]	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
A4	Bulk Water	Impact on water stressed catchment - fully allocated	Negative	Very High Risk	Moderate Significance	• The bulk water source will be determined during the Feasibility Phase, followed by a detail EIA for the selected option. • Design closed system to ensure optimal recycling of water and minimise water requirements for the mine. • Installation of filter presses to increase water recovery in the process plant.	High Risk	Moderate Significance
A5	Bulk Electricity	Further impact on over-allocated electricity reticulation system	Negative	High Risk	Moderate Significance	• Energy efficient designs such as: o High efficiency motors in plant and workshops o Power Factor Correction o Use VSDs o Use solar power where possible o Install solar geysers at change houses\Optimal building design to make use of ambient light • Energy Policy must govern energy efficient designs such as: power factor correction; lighting designs; cooking and heating - avoid electricity use gas; process efficiency; high efficiency motors; low loss transformers; green building designs; use of solar and heat pumps for water heating. • Implement Energy Management Plan. • Monitor and record energy usage on site. Ongoing improvement in energy consumption should form part of the mine's KPIs.	Moderate Risk	Moderate Significance
A6	Heritage Resources	Destruction of heritage & cultural resources as a result of mining and associated infrastructure (including linear activities)	Negative	Very High Risk	Moderate Significance	• A Heritage Management Plan will be developed during the Feasibility Phase once the mining and infrastructure has been finalised. • Implementation of Heritage Management Plan dealing with the Phase 1B&2 assessments as well as the relocation of burial sites. • National Heritage and Cultural issues will be included in the environmental awareness programme. • Regular monitoring of off-site heritage resources of importance.	Moderate Risk	Low Significance
A7	Sense of Place	Impact on conservation value of the region	Negative	High Risk	Moderate Significance	• Identify and implement biodiversity offset programmes in conjunction with the IAPs and authorities, including the Vhembe Biosphere Reserve. • Close collaboration with the Vhembe Biosphere Reserve in respect of final end land use and sustainable mining. • Participation on a collaborative approach for the development of a	Moderate Risk	Moderate Significance

ID[#]	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
						Regional Strategic Environmental Impact Assessment (SEIA). • Implementation of environmental monitoring programme. • Develop environmental awareness & educational programmes. • Environmental auditing and reporting.		
OC1	Soils / Land Use & Capability	Potential hard setting of soils post reclamation	Negative	Moderate Risk	Moderate Significance	• Soil analyses and amelioration during reclamation.	Low Risk	Low Significance
OC2	Soils / Land Use & Capability	Subsidence of rehabilitated areas	Negative	Moderate Risk	Low Significance	• Free-draining profile (as far as practically possible) for rehabilitated areas and ongoing monitoring.	Low Risk	Low Significance
OC3	Surface Water	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff	Negative	High Risk	Moderate Significance	• Optimisation of the storm water management plan and positioning of mining pits during the Feasibility Phase. • Diversion of non-perennial streams around opencast areas to minimise decrease in surface runoff • Rehabilitation concurrent to mining – limit dirty footprint.	Moderate Risk	Moderate Significance
OC4	Surface Water	Impact on 1:100 year flood-line of the Sand and Mutamba Rivers	Negative	High Risk	Moderate Significance	• Revise mining footprint during Feasibility Phase to avoid 1:100 flood-lines of the major drainage lines, plus a 100m buffer zone.	Moderate Risk	Low Significance
OC5	Surface Water	Impact on wetland areas and aquatic ecosystems	Negative	High Risk	Moderate Significance	• Maintain a buffer zone of 100m from the 1:100 year flood-line of major drainage lines to reduce impact on aquatic systems. • Reposition surface infrastructure and stockpiles to avoid drainage lines and sensitive wetland systems. • Implement aquatic (bio) monitoring. • Create small impoundments at head of stream diversions to limit erosion. This could potentially become artificial wetlands over time. • Identify and implement biodiversity offset programmes (including wetland offsets) in conjunction with the IAPs and authorities, including the Vhembe Biosphere Reserve.	Moderate Risk	Moderate Significance
OC6	Surface Water	Increased sedimentation into Sand River due to uncontrolled surface run-off	Negative	High Risk	Moderate Significance	• Design and install appropriate outlet structures to retard flow velocity. • Construction of energy dissipating structures along steep slopes. • Side slopes of earth berms / canals to be designed to 1:3 and protected & vegetated to prevent erosion.	Moderate Risk	Moderate Significance
OC7	Surface Water	Potential impact on in-stream habitat and riverine vegetation as a	Negative	Moderate Risk	Low Significance	• Implementation of monitoring programme for early detection of impacts (plant moisture stress monitoring). • Diversion of clean storm water runoff around opencast areas to	Moderate Risk	Low Significance

ID[#]	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
		result of decrease in runoff				minimise impact of flow within the Sand and Mutamba Rivers.		
OC8	Surface Water	Impact of long-term decant on water quality	Negative	High Risk	High Significance	• Investigate appropriate management measures over the LOM.	High Risk	High Significance
OC9	Groundwater	Dewatering of aquifer as a result of mining, resulting in drying up of boreholes and springs	Negative	Very High Risk	High Significance	• Revision and phasing in of mining schedules during the Feasibility Phase on a regional basis to reduce the radius of influence. The groundwater flow model will be utilised during this exercise to obtain the most feasible option from a groundwater impact perspective. • Implementation of baseline monitoring programme on farms that are potentially impacted once the mining and infrastructure feasibility studies have been completed. • Provide alternative water sources where appropriate. • Compensation mechanisms need to be developed and agreed with impacted landowners to compensate those who are impacted upon.	High Risk	High Significance
OC10	Groundwater	Impact on surrounding vegetation as a result of dewatering and subsequent recovery	Negative	Moderate Risk	Moderate Significance	• Ongoing monitoring of springs and fountains. • Implementation of monitoring programme for early detection of impacts (plant moisture stress monitoring). • Diversion of clean storm water runoff around opencast areas to minimise impact of flow within the Sand and Mutamba Rivers.	Moderate Risk	Moderate Significance
OC11	Groundwater	Decrease in regional water quality due to seepage from rehabilitated pits	Negative	Moderate Risk	Low Significance	• Potential acid generating horizons will be placed at bottom of pit and submerged below the water table, thereby preventing oxidation. • Rehabilitation will be concurrent with mining, minimising the potential for oxidation of sulphide bearing rocks and controlling the migration of high sulphate leachate. • Exposed residue material will be minimised by direct placement of overburden and topsoil. • Vegetation will be re-established as soon as possible after topsoiling to minimise infiltration of water through residue material. • Implementation of baseline monitoring programme to detect any seepage. • Compensation mechanism to compensate landowners who are impacted upon.	Moderate Risk	Low Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
OC12	Groundwater	Mixing of fresh and saline aquifers due to the disturbance of aquitards during mining	Negative	High Risk	High Significance	• Grout off saline aquifers	High Risk	High Significance
OC13	Groundwater	Migration of pollution plume after full recovery of groundwater levels (prior to decant)	Negative	High Risk	Moderate Significance	• Investigate appropriate management measures over the LOM. • Groundwater and geochemical models must be updated on a regular basis (every 5 years) to verify potential for decant.	High Risk	Moderate Significance
OC14	Air Quality	Dust impact caused by vehicle movement	Negative	High Risk	Moderate Significance	• Application of dust suppression measures (surface surfactants) such as Dustex. • Reduce vehicle speed on unpaved roads to limit dust creation.	Low Risk	Low Significance
OC15	Air Quality	Dust impact caused by blasting activities	Negative	High Risk	Moderate Significance	• Develop Blasting Procedure to minimise impacts.	Moderate Risk	Low Significance
OC16	Air Quality	Dust impact caused by materials handling	Negative	High Risk	Moderate Significance	• Reduction of drop height to reduce the dispersion of materials being transferred, and increase in moisture content (water sprays). • Creation of wind breaks in close proximity to storage piles to reduce the potential erosive forces of the wind.	Low Risk	Low Significance
OC17	Air Quality	Methane emissions leading to air quality impacts	Negative	Low Risk	Low Significance	• Ongoing methane monitoring if required.	Low Risk	Low Significance
OC18	Noise	Elevated noise levels caused by mining operation, dewatering (pumping) and blasting activities	Negative	High Risk	Moderate Significance	• Noise attenuation berms (topsoil) on footprint of opencast areas. • Noise suppression devices on heavy vehicles and all noisy plant. • Alternative reverse hooting systems will be implemented to reduce the noise levels. • Low noise generator sets will be used in pit. • Develop air blast control measures. • Blasting limited on regular times, restricted to 08:00-18:00. • All plant, equipment and vehicles to be kept in good repair. • Employees / contractors working in areas where the 8-hour ambient noise levels exceed 85dBA shall wear ear protection equipment.	Moderate Risk	Moderate Significance
OC19	Visual / Aesthetics	The mining will have a negative on the aesthetics / sense of place	Negative	High Risk	Moderate Significance	• Berms on footprint of opencast areas to be protected and vegetated to reduce the visual impact. • Avoid the unnecessary removal of vegetation during the operational phase. • Rehabilitation and revegetation will be performed concurrent to	Moderate Risk	Moderate Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
						mining. • Introduce trees to the landscape at strategic locations (sensitive receptors) to break full exposure of the mine. Further analyses and stakeholder engagement will be required for this commitment.		
OC20	Blasting	Impact on the communities and sensitive receptors as a result of blasting	Negative	High Risk	Moderate Significance	• Develop and implement Blasting Procedure as well as an Evacuation Procedure.	Moderate Risk	Low Significance
P1	Soils / Land Use & Capability	Soil impacts as a result of poor hydrocarbon management and spillages	Negative	Moderate Risk	Low Significance	• Develop and implement hydrocarbon management procedure. • Reclamation of soils in the event of accidental spillages.	Low Risk	Low Significance
P2	Soils / Land Use & Capability	Surface disturbance caused by infrastructure	Negative	High Risk	Moderate Significance	• Dismantling of infrastructure. • Final rehabilitation of disturbed areas. • Rehabilitation of dams and storm water drainage.	Moderate Risk	Low Significance
P3	Surface Water	Water quantity impact due to decreased surface runoff	Negative	Moderate Risk	Moderate Significance	• Optimisation of the storm water management plan and positioning of infrastructure during the Feasibility Phase. • Separation of clean and dirty water systems (stream diversions) to minimise impact on runoff.	Low Risk	Low Significance
P4	Surface Water	Water quality impact on Sand and Mutamba Rivers	Negative	Moderate Risk	Moderate Significance	• Directing and containment of dirty water runoff in dirty water dams and providing silt traps. • Recycling (reuse) of dirty water in process. • The dirty water dam will be designed for the 1:50 year flood-event and HDPE lined to prevent discharges / seepage into the surface water resources.	Low Risk	Low Significance
P5	Surface Water	Water quality impacts as a result of poor hydrocarbon management and spillages	Negative	Moderate Risk	Moderate Significance	• Develop and implement hydrocarbon management procedure. • Bulk facilities to be concrete lined and bunded to capacity of 110%.	Low Risk	Low Significance
P6	Surface Water	Impact on wetland areas and aquatic ecosystems	Negative	High Risk	Moderate Significance	• Maintain a buffer zone of 100m from the 1:100 year flood-line of major drainage lines to reduce impact on aquatic systems. • Reposition surface infrastructure to avoid drainage lines and sensitive wetland systems (e.g. Chapudi Section processing plant on Blackstone Edge/Woodlands). • Implement aquatic (bio) monitoring.	Moderate Risk	Moderate Significance

ID[#]	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
P7	Groundwater	Water quality impacts due to infiltration of dirty water from the plant and infrastructure areas	Negative	High Risk	Moderate Significance	• Dirty water dams to be plastic (HDPE) lined to prevent groundwater contamination. • Carbonaceous plant stockpile areas to be appropriately lined with dedicated dirty water drainage from the stockpile to prevent groundwater contamination. • Dirty water canals in the infrastructure area to be concrete lined to prevent groundwater contamination.	Moderate Risk	Low Significance
P8	Air Quality	Air quality impacts associated with processing activities and movement of vehicles	Negative	Moderate Risk	Low Significance	• Reduction of drop height to reduce the dispersion of materials being transferred, and increase in moisture content (water sprays). • Plant and access roads to be surfaced or treated with dust palliatives such as Dustex.	Low Risk	Low Significance
P9	Air Quality	Dust impact caused by crushing and screening operations	Negative	Moderate Risk	Moderate Significance	• Introduce dust suppression systems, either in the form of water sprays or cladding in order to reduce the potential emissions. • Reduce vehicle speed on unpaved roads to limit dust creation.	Low Risk	Low Significance
P10	Noise	Elevated noise levels caused by crushing and processing activities	Negative	Moderate Risk	Moderate Significance	• Rubber vulcanised belt – less noisy / vibration. • Cladding of crushing and screening plants and noisy equipment – encapsulation in buildings, acoustic covers, screens or sheds. • Noise suppression devices on heavy vehicles / crushing equipment. • Low noise generator sets will be used in plant. • Employees / contractors working in areas where the 8-hour ambient noise levels exceed 85dBA shall wear ear protection equipment.	Moderate Risk	Low Significance
P11	Visual / Aesthetics	Processing plant will have a visual impact as a result of high buildings	Negative	High Risk	Moderate Significance	• Avoid the use of highly reflective material in construction. • Metal surfaces should be painted in natural soft colours (Aloe Green) that would blend in with the environment.	Moderate Risk	Moderate Significance
P12	Lighting	Sky glow effect will have an impact on the sense of place at night	Negative	High Risk	Moderate Significance	• Use specifically designed lighting equipment that minimises the upward spread of light near to and above the horizontal. Care should be taken when selecting luminaries to ensure that appropriate units are chosen and that their location will reduce spill light and glare to a minimum. • Keep glare to a minimum by ensuring that the main beam angle of all lights directed towards any potential observer is not more than 70°. Higher mounting heights allow lower main beam angles, which can assist in reducing glare. In areas with low ambient lighting levels, glare can be very obtrusive and extra care should be taken when positioning and aiming lighting equipment.	Moderate Risk	Moderate Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
						• Covering of high lighting masts to reduce the glow. • Suppress dust forming to minimise the effect of sky glow during night.		
P13	Lighting	Impact on invertebrates	Negative	Moderate Risk	Moderate Significance	• Long-wavelength light sources should be used, e.g. low-pressure sodium vapour lights.	Moderate Risk	Low Significance
ON1	Air Quality	On-site conveyance will increase the ambient air quality	Negative	Moderate Risk	Moderate Significance	• Application of dust suppression (Dustex) on internal haul roads. • Surfacing of access road and main haul roads. • Water sprays at stockpiles and transfer points. • Water misters will be installed at strategic points at the transfer points along the conveyor in order to abate dust emission. • Vehicle speed on unpaved roads limited to prevent dust creation. • Conveyor design to include 'dogsheeting' on top and along the prevailing wind direction sides to minimise dust generation. • Use of appropriate plant operation and material handling techniques, good maintenance and housekeeping. Therefore the implement measures to minimise the generation and dispersion of dust and surface disturbances. • Employ latest technology to reduce vehicle exhaust gas emissions.	Low Risk	Low Significance
ON2	Surface Water	Stream crossings (road and conveyor) could potentially impact on the stream flow and lead to stream flow reductions downstream	Negative	Moderate Risk	Moderate Significance	• Design crossings for 1:20 year flood to minimise effect of damming of water upstream. No permanent retention of water in river at crossings. • Avoid sensitive wetland systems as far as possible.	Low Risk	Low Significance
ON3	Surface Water	Spillages along conveyors/roads could impact on water quality	Negative	Moderate Risk	Moderate Significance	• Regular inspections will be implemented for early detection of spillages. Cleaning up of any spillages that may have occurred. • All conveyors to be fully enclosed for zero spillage over all stream crossings. • Conveyors covered to deflect rain water away from conveyor belt. • Installation of primary and secondary scrapers ensures that there is continuous contact between the scrapers and the belt which will prevent spillages on the return belt.	Moderate Risk	Low Significance

ID[#]	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
ON4	Noise	Elevated noise levels caused by trucking and conveying activities	Negative	High Risk	Moderate Significance	• Rubber vulcanised belt – less noisy / vibration. • Maintenance of vehicles. • All equipment selection to fall in line with permissible noise dBA. • During the selection of the main components and equipment of the proposed undertaking as a whole, installation of alternative low-noise generating makes and models will be considered. • Noise suppression devices on heavy vehicles / conveying equipment.	Moderate Risk	Moderate Significance
ON5	Soils / Land Use & Capability	Surface disturbance caused by infrastructure	Negative	Low Risk	Low Significance	• Dismantling of infrastructure. • Final rehabilitation of disturbed areas and storm water drainage.	Low Risk	Low Significance
MR1	Groundwater	Impact of carbonaceous stockpiles on groundwater resources	Negative	High Risk	Moderate Significance	• Carbonaceous stockpiles to be appropriately lined with a sub-surface drainage system. • Stockpiles to be compacted, properly capped and revegetated to reduce recharge. • Stockpiles slopes to be designed such to increase runoff whilst preventing erosion. • Carbonaceous stockpiles to be disposed in-pit as far as possible at closure to minimise final footprint of surface carbonaceous stockpiles.	Moderate Risk	Low Significance
MR2	Surface Water	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff	Negative	Moderate Risk	Moderate Significance	• Optimisation of the storm water management plan and re-positioning of stockpiles during the Feasibility Phase. • Diversion of non-perennial streams around stockpile areas to minimise decrease in surface runoff.	Low Risk	Low Significance
MR3	Surface Water	Impact on wetland areas and aquatic ecosystems	Negative	High Risk	Moderate Significance	• Maintain a buffer zone of 100m from the 1:100 year flood-line of major drainage lines to reduce impact on aquatic systems. • Reposition stockpiles to avoid drainage lines and sensitive wetland systems. • Implement aquatic (bio) monitoring.	Moderate Risk	Moderate Significance
MR4	Surface Water	Increased sedimentation in drainage lines due to uncontrolled surface run-off and erosion	Negative	Moderate Risk	Moderate Significance	• Side slopes of stockpiles to be protected and vegetated to prevent erosion. • Construction of energy dissipating structures along steep slopes.	Low Risk	Low Significance
MR5	Surface Water	Water quality impacts as a result of dirty water runoff / seepage from	Negative	High Risk	Moderate Significance	• Dirty water / seepage to be collected in lined facility and recycled to dirty water dams for use in process.	Moderate Risk	Moderate Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
		carbonaceous stockpiles						
MR6	Visual / Aesthetics	Large stockpiles will impact on the landscape	Negative	High Risk	Moderate Significance	• In-pit disposal as far as possible. • Stockpiles to be protected and vegetated to reduce visual impact. • Landscaping of stockpiles to minimise impact – avoid straight lines and design contoured stockpiles that represent the natural lines of the existing topography.	Moderate Risk	Moderate Significance
MR7	Air Quality	Increase dust emissions as a result of stockpiles	Negative	Moderate Risk	Moderate Significance	• Compaction by heavy vehicles used for stockpile operations. • Stockpiles to be vegetated to reduce dust emissions.	Moderate Risk	Low Significance
MR8	Noise	Noise from stockpile construction leading to the main contributing factors to the noise at the sensitive receptors, especially at night-time	Negative	High Risk	Moderate Significance	• Noise suppression devices on heavy vehicles and other noisy equipment. • Alternative reverse hooting systems will be implemented to reduce the noise levels.	Moderate Risk	Moderate Significance
RL1	Safety	Road / conveyor crossings could lead to safety risks to road users	Negative	Moderate Risk	Moderate Significance	• Appropriate crossings (under or over-passes) will be designed to eliminate the safety risks. • The rail link will be fenced off to prevent people and animals from going onto or across the railway line.	Moderate Risk	Low Significance
RL2	Surface Water	Stream crossings where culverts may concentrate flow, leading to enhanced flow velocities and associated erosion problems	Negative	Moderate Risk	Moderate Significance	• Design crossings according to TFR standards – design flow rate 1:50 year flood event – to minimise effect of damming of water upstream. No permanent retention of water in river at crossings. • Construct the necessary erosion control measures at these crossings to reduce the impact. • Avoid sensitive wetland systems as far as possible.	Low Risk	Low Significance
RL3	Surface Water	Potential for water quality impacts due to dirty runoff and spillages along the rail link	Negative	Moderate Risk	Moderate Significance	• Regular inspections will be implemented for early detection of spillages. Cleaning up of any spillages that may have occurred.	Low Risk	Low Significance
RL4	Noise	Increase of ambient noise levels along the rail route	Negative	Moderate Risk	Moderate Significance	• Rail line to be flush-welded to reduce noise. • Diesel locomotives to operate at lower speed along the rail link. • Noise attenuation berms should be constructed at sensitive receptors closest to the rail link in cooperation with the landowners.	Moderate Risk	Low Significance
RL5	Air Quality	Increase of dust emissions along the rail route	Negative	Moderate Risk	Moderate Significance	• Dust fallout monitoring points will be established along the rail link to detect an increase in emissions. • Regular inspections will be done along the rail route to detect and	Moderate Risk	Moderate Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
						clean any spillages that could lead to increased dust levels. • Use of low sulphur grade fuels.		
RL6	Biodiversity	Land units will be divided into smaller units which may not be ecologically viable	Negative	High Risk	Moderate Significance	• Align rail link with existing disturbed corridors, i.e. roads, fence lines. This will be finalised during the Feasibility Phase. • Animal crossings (underpasses or level-crossings with cattle grid) will be created along the rail link for animals and domestic livestock.	Low Risk	Low Significance
RL7	Biodiversity	Potential impact on protected flora species identified along the route	Negative	Moderate Risk	Low Significance	• The rail route will be diverted to prevent impact to specific protected species, e.g. baobabs, impala lilies. • Where possible, the species that cannot be avoided will be rescued and relocated as per the Rescue & Relocation Plan.	Low Risk	Low Significance
RL8	Biodiversity	Creation of additional corridors which could lead to increased poaching	Negative	Moderate Risk	Low Significance	• Fencing (game fence) of the rail link for safety and access control.	Moderate Risk	Low Significance
RL9	Biodiversity	Killing of animals crossing the rail line	Negative	Moderate Risk	Moderate Significance	• The rail link will be fenced off to prevent animals from going onto the railway line. • Animal crossings (underpasses or level-crossings with cattle grid) will be created along the rail link for animals and domestic livestock.	Low Risk	Low Significance
EM1	Safety	Road transport of product will impact on the traffic along the route, safety risk to road users	Negative	High Risk	Moderate Significance	• Implementation of Community Safety and Traffic Management Procedure, including: o Upgrading of road intersections. o Other traffic calming measures identified during the LOM. o Maintaining vehicle speeds. o Covering of vehicles when in motion, both for loaded and unloaded vehicles. o Switching on head lights of trucks. • Due notification to the surrounding landowners and communities in the event of emergency trucking. • Implement a Traffic Awareness Programme within the surrounding communities.	Moderate Risk	Moderate Significance
EM2	Biodiversity	Killing of animals and avifauna on the roads, especially nocturnal animals/birds	Negative	Moderate Risk	Moderate Significance	• Maintaining vehicle speeds. • Trucking during daylight hours only. • Implement an Environmental Awareness Programme for trucking contractor.	Moderate Risk	Moderate Significance

ID#	Environmental Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
EM3	Surface Water	Potential for water quality impacts due to spillages and dirty runoff into the streams	Negative	Moderate Risk	Moderate Significance	• Regular inspections will be done along the route to detect and clean any spillages from the trucks. • Emergency procedure to be developed and implemented in the event of any spillage / accident along the route. • Covering of vehicles when in motion, both for loaded and unloaded vehicles.	Moderate Risk	Moderate Significance
EM4	Air Quality	Material and product loss from trucks	Negative	Moderate Risk	Moderate Significance	• Gravel roads to be surfaced or treated with dust palliatives such as Dustex. • Covering of vehicles when in motion, both for loaded and unloaded vehicles. • Regular inspections will be done along the route to detect and clean any spillages from the trucks.	Low Risk	Low Significance
EM5	Noise	Increase of ambient noise levels along the route	Negative	Low Risk	Low Significance	• Noise suppression devices on transport trucks. • Trucking during daylight hours only.	Low Risk	Low Significance

Table 48: Social Impact Risk Matrix

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Demographic and Population Impacts	Influx of work seekers into the area	Negative	Moderate Risk	Moderate Significance	• Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally • Development and Implementation of an Influx and Land use Management Plan • Develop a code of conduct with which contractors and their employees must comply. The code should deal with the interaction with local communities and substance abuse among other things. • Develop a Stakeholder Engagement Plan (SEP) which clarifies the principles of engagement with community and other stakeholders, sets in place appropriate liaison forums (a community forum is recommended), and describes the grievance management procedure to be adopted by the Chapudi Project. Establishment of a local labour recruitment committee to monitor recruitment procedures and results • Communicate through media the recruitment procedures and priorities to discourage work seekers from outside the area	Low Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Demographic and Population Impacts	Influx of construction labour with pressure on services and social structures	Negative	Moderate Risk	Moderate Significance	• Facilitate the provision of housing and associated infrastructure. Establishment of a construction accommodation camp to house those employees that cannot be sourced from the local community due to a lack of skills • Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally • Development and Implementation of an Influx and Land use Management Plan • Develop a code of conduct with which contractors and their employees must comply. The code should deal with the interaction with local communities and substance abuse among other things. • Develop a Stakeholder Engagement Plan (SEP) which clarifies the principles of engagement with community and other stakeholders, sets in place appropriate liaison forums (a community forum is recommended), and describes the grievance management procedure to be adopted by the Chapudi Project. Establishment of a local labour recruitment committee to monitor recruitment procedures and results • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Implementation of a programme of STD and HIV/AIDS screening, counselling and (where possible) treatment.	Low Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Demographic and Population Impacts	Influx of operational workforce with pressure on services and social structures	Negative	Moderate Risk	Moderate Significance	• Contribution towards the provision of housing, infrastructure and services for operational staff. The establishment of partnerships with other private sector stakeholders, government authorities and civil society organisations to integrate planning around the provision of services and infrastructure, and to ensure that Mine inputs in this context compliment initiatives led by other players, especially the local and district municipality. • Development and Implementation of an Influx and Land use Management Plan • Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally • Induction of contractors and workforce with regard to their code of conduct in the local communities • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Implementation of a programme of STD and HIV/AIDS screening, counselling and (where possible) treatment. • Continuous assessment and monitoring of infrastructure and services capacity in focal points (assessment every 5 years) • Determine scale of assistance required at focal points and enter into an agreement with the municipality • Establish a development, infrastructure and service monitoring forum with the municipality to continuously assess and monitor capacity, determine assistance required and oversee implementation	Low Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Demographic and Population Impacts	Influx of people and the development of spontaneous settlements near project facilities, in the Waterpoort Town and surrounding areas	Negative	High Risk	Moderate Significance	• Develop a Community Development Plan which addresses issues relating to provision of housing for the workforce through on-going communication and engagement between the mine and local authorities for implementation of this plan. • Develop and adoption of an Influx Management Plan in consultation with the local government that outlines proactive management measures to discourage and manage influx, outlines and refines relevant stakeholders and their roles and responsibilities and the way in which each role-player intends to manage influx and spontaneous settlements. • Support the compilation of a development master plan, in cooperation with relevant local and regional authorities for the Musina and Makhado areas, whereby new development areas for workers' and new arrivals' accommodation will be catered for and duly planned • Support local government capacity for integrated development planning. • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Continuous assessment and monitoring of infrastructure and services capacity in focal points (assessment every 5 years) • Determine scale of assistance required at focal points and enter into an agreement with the municipality • Establish a development, infrastructure and service monitoring forum with the municipality to continuously assess and monitor capacity, determine assistance required and oversee implementation	Moderate Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Demographic and Population Impacts	Conflicts arising at the end of construction due to the termination of job opportunities for contractors	Negative	High Risk	Moderate Significance	• Investigate the possibility of transferring labour from one operation to another – depending on the phasing of the projects • Develop the MbeuYashu grievance procedure to capture and address grievances arising due to retrenchments and downscaling. • Ensure compliance with all applicable Labour Regulations of South Africa • Consider compliance with Best Practice , i.e. IFC's Performance Standard 2 "Labour and Working Conditions" • Monitoring of all contractors and sub-contractors for compliance with the above standards, with contractually-established financial sanctions for observed non-compliances • Communicate the termination conditions to the communication structure established • Communicate the termination conditions to all employees – including contractors and sub-contractors	Moderate Risk	Low Significance
Health and Social Wellbeing	Increased chances of the spread of communicable diseases such as HIV/AIDS and STDs linked to influx of predominantly male job-seekers and workers	Negative	High Risk	Moderate Significance	• Develop a comprehensive HIV/AIDS and STD program to employees through employee wellness programmes which should include prevention, voluntary counselling for HIV testing, as well as anti-retroviral treatment for employees. • Develop a Community Health Action Plan which focuses on HIV/AIDS, tuberculosis. • Repeated awareness campaigns that is focused beyond employees and includes contractors and the communities near project facilities	Moderate Risk	Moderate Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Health and Social Wellbeing	Safety and Risk Exposure through an increase in crime	Negative	Moderate Risk	Low Significance	• Increased security on mine premises • Construction and permanent workers are identified and marked with clear identifiable clothing • Code of Conduct to form part of induction of new workers with a clear statement and procedure regarding access, conduct and identification. All construction workers should wear clothing marked (and reflective vests) with the logo of the construction firm/contractor or sub-contractor as well as identification cards that cannot be easily forged, so that they can be easily recognized as being legitimate. • Workers to be screened including criminal background checks. • Properly constructed and secured fences can control access to construction sites. Implementing strict access control of the project site and specifically the contractors workforce camp. • Workers should be urged to recognize and report suspicious activity and signs of burglary and be informed of crime prevention measures that they themselves can take. • Employment of local people on the mine to improve the poverty levels in the host and neighbouring communities • MbeuYashu to liaise with existing community policing forums and project security to properly secure the project area and surrounding area • Investigate the implementation of an anti-poaching unit in collaboration with local stakeholders, policing forums and police	Low Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Health and Social Wellbeing	Safety and Risk Exposure due to an increase in poaching on neighbouring game farming properties	Negative	Moderate Risk	Low Significance	• Establishment of an anti-poaching unit available to adjacent land owners, and establishing a security forum in collaboration with these land owners. Land owners are to be actively involved in the selection of the contracting company employed to conduct anti-poaching in the area. • Increased security measures (fencing, access control and monitoring) on mine premises. Properly constructed and secured fences can control access to construction sites. Implementing strict access control of the project site and the contractors workforce camp. Curfew times to be established in accommodation areas. Construction workers accommodated on mine are identified and marked with clear identifiable clothing • Code of Conduct to form part of induction of new workers with a clear statement and procedure regarding access, conduct and identification. All construction workers should wear clothing marked (and reflective vests) with the logo of the construction firm/contractor or sub-contractor as well as identification cards that cannot be easily forged, so that they can be easily recognized as being legitimate. • Workers to be screened including criminal background checks. • Employment of local people on the mine to improve the poverty levels in the local communities	Low Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Quality of Living Environment	Change in "sense of place"	Negative	High Risk	Moderate Significance	• Regular and effective engagement with stakeholders through the SEP. • An effective grievance management procedure managed within the framework of the SEP. Grievance mechanisms must be in place throughout the life of the mine, including for a determined period post-closure, to address any impact for affected communities. • Implementation of traffic management measures Implementation of insulation and mitigation measures for noise • Implementation of visual barriers and other mitigation measures as recommended in the visual study • Colour schemes must complement the local environment. • Minimising disturbance to vegetated areas outside the critical development areas where possible • Revegetation/rehabilitation of disturbed sites in parallel with development • Successful mitigation interventions can reduce the intensity of the impact to at least moderate and ultimately moderate-low levels. If grievances are addressed adequately, and communication and engagement is effective affected communities may be able to adjust more easily to the changes.	Moderate Risk	Low Significance
Quality of Living Environment	Disruption of Social Networks and decrease in Social Capital	Negative	Moderate Risk	Low Significance	• Employment of local people already part of the community. • Code of conduct to form part of induction for all new workers • Grievance Procedure within the local communities	Low Risk	Low Significance
Quality of Living Environment	Perceptions of and Feelings in relation to the project	Negative	High Risk	Moderate Significance	• Establish on-going Consultative Forums with concerned groups to air concerns, find possible mitigation measures for their perceived impacts, solutions to co-existence and monitor implementation and effectiveness of mitigation measures • Continuous communication with all stakeholders providing information on anticipated impacts and planned mitigation measures	Moderate Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Family and Community Impacts	Impacts on land owner and labourers	Negative	Very High Risk	Moderate Significance	• Development of a land acquisition and lease policy defining the negotiation process to minimize the feelings of uncertainty • Financial compensation of affected property owners/tenants, employees and their families in terms of the relevant legislation. • Displacement of workers and their dependents requires an equitable policy, principles, financial guidelines and clarification of operational approaches. • Land Acquisition, lease and compensation agreements reached with affected landowners that include arrangements and measures for labour tenants	Moderate Risk	Low Significance
Family and Community Impacts	Change processes and impacts related to daily movement patterns	Negative	Moderate Risk	Moderate Significance	• The project description defines that no hauling will take place along existing farm roads or regional / national roads. It is planned that the run-of-mine (ROM) coal will be transported for short distances by truck, on the in-pit haul roads to the crushing and screening facilities. The crushed and screened ROM product will be transported to the coal beneficiation plant at the Infrastructure Hub via conveyor. It is further planned that the product will be loaded directly onto trains at the Rail Load-out Terminal situated at the Infrastructure Hub which links up with the existingMusina-Makhado railway line. • Therefore only supplier light-vehicles and employee busses will disrupt movement patterns, these will stabilize once the mine is fully operational	Low Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Family and Community Impacts	Conversion of land use	Negative	High Risk	Moderate Significance	• Acquisition and or leasing of directly impacted land • Fair compensation negotiated and agreed with land owners that will lose agricultural land • Continuous consultation with landowners discussing co-existence and feasibility • Educate landowners in terms of their rights and responsibilities prior to the construction phase • Assist landowners in identifying ways to adapt their land uses, to the benefit of both the landowner and MbeuYashu • Implement a consultation programme with regional stakeholders in the development of a closure plan and rehabilitation programme • Determine the regional needs and characteristics to ensure post mining use of land enhances the regional characteristics	Moderate Risk	Low Significance
Institutional/Legal/Political/Equity Impacts	Challenge to local government capacity	Negative	Moderate Risk	Low Significance	• Intensive engagement between MbeuYashu / CoAL and the municipality well in advance of construction. In this context the responsibilities of local government should be well understood, and potential problems defined and addressed as early as possible. • Establishment of a limited and time-bound municipal support function. MbeuYashu / CoAL should contribute funding and appropriate technical resources. The participation of other major mines and industries in the area should be promoted by both MbeuYashu / CoAL and the local municipality.	Low Risk	Low Significance
Institutional/Legal/Political/Equity Impacts	Participation and Consultation in process	Negative	Moderate Risk	Low Significance	• Provide transport and/or reimbursement to the Historical Disadvantaged Communities • During the Operational phase, the structures established for participation should have a proper constitution that addresses reimbursement of costs • Arrangement of meetings in proximity to the mine or in affected communities to minimize the distance of directly affected parties to travel Cluster meetings together on the same day or over 2 days to minimize disruption of personal schedules	Low Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Institutional/Legal/Political/Equity Impacts	Impact equity	Negative	High Risk	Moderate Significance	• Tax and Profit benefits must be ploughed back into the Local Municipal areas and immediate communities • Employment should be prioritized to local communities • Local beneficiation programmes to be investigated and implemented	Moderate Risk	Low Significance
Socio-economic Wellbeing	Increase in South African GDP and Trade Balance	Positive	High Positive	Moderate Significance	• Procure goods and services from South African suppliers as far as possible. • Procure ancillary services for goods procured abroad, such as installation, customisation and maintenance, from South African companies as far as possible.	Very High Positive	High Significance
Socio-economic Wellbeing	Increase in provincial and local GDP	Positive	High Positive	Moderate Significance	• Procure goods and services from local or provincial suppliers as far as possible. • Procure ancillary services for goods purchased from outside of the Limpopo Province, such as installation, customisation and maintenance, from local or provincial companies as far as possible.	Very High Positve	High Significance
Socio-economic Wellbeing	Increase in government revenue	Positive	High Positive	Moderate Significance	• None	High Positive	Moderate Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Socio-economic Wellbeing	Increase in employment, income and skills development	Positive	High Positive	Moderate Significance	• Aim to use local workers as far as possible and formalise this policy in contracts. • Consider implementing labour-intensive rather than capital-intensive work methods wherever possible. • Procure resources from local sources wherever possible. • Establish a database of local people with information on qualifications and skills, utilize this database to develop skills plans and recruit local people. • Implement early on skills development programmes in the areas where most job opportunities will be created, i.e. operators and drivers • Include training for general life skills such as financial management and health. • Implement portable skills development programmes • Design and implement economic development programmes that will assist people being retrenched in sustaining their livelihoods • Establish a future forum with representation from the workforce to discuss potential difficulties and solutions • Implementation of programmes to minimize and mitigate the impact of downscaling and retrenchment	Very High Risk	Moderate Significance
Socio-economic Wellbeing	Impact on existing businesses in surrounding areas	Negative	High Risk	Moderate Significance	• Devise a compensation plan for direct impacts of mining on adjacent farms, such as loss or pollution of land. • Screen mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place and tourists. • Identification of employees that may lose their employment and enrol in skills programme	Moderate Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Socio-economic Wellbeing	Change in property values	Negative	High Risk	Moderate Significance	• Attempt to minimize impacts through implementation of mitigation strategies focusing on aspects that may affect tourism characteristics including traffic, noise, and visual aspects such as screening mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place. Establish a baseline of property values by conducting baseline valuations on representative properties and providing such to landowners, thereafter conducting monitoring valuations in periods of 5 years or as may be agreed with landowners • Establish a communication channel with direct adjacent land owners to address impacts and grievances • Adopting principles of good corporate citizenship focused on conservation of natural resources such as water, biodiversity, etc. Inclusion of these principles and actions into information disseminated in the local area ("how mining can be done differently")	Moderate Risk	Low Significance
Socio-economic Wellbeing	Decrease of visitors, tourists and hunting parties	Negative	High Risk	Moderate Significance	• Attempt to minimize impacts through implementation of mitigation strategies focusing on aspects that may affect tourism characteristics including traffic, noise, and visual aspects such as screening mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place. • Collaborate with local stakeholders in terms of regional planning to ensure certain areas are protected for tourism and hunting activities. • Adopting principles of good corporate citizenship focused on conservation of natural resources such as water, biodiversity, etc. Inclusion of these principles and actions into information disseminated in the local area ("how mining can be done differently")	Moderate Risk	Low Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Socio-economic Wellbeing	Equity Participation of the Local Communities	Positive	Moderate Risk	Moderate Significance	• Ensure communities are fully involved and properly represented in the structures • Ensure capacity is built at an early stage for communities to understand how equity and dividends work • Place protective measures in place that will shield the communities from any business risk or liabilities	High Positive	Moderate Significance
Socio-economic Wellbeing	Participation of local business in procurement opportunities	Positive	High Positive	Moderate Significance	• Ensure communities are fully involved and understand the local procurement policy and procedure • Ensure capacity is built at an early stage through enterprise development to enable local business to participate in opportunities • Identify local only opportunities that is reserved for local business	High Positive	Moderate Significance
Socio-economic Wellbeing	Decline in South African GDP and Trade Balance at Decommissioning	Negative	Moderate Risk	Moderate Significance	• None	Low Risk	Moderate Significance
Socio-economic Wellbeing	Decline in provincial and local GDP at decommissioning	Negative	High Risk	Moderate Significance	• Actively promote the development of different economic sectors from an early stage, e.g. through incentivising other industries to locate in the area, providing adequate infrastructure and promoting an increase and diversity of skills in the local population. • Actively engage with a range of stakeholders throughout the life-of-mine to discuss potential consequences of mine closure and possible mitigation. • Incorporate measures to retrain workers in the Social and Labour Plan.	Moderate Risk	Moderate Significance
Socio-economic Wellbeing	Decline in government revenue at Decommissioning	Negative	High Risk	Moderate Significance	• None	Moderate Risk	Moderate Significance

Social Aspect	Potential Impact	Nature of Impact	Risk Map	Impact Significance	Proposed Mitigation measures	Risk Map	Impact Significance
Socio-economic Wellbeing	Decline in employment, income and skills development at decommissioning	Negative	High Risk	Moderate Significance	• Aim to use local workers as far as possible and formalise this policy in contracts. • Consider implementing labour-intensive rather than capital-intensive work methods wherever possible. • Purchase resources from local sources wherever possible. • Institute training programmes for local workers to raise skills levels. • Include training for general life skills such as financial management and health.	Moderate Risk	Moderate Significance
Vulnerable Group Impacts	Gendered Division of labour	Negative	Moderate Risk	Low Significance	• Women must have equal employment opportunities, • Training and skills development for women, and • Salaries of women must be equal to that of men • Establish opportunities that are suitable for women employment • Implement measures to enable working environment for women • Establishing gender-sensitive policy positions, such as for cultural heritage, employment and business development • Mainstreaming gender into project planning, particularly for community development • Using gender-sensitive indicators, such as employment data disaggregated by gender • Consultation with national women's organizations	Low Risk	Low Significance
Vulnerable Group Impacts	Potential Infringements on Historically Disadvantaged People's Human Rights	Negative	Moderate Risk	Low Significance	• Focusing local benefits on those communities previously disadvantaged to ensure upliftment • Enter into agreements with local communities to address post closure land use and sustainability • Optimization of local employment to minimize impacts of external or migrant workers on the local communities	Low Risk	Low Significance

7 COMPARATIVE ASSESSMENT OF LAND USE AND DEVELOPMENT ALTERNATIVES

7.1 CURRENT LOCAL ECONOMIC ACTIVITIES

The following Current Economic Activities have been identified as being present in the area:

- Live Stock Farming
    - Commercial Cattle
- Game Farming
    - Live Sales
    - Hunting, sub-divided into “Trophy” and “Biltong”
        - Trophy hunting including services like professional hunter, skinner, tracker, etc.
        - Biltong hunting including the services of trackers, skinners, etc.
    - Hunting Accommodation
- Eco-Tourism
- Irrigation

Mosaka Economic Consultants was appointed to perform a Macro- and Micro-Economic Impact Assessment Analysis for the Chapudi Project – refer to ANNEX-10 for the full report.

The approach followed was to first establish the current activities in the area which then formed the baseline used to draw up a risk profile in order to calculate the projected impacts and lastly convert it to macro-economic parameters. However, as so often happens, the economic benefits accruing from the mining project could put a negative burden on the current local economic activities in the project area. For purposes of the study the area was divided into three sub-areas, namely the project area east of the Sand River which includes the Wildebeesthoek Section and the Chapudi Section and the area west of the Sand River referred to as the Chapudi West Section.

The following table presents a summary of the current land use in the project area.

Land Use	Wildebeesthoek		Chapudi		Chapudi West		Total	
	Percentage	Hectares	Percentage	Hectares	Percentage	Hectares	Percentage	Hectares
Irrigation	0.5%	51	1.4%	213	2.2%	274	1.4%	537
Beef Game	14.0%	1 566	12.1%	1 819	10.8%	1366	12.2%	4 750
Game	85.5%	9 568	86.5%	12 998	87.0%	11 008	86.4%	33 574
Total	100.0%	11 185	100.0%	15 029	100.0%	12 648	100.0%	38 862

The following table gives an indication of the magnitude of the current activities in the project area.

Land Use	Annual Income (Rand million)			
	Wildebeesthoek	Chapudi	Chapudi West	Total
Beef Farming	R 0.40	R 0.46	R 0.49	R 1.36
Game Farming – Animals (turn over)	R 2.35	R 3.33	R 3.19	R 8.87
Hunting	R 3.32	R 3.75	R 0.68	R 7.75
Eco-Tourism	R 10.19	R 6.72	R 3.10	R 20.02
Irrigation	R 10.51	R 47.35	R 64.22	R 122.07
Grand Total	R 26.78	R 61.61	R 71.68	R 160.07

The table shows that irrigation and game farming with the related activities such as accommodation are by far the largest income generators in the area representing 90% of the total annual estimated turnover of R160.07 million, expressed in 2013 prices.

In the following table the total economic activities for the Chapudi Project area identified and analysed are expressed in terms of GDP and employment opportunities.

Land Use	Gross Domestic Product (R mil)			Employment (No)			Payments to Households (R mil)		
	Direct	Indirect/ Induced	Total	Direct	Indirect/ Induced	Total	Total	High/ Medium	Low
Irrigation	64.29	65.33	129.62	737	335	1 073	47.61	38.23	9.38
Beef Farming	1.28	0.56	1.83	4	1	5	0.29	0.22	0.07
Game Farming	8.36	5.77	14.14	28	42	70	3.45	2.80	0.65
Hunting	4.51	4.41	8.92	50	18	68	4.19	2.83	1.35
Taxidermy, Game catching, etc.	3.45	3.47	6.92	19	13	32	2.19	1.62	0.56
Accommodation	9.09	10.60	19.68	60	43	103	10.27	6.94	3.33
Total	90.98	90.14	181.12	898	452	1350	67.99	52.65	15.34

The table shows that the activities support 898 full time direct employment opportunities with another 452 indirect and induced opportunities, in total 1 350. It generates a total of R181.12 million in GDP of which R90.98 million is direct, expressed in 2013 prices.

The total payments to households are R67.99 million of which R15.34 million is to low income households.

The following table presents the estimated incremental negative impact of the proposed mines in the study area, expressed in macro-economic parameters.

Land Use	Gross Domestic Product (R mil)			Employment (No)			Payments to Households (R mil)		
	Direct	Indirect/ Induced	Total	Direct	Indirect/ Induced	Total	Total	High/ Medium	Low
Irrigation	-32.14	-32.14	-64.28	-341	-184	-525	-23.95	-19.34	-4.61
Beef Farming	-0.34	-0.15	-0.49	-1	-1	-2	-0.08	-0.06	-0.02
Game Farming	-2.20	-1.52	-3.72	-7	-10	-17	-0.91	-0.74	-0.17
Hunting	-1.27	-1.24	-2.52	-16	-5	-21	-1.18	-0.80	-0.38
Taxidermy, Game catching, etc.	-1.25	-1.26	-2.51	-7	-4	-11	-0.79	-0.59	-0.20
Accommodation	-6.07	-7.08	-13.14	-40	-30	-70	-6.86	-4.64	-2.22
Total	-43.27	-43.38	-86.66	-412	-234	-646	-33.76	-26.16	-7.61

The table shows that as many as 412 direct employment opportunities may be lost in the project area and a total of 646 overall. The projected direct GDP loss is R43.27 million with a total of R86.66 million. The estimated reduction in payments to low income households is R7.61 million.

7.2 PROPERTY VALUES

The estimated property values depend on a number of issues and are normally valuated using a number of different fixed capital improvements. The economic values differ from R1 503 per hectare for a beef producing unit and from R2 344 for a basic game producing unit without any value added improvements to R12 204 per hectare for units catering for the luxury market.

It is accepted that some of the property owners will not only suffer losses as far as income is concerned, but also face the possibility that their property value could be devaluated, especially in cases where the mining company is not interested in acquiring the property. It must be kept in mind that the major contributing factor to a possible devaluation in property values is the negative experience of "sense of place" for a specific property, especially those catering for the upmarket trophy hunters and eco-tourists. The two main issues affecting the formation of these perceptions are noise and visual intrusions.

In the case of the irrigation units the possible threat of the water being contaminated can affect the property values, also where the mining company is not interested in buying the specific farm.

7.3 COST BENEFIT ANALYSIS – ECONOMIC VIABILITY

A detailed Economic Cost Benefit Analysis (CBA) was performed for the proposed mining activity, and the coal rail transport option to the identified siding in current financial prices using a varying inflation for different elements and constant economic prices was used. The CBA analysis incorporated the negative impacts on current local activities as a cost item over the mining period, environmental and loss of biodiversity costs and identified social costs.

In the following table the differences between a private sector financial CBA and a public sector economic CBA is presented.

Attributes	Economic CBA	Financial CBA
Perspective	The broader community.	Project shareholders/capital providers.
Goal	The most effective application of scarce resources.	Maximization of net value.
Discount Rate	Social discount rate.	Market determined weighted cost of capital.
Unit of Valuation	Opportunity costs.	Market prices.
Scope	All aspects necessary for a rational, economic decision.	Limited to aspects that affect profits.
Benefits	Additional goods, services, income and/or cost saving.	Profit and financial return on capital employed.
Costs	Opportunity costs of goods and services foregone.	Financial payments and depreciation calculated according to generally accepted accounting principles.

The benefits associated with the project are the revenue resulting from the sale of the coking coal variety and Eskom quality coal.

Approximately 205.9 million tons of coking coal is expected to be produced over the LOM of the Wildebeesthoek Section with another approximately 205 million tons from the Chapudi and Chapudi West Sections. Of this volume about 18% of the Wildebeesthoek Section and 28% of the two Chapudi Sections will be destined for Eskom. The 2011 price of HCC coking coal was at an all-time high, the Australian coking coal varied from July 2010 to June 2011 from US$ 225 to $328 per ton FOB. Currently, September 2013, the price is varying around US$ 171 per ton FOB for the export of the HCC variety. Determining the Free-on-Board (FOB) price was therefore complex and it is necessary to discuss some of the parameters used in the calculations:

- The 2011 situation
  - FOB HCC price expressed in US$ - $207 ton/coking coal, the average 2010 price.
  - Exchange rate – R7 per 1US$.
  - Providing a FOR price of R1449 per ton.
- Current 2013 situation
  - Average 2013 FOB HCC price expressed in US$ - $171 per ton.
  - Exchange Rate –R9.50 per 1 US$.
  - Providing a FOB price of R1 624 per ton.

Although the price has dropped in US$ terms by 8% expressed in terms of Rand, the price has actually increased by 12%, compensating for any inflated expenditure prices.

Coal had a separate coking coal market study done by Wood Mackenzie; the report forecasted the following price scenario for the next number of years based on the different coking quality coal.

A summary of the forecasted prices for HCC and SHCC varieties is shown in the next table.

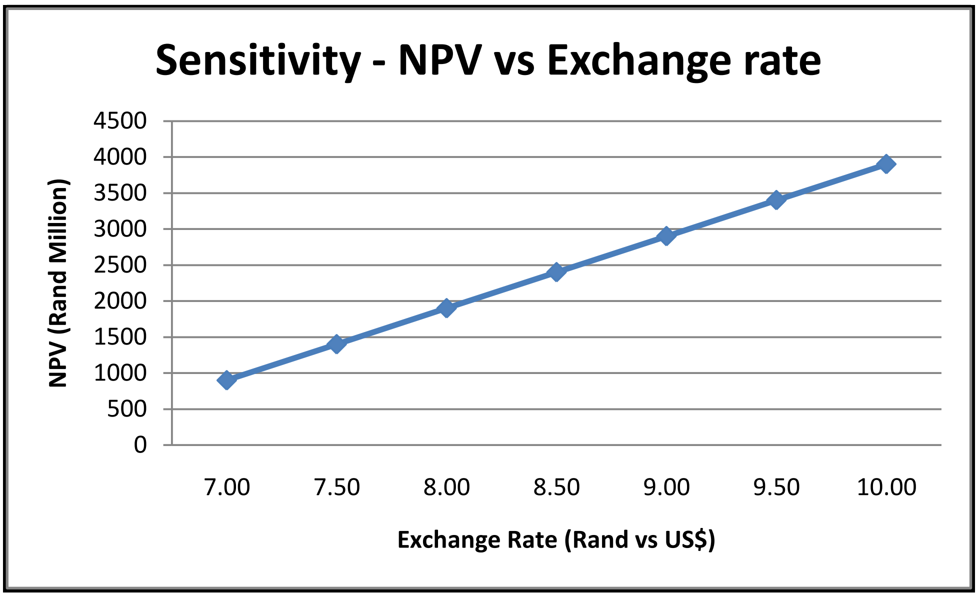
	2013	2014	2015	2020	2025	2030
Hard Coking Coal (HCC)	171.25	176.25	184	194	229	235
Semi Hard Coking Coal (SHCC)	143.64	147.84	154.56	164.9	194.65	202.1

The table shows that they expect the price, over time, will increase in constant terms; we accepted these figures for the base scenario as they are in line with other predictions found in a cursory research of possible coal price expectations.

The second issue is the possible movement of the South African Rand exchange rate, we accepted for the base scenario an annual weakening of 1.67% against the US dollar as forecasted in the Manual for Cost Benefit Analysis. However, current predictions produce even a faster deterioration of the value of the Rand.

The Eskom destined coal is priced according to the average 2012 price of R283 per ton FOR with a 10% annual escalation for the first number of years as announced by Eskom and then a constant price.

The following graph shows the impact of different exchange rates on the Net Present Value for the R1 477 per ton, the average 2011 price.



The graph shows that a linear relationship exists between the exchange rate and economic viability of the project. Currently the exchange rate is very volatile with dramatic movements up and down, however, a consensus opinion is that the lower limit would be R9 to the US$, although no guarantee exists that this would be the lower limit.

The following table presents the results of the financial and economic CBA models.

	Financial CBA	Economic CBA
Net Present Value (NPV) (Rand million)	32 534.92	18 623.32
Benefit Cost Ratio (BCR)	5.30	4.53
Internal Rate of Return (IRR)	43.3%	37.6%

The results show that the project is economically very viable when the inflation adapted financial prices have positive parameters for all three the price scenarios as well as the economic CBA in constant economic prices.

7.4 MACRO-ECONOMIC IMPACT ANALYSIS

The macro-economic impact analysis also shows a positive picture for both the economic impacts on the Limpopo Province as well as for the South African economy. In the following tables the total macro-economic impacts on the RSA and the Limpopo Province is presented.

Summary of the Construction Phase Results on the National Economy [R millions, 2010/2011 Prices]

	Wildebeesthoek	Chapudi	Chapudi West
Total GDP (R mil)	1 568.6	1 069.7	883.34
Total Employment	6 343	4 325	3 572
Total Payments to Households (R mil)	1 061.4	723.8	597.7
Fiscal Impact	477.0	325.3	268.6

Summary of the Construction Phase Results on the Limpopo Province Economy [R millions, 2010/2011 Prices]

	Wildebeesthoek	Chapudi	Chapudi West
Total GDP (R mil)	354	242	200
Total Employment	2 136	1 778	1 486
Total Payments to Households (R mil)	187.3	127.7	105.5
Fiscal Impact	78.8	53.9	44.4

The above tables show that the construction phase will have a positive impact on the National as well as the Limpopo Provincial Economy for the duration of the construction phase. It is interesting to observe that out of a total 6 343 employment opportunities created, 2 136 will be in the Limpopo Province during the construction period.

Summary of the Operational Phase results of the Chapudi Project showing the impact on the National and Limpopo Province economies [R millions, 2012/2013 Prices]. The Limpopo results are included in the National results.

	National - RSA Economy	Provincial - Limpopo Economy
Impact on GDP (R mil)	25 329	14 362
Impact on Total Employment [numbers]:	42 665	14 472
Impact on Households (R mil):	17 710	7 503
Low Income Households (R mil)	2 945	2 254
Medium Income Households (R mil)	7 276	1 473
High Income Households (R mil	8 517	3 776
Fiscal Impact (R mil):	6 960	2 887
Balance of Payments (R mil)	10 827	

The table shows that the operational phase of the proposed Chapudi Project will have a very positive impact on the economy of the province and that as much as 14 472 employment opportunities can be created of which over 1 834 will be direct employment opportunities on the mine itself.

The mine will, at full production, pay various taxes amounting to R6 960 million annually and have a positive contribution to the "Balance of Payments" of R10 827 million per annum if expressed in 2013 prices and values.

7.5 CONCLUSION

Comparison of the Local Economic Activities Baseline and estimated Negative Impact with the estimated impact of the operational phase of the proposed Chapudi Project (2013 prices).

<table>
<tr><th colspan="8">Baseline Local Economic Activities and Impact of Mining</th></tr>
<tr><th colspan="8">Annual Current Activities and Impact of the Mining Activities</th></tr>
<tr><th colspan="2"></th><th>Base Line</th><th>Impact</th><th colspan="2"></th><th>Base Line</th><th>Impact</th></tr>
<tr><td rowspan="3">GDP (R mil)</td><td>Direct</td><td>90.98</td><td>-43.27</td><td rowspan="3">Employment</td><td>Direct</td><td>898</td><td>-412</td></tr>
<tr><td>Indirect/Induced</td><td>90.14</td><td>-43.28</td><td>Indirect/Induced</td><td>452</td><td>-234</td></tr>
<tr><td>Total</td><td>181.12</td><td>-86.66</td><td>Total</td><td>1 350</td><td>-646</td></tr>
<tr><th colspan="8">Mining Operational Phase – Annual Impact Limpopo Province</th></tr>
<tr><td rowspan="3">GDP (R mil)</td><td>Direct</td><td colspan="2">10 517</td><td rowspan="3">Employment</td><td>Direct</td><td colspan="2">1 834</td></tr>
<tr><td>Indirect/Induced</td><td colspan="2">3 845</td><td>Indirect/Induced</td><td colspan="2">12 638</td></tr>
<tr><td>Total</td><td colspan="2">14 362</td><td>Total</td><td colspan="2">14 472</td></tr>
</table>

From the above table it appears that the current local economic activities in the defined project area contribute R181.12 million in total GDP and sustain 1 350 total employment opportunities of which 898 are direct. The mine activity will cost the local economic activities in the project area R 86.66 million in GDP and 646 employment opportunities, of which 412 will be direct.

The project will offer 1 834 direct employment opportunities compensating for the loss of 412 jobs in the project area. It is, however, in the rest of the province where the project will create many more jobs than the current activities namely 12 638 versus 452.

From the above and the rest of the analysis it appears that the proposed mining project will be an economic viable entity which will add value to the province. This will, however, take place at the expense of some of the current local economic activities, especially the game with ecology included, however, proper mitigation and even compensation must be part of the final solution. The investment the owner has made to a property can be negatively impacted if the hunting and accommodation facilities on the property are not fully utilised because of a down turn in visitors resulting from the mining activities.

The possible threat to the irrigators of ground- and surface water being contaminated is of utmost importance and possible mitigation will have to be put in place. In this respect the irrigators further to the north along the Sand River and outside of the project area should be included.

Probably the two most important benefits to the national economy are:

- The annual impact on the "Fiscus" with an annual tax contribution of R 6 960 million expressed in 2013 prices.
- The second impact is the favourable annual impact on the "Balance of Payments "amounting to R 10 827 million, if expressed in 2013 prices.

8 LIST OF SIGNIFICANT IMPACTS AND PROPOSED MITIGATORY MEASURES

The lists of significant environmental and socio-economic impacts are provided in Table 49 and Table 50 respectively, together with the proposed mitigation measures to prevent and/or reduce these impacts.

8.1 CONSIDERATION OF CONCERNS RAISED BY STAKEHOLDERS

The main comments raised by the stakeholders included the following aspects:

- Water scarcity / availability for mining
- Surface and groundwater impacts (quantity & quality)
- Wetlands and springs (fountains)
- Ecological impact (destruction)
- Biodiversity and Sensitive Areas
- Protected areas
- Conservation value and initiatives of the area
- Cumulative impacts
- Heritage and Cultural Resources
- Sensitivity of Graves / Consultation with next of kin
- Noise and dust pollution
- Visual and aesthetic value of the area
- Sense of place
- Impacts on existing land use, intensive irrigation, winter vegetable basket of SA, hunting and eco-tourism
- Land value, compensation
- Impact on Property Values of neighbouring properties
- Consultation process
- Phasing of project (schedule of larger GSP) Sustainability of land use options in the short and long term
- Potential selling of rights –EMP commitments
- Potential changes in social structure and character of the area, due to the influx of work-seekers and illegal immigrants to the area
- Labour and accommodation (squatting)
- Job creation, procurement opportunities
- Equity / Community ownership in project
- Finalisation of land claim validation process
- Safety and Security

These concerns were addressed as far as possible in the specialist studies and included in this report. In addition, the following alternative options were proposed by stakeholders during the various engagement sessions and will be investigated further during the Feasibility Phase of the project:

- Diversion of R523 to allow mining of the Chapudi West Section:
  - Diversion to the north, from the Alldays road.
  - Upgrading of old road along the mountain to the south of the MRA area.
- Mining layout:
  - Combining the Wildebeesthoek and Chapudi Sections, utilizing the same mining and processing infrastructure.
  - Repositioning of the stockpiles and infrastructure at Wildebeesthoek to avoid the Mutamba River and associated wetland areas.
- Consideration of creating a Community Trust Fund for all potentially impacted landowners and farm workers as a compensation mechanism.
- Preferential lease back agreements with landowners in the case of land purchase.

Table 49: List of all potential environmental impacts for the Chapudi Project with proposed mitigation measures

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
All activities	**Biodiversity / Land Use & Capability**	Surface disturbance of approximately 7,600 hectares for the purpose of mining and infrastructure development over the LOM will lead to impacts on the soil, land use and land capability, natural vegetation and fauna	• Development and implementation of a detailed Mine Rehabilitation and Reclamation Plan during the Feasibility Phase. • Concurrent rehabilitation and levelling of opencast pits in line with the Mine Rehabilitation and Reclamation Plan. • Monitoring, auditing and regular review (if required) of the Mine Rehabilitation and Reclamation Plan. • Rehabilitation of infrastructure and other disturbed areas post-mining. • Implementation of Flora Rescue and Relocation Plan prior to any surface disturbances. • Develop species rescue, relocation and re-introduction plan (fauna) with the assistance of specialists in this field. • Develop and implement Biodiversity Action Plan, including avifaunal plan. • Fencing of designated mining and infrastructure areas. • Implementation of biodiversity monitoring. • Close collaboration with the Vhembe Biosphere Reserve in respect of final end land use and sustainable mining. • Participation on a collaborative approach for the development of a Regional Strategic Environmental Impact Assessment (SEIA).
All activities	**Waste management**	Poor waste management could lead to environmental impacts	• Implementation and regular review of Waste Management Procedure. • Appoint an approved, registered waste contractor to manage the waste generation and safe disposal thereof. • No waste will be disposed of or buried on site, or in any other location that is not a licensed waste disposal site.
		Poor sewage management could impact on water resources	• Sewage effluent will be treated to General Standards and pumped to the Infrastructure Area storage dams for re-use in the process. No effluent will be discharged to the environment.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
All activities	**Bulk water**	Impact on water stressed catchment - fully allocated	• The bulk water source will be determined during the Feasibility Phase, followed by a detail EIA for the selected option. • Design closed system to ensure optimal recycling of water and minimise water requirements for the mine. • Installation of filter presses to increase water recovery in the process plant.

All activities	**Bulk electricity**	Further impact on over-allocated electricity reticulation system	• Energy efficient designs such as:
			  ○ High efficiency motors in plant and workshops
			  ○ Power Factor Correction
			  ○ Use VSDs
			  ○ Use solar power where possible
			  ○ Install solar geysers at change houses\Optimal building design to make use of ambient light
			• Energy Policy must govern energy efficient designs such as: power factor correction; lighting designs; cooking and heating - avoid electricity use gas; process efficiency; high efficiency motors; low loss transformers; green building designs; use of solar and heat pumps for water heating.
			• Implement Energy Management Plan.
			• Monitor and record energy usage on site. Ongoing improvement in energy consumption should form part of the mine's KPIs.

All activities	**Heritage resources**	Destruction of heritage & cultural resources as a result of mining and associated infrastructure (including linear activities)	• A Heritage Management Plan will be developed during the Feasibility Phase once the mining and infrastructure designs and footprints have been finalised. • Implementation of Heritage Management Plan dealing with the Phase 1B&2 assessments as well as the relocation of burial sites. • National Heritage and Cultural issues will be included in the environmental awareness programme. • Regular monitoring of off-site heritage resources of importance.
All activities	**Sense of place**	Impact on conservation value of the region	• Identify and implement biodiversity offset programmes in conjunction with the IAPs and authorities, including the Vhembe Biosphere Reserve. • Close collaboration with the Vhembe Biosphere Reserve in respect of final end land use and sustainable mining. • Participation on a collaborative approach for the development of a

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
			Regional Strategic Environmental Impact Assessment (SEIA). • Implementation of environmental monitoring programme. • Develop environmental awareness & educational programmes. • Environmental auditing and reporting.
Opencast mining	**Soils / Land Use & Capability**	Potential hard setting of soils post-reclamation	• Soil analyses and amelioration during reclamation.
		Subsidence of rehabilitated areas	• Free-draining profile (as far as practically possible) for rehabilitated areas and ongoing monitoring.
Opencast mining	**Surface water**	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff	• Optimisation of the storm water management plan and positioning of mining pits during the Feasibility Phase. • Diversion of non-perennial streams around opencast areas to minimise decrease in surface runoff. • Rehabilitation concurrent to mining – limit dirty footprint.
		Impact on 1:100 year flood-line of the Sand and Mutamba Rivers	• Revise mining and infrastructure footprints during the Feasibility Phase to avoid 1:100 flood-lines of the major drainage lines, plus a 100m buffer zone.
		Impact on wetland areas and aquatic ecosystems	• Maintain a buffer zone of 100 m from the 1:100 year flood-line of major drainage lines to reduce impact on aquatic systems. • Reposition surface infrastructure and stockpiles to avoid drainage lines and sensitive wetlands systems. • Implement aquatic (bio) monitoring. • Create small impoundments at head of stream diversions to limit erosion. This could potentially become artificial wetlands over time. • Identify and implement biodiversity offset programmes (including wetland offsets) in conjunction with the IAPs and authorities, including the Vhembe Biosphere Reserve.
		Increased sedimentation into the river systems due to uncontrolled surface run-of	• Design and install appropriate outlet structures to retard flow velocity. • Construction of energy dissipating structures along steep slopes. • Side slopes of earth berms / canals to be designed to 1:3 and protected & vegetated to prevent erosion.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
		Potential impact on in-stream habitat and riverine vegetation as a result of decrease in runoff	• Implementation of monitoring programme for early detection of impacts (plant moisture stress monitoring). • Diversion of clean storm water runoff around opencast areas to minimise impact of flow within the Sand and Mutamba River catchments.
		Impact of long-term decant on water quality	• Investigate appropriate management measures over the LOM.
Opencast mining	**Groundwater**	Dewatering of aquifer as a result of mining, resulting in drying up of boreholes and springs	• Revision and phasing in of mining schedules during the Feasibility Phase on a regional basis to reduce the radius of influence. The groundwater flow model will be utilized during this exercise to obtain the most feasible option from a groundwater impact perspective. • Implementation of baseline monitoring programme on farms that are potentially impacted once the mining and infrastructure feasibility studies have been completed. • Provide alternative water sources where appropriate. • Compensation mechanisms need to be developed and agreed with impacted landowners to compensate those who are impacted upon.
		Impact on surrounding vegetation as a result of dewatering and subsequent recovery	• Ongoing monitoring of fountains and springs. • Implementation of monitoring programme for early detection of impacts (plant moisture stress monitoring). • Diversion of clean storm water runoff around opencast areas to minimise impact of flow within the Sand and Mutamba River catchments.
		Decrease in regional water quality due to seepage from rehabilitated pits	• Potential acid generating horizons will be placed at bottom of pit and submerged below the water table, thereby preventing oxidation. • Rehabilitation will be concurrent with mining, minimising the potential for oxidation of sulphide bearing rocks and controlling the migration of high sulphate leachate. • Exposed residue material will be minimised by direct placement of overburden and topsoil. • Vegetation will be re-established as soon as possible after topsoiling to minimise infiltration of water through residue material. • Implementation of baseline monitoring programme to detect any seepage. • Compensation mechanism to compensate landowners who are impacted

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
			upon.
		Mixing of fresh and saline aquifers due to the disturbance of aquitards during mining	• Grout off saline aquifers
		Migration of pollution plume after full recovery of groundwater levels (prior to decant)	• Investigate appropriate management measures over the LOM. • Groundwater and geochemical models must be updated on a regular basis (every 5 years) to verify potential for decant.
Opencast mining	**Air Quality**	Dust impact caused by vehicle movement	• Application of dust suppression measures (surface surfactants) such as Dustex. • Reduce vehicle speed on unpaved roads to limit dust creation.
		Dust impact caused by blasting activities	• Develop Blasting Procedure to minimise impacts.
		Dust impact caused by materials handling	• Reduction of drop height to reduce the dispersion of materials being transferred, and increase in moisture content (water sprays). • Creation of wind breaks in close proximity to storage piles to reduce the potential erosive forces of the wind.
		Methane emissions leading to air quality impacts	• Ongoing methane monitoring if required.
Opencast mining	**Noise**	Elevated noise levels caused by mining operation, dewatering (pumping) and blasting activities	• Noise attenuation berms (topsoil) on footprint of opencast areas. • Noise suppression devices on heavy vehicles and all noisy plant. • Alternative reverse hooting systems will be implemented to reduce the noise levels. • Low noise generator sets will be used in pit. • Develop air blast control measures. • Blasting limited on regular times, restricted to 08:00-18:00. • All plant, equipment and vehicles to be kept in good repair. • Employees / contractors working in areas where the 8-hour ambient noise levels exceed 85dBA shall wear ear protection equipment.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
Opencast mining	**Visual / Aesthetics**	The mining will have a negative on the aesthetics / sense of place	• Berms on footprint of opencast areas to be protected and vegetated to reduce the visual impact. • Avoid the unnecessary removal of vegetation during the operational phase. • Rehabilitation and revegetation will be performed concurrent to mining. • Introduce trees to the landscape at strategic locations (sensitive receptors) to break full exposure of the mine. Further analyses and stakeholder engagement will be required for this commitment.
Opencast mining	**Blasting**	Impact on the communities and sensitive receptors as a result of blasting	• Develop and implement Blasting Procedure as well as an Evacuation Procedure.
Processing plant / infrastructure areas	**Soils / Land Use & Capability**	Soil impacts as a result of poor hydrocarbon management and spillages	• Develop and implement hydrocarbon management procedure. • Reclamation of soils in the event of accidental spillages.
		Surface disturbance caused by infrastructure	• Dismantling of infrastructure. • Final rehabilitation of disturbed areas. • Rehabilitation of dams and storm water drainage.
Processing plant / infrastructure areas	**Surface water**	Water quantity impact due to decreased surface runoff	• Optimisation of the storm water management plan and positioning of infrastructure during the Feasibility Phase. • Separation of clean and dirty water systems (stream diversions) to minimise impact on runoff.
		Water quality impact on Sand and Mutamba Rivers	• Directing and containment of dirty water runoff in dirty water dams and providing silt traps. • Recycling (reuse) of dirty water in process. • The dirty water dam will be designed for the 1:50 year flood-event and HDPE lined to prevent discharges / seepage into the surface water resources.
		Water quality impacts as a result of poor hydrocarbon management and spillages	• Develop and implement hydrocarbon management procedure. • Bulk facilities to be concrete lined and bunded to capacity of 110%.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
		Impact on wetland areas and aquatic ecosystems	• Maintain a buffer zone of 100 m from the 1:100 year flood-line of major drainage lines to reduce impact on aquatic systems. • Reposition surface infrastructure to avoid drainage lines and sensitive wetlands systems (e.g. Chapudi Section processing plant on Blackstone Edge/Woodlands). • Implement aquatic (bio) monitoring.
Processing plant / infrastructure areas	**Groundwater**	Water quality impacts due to infiltration of dirty water from the plant and infrastructure areas	• Dirty water dams to be plastic (HDPE) lined to prevent groundwater contamination. • Carbonaceous plant stockpile areas to be appropriately lined with dedicated dirty water drainage from the stockpile to prevent groundwater contamination. • Dirty water canals in the infrastructure areas to be concrete lined to prevent groundwater contamination.
Processing plant / infrastructure areas	**Air quality**	Air quality impacts associated with processing activities and movement of vehicles	• Reduction of drop height to reduce the dispersion of materials being transferred, and increase in moisture content (water sprays). • Plant and access roads to be surfaced or treated with dust palliatives such as Dustex.
		Dust impact caused by crushing and screening operations	• Introduce dust suppression systems, either in the form of water sprays or cladding in order to reduce the potential emissions. • Reduce vehicle speed on unpaved roads to limit dust creation.
Processing plant / infrastructure areas	**Noise**	Elevated noise levels caused by crushing and processing activities	• Rubber vulcanised belt – less noisy / vibration. • Cladding of crushing and screening plants and noisy equipment – encapsulation in buildings, acoustic covers, screens or sheds. • Noise suppression devices on heavy vehicles / crushing equipment. • Low noise generator sets will be used in plant. • Employees / contractors working in areas where the 8-hour ambient noise levels exceed 85dBA shall wear ear protection equipment.
Processing plant / infrastructure area	**Visual / aesthetics**	Processing plant will have a visual impact as a result of high buildings	• Avoid the use of highly reflective material in construction. • Metal surfaces should be painted in natural soft colours (Aloe Green) that would blend in with the environment.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
Processing plant / infrastructure areas	**Lighting**	Sky glow effect will have an impact on the sense of place at night	• Use specifically designed lighting equipment that minimises the upward spread of light near to and above the horizontal. Care should be taken when selecting luminaries to ensure that appropriate units are chosen and that their location will reduce spill light and glare to a minimum. • Keep glare to a minimum by ensuring that the main beam angle of all lights directed towards any potential observer is not more than 70°. Higher mounting heights allow lower main beam angles, which can assist in reducing glare. In areas with low ambient lighting levels, glare can be very obtrusive and extra care should be taken when positioning and aiming lighting equipment. • Covering of high lighting masts to reduce the glow. • Suppress dust forming to minimise the effect of sky glow during night.
		Impact on invertebrates	• Long-wavelength light sources should be used, e.g. low-pressure sodium vapour lights.
On-site conveyance of ROM and product	**Air Quality**	On-site conveyance will increase the ambient air quality	• Application of dust suppression (Dustex) on internal haul roads. • Surfacing of access road and main haul roads. • Water sprays at stockpiles and transfer points. • Water misters will be installed at strategic points at the transfer points along the conveyor in order to abate dust emission. • Vehicle speed on unpaved roads limited to prevent dust creation. • Conveyor design to include 'dogsheeting' on top and along the prevailing wind direction sides to minimise dust generation. • Use of appropriate plant operation and material handling techniques, good maintenance and housekeeping. Therefore the implement measures to minimise the generation and dispersion of dust and surface disturbances. • Employ latest technology to reduce vehicle exhaust gas emissions.
On-site conveyance of ROM and product	**Surface water**	Stream crossings (road and conveyor) could potentially impact on the stream flow and lead to stream flow reductions downstream	• Design crossings for 1:20 year flood to minimise effect of damming of water upstream. No permanent retention of water in river at crossings. • Avoid sensitive wetland systems as far as possible.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
		Spillages along conveyors/roads could impact on water quality	• Regular inspections will be implemented for early detection of spillages. Cleaning up of any spillages that may have occurred. • All conveyors to be fully enclosed for zero spillage over all stream crossings. • Conveyors covered to deflect rain water away from conveyor belt. • Installation of primary and secondary scrapers ensures that there is continuous contact between the scrapers and the belt which will prevent spillages on the return belt.
On-site conveyance of ROM and product	**Noise**	Elevated noise levels caused by trucking and conveying activities	• Rubber vulcanised belt – less noisy / vibration. • Maintenance of vehicles. • All equipment selection to fall in line with permissible noise dBA. • During the selection of the main components and equipment of the proposed undertaking as a whole, installation of alternative low-noise generating makes and models will be considered. • Noise suppression devices on heavy vehicles / conveying equipment.
On-site conveyance of ROM and product	**Soils / Land Use & Capability**	Surface disturbance caused by infrastructure	• Dismantling of infrastructure. • Final rehabilitation of disturbed areas and storm water drainage.
Mine residue stockpiles	**Groundwater**	Impact of carbonaceous stockpiles on groundwater resources	• Carbonaceous stockpiles to be appropriately lined with a sub-surface drainage system. • Stockpiles to be compacted, properly capped and revegetated to reduce recharge. • Stockpiles slopes to be designed such to increase runoff whilst preventing erosion. • Carbonaceous stockpiles to be disposed in-pit as far as possible at closure to minimise final footprint of surface carbonaceous stockpiles.
Mine residue stockpiles	**Surface water**	Impact on non-perennial streams cutting through mining areas leading to decrease in runoff	• Optimisation of the storm water management plan and re-positioning of stockpiles during the Feasibility Phase. • Diversion of non-perennial streams around stockpile areas to minimise decrease in surface runoff.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
		Impact on wetland areas and aquatic ecosystems	• Maintain a buffer zone of 100 m from the 1:100 year flood-line of major drainage lines to reduce impact on aquatic systems. • Reposition stockpiles to avoid drainage lines and sensitive wetlands systems. • Implement aquatic (bio) monitoring.
		Increased sedimentation in drainage lines due to uncontrolled surface run-off and erosion	• Side slopes of stockpiles to be protected and vegetated to prevent erosion. • Construction of energy dissipating structures along steep slopes.
		Water quality impacts as a result of dirty water runoff / seepage from carbonaceous stockpiles	• Dirty water / seepage to be collected in lined facility and recycled to dirty water dams for use in process.
Mine residue stockpiles	**Visual / Aesthetics**	Large stockpiles will impact on the landscape	• In-pit disposal as far as possible. • Stockpiles to be protected and vegetated to reduce visual impact. • Landscaping of stockpiles to minimise impact – avoid straight lines and design contoured stockpiles that represent the natural lines of the existing topography.
Mine residue stockpiles	**Air quality**	Increase dust emissions as a result of stockpiles	• Compaction by heavy vehicles used for stockpile operations. • Stockpiles to be vegetated to reduce dust emissions.
Mine residue stockpiles	**Noise**	Noise from stockpile construction leading to the main contributing factors to the noise at the sensitive receptors, especially at night-time	• Noise suppression devices on heavy vehicles and other noisy equipment. • Alternative reverse hooting systems will be implemented to reduce the noise levels.
Rail link to main TFR railway line	**Safety**	Road / rail crossings could lead to safety risks to road users	• Appropriate crossings (under or over-passes) will be designed to eliminate the safety risks. • The rail link will be fenced off to prevent people and animals from going onto or across the railway line.
Rail link to main TFR railway line	**Surface water**	Stream crossings where culverts may concentrate flow, leading to enhanced flow velocities and associated erosion problems	• Design crossings according to TFR standards – design flow rate 1:50 year flood event – to minimise effect of damming of water upstream. No permanent retention of water in river at crossings. • Construct the necessary erosion control measures at these crossings to reduce the impact.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
			• Avoid sensitive wetland systems as far as possible.
Rail link to main TFR railway line	**Surface water**	Potential for water quality impacts due to dirty runoff and spillages along the rail link	• Regular inspections will be implemented for early detection of spillages. Cleaning up of any spillages that may have occurred.
Rail link to main TFR railway line	**Noise**	Increase of ambient noise levels along the rail route	• Rail line to be flush-welded to reduce noise. • Diesel locomotives to operate at slower speed along the rail link. • Noise attenuation berms should be constructed at sensitive receptors closest to the rail link in cooperation with the landowners.
Rail link to main TFR railway line	**Air quality**	Increase of dust emissions along the rail link	• Dust fallout monitoring points will be established along the rail link to detect an increase in emissions. • Regular inspections will be done along the rail route to detect and clean any spillages that could lead to increased dust levels. • Use of low sulphur grade fuels.
Rail link to main TFR railway line	**Biodiversity**	Land units will be divided into smaller units which may not be ecologically viable	• Align rail link with existing disturbed corridors, i.e. roads, fence lines. This will be finalised during the Feasibility Phase. • Animal crossings (underpasses or level-crossings with cattle grid) will be created along the rail link for animals and domestic livestock.
		Potential impact on protected flora species identified along the route	• The rail route will be diverted to prevent impact to specific protected species, e.g. baobabs, impala lilies. • Where possible, the species that cannot be avoided will be rescued and relocated as per the Rescue & Relocation Plan.
		Creation of additional corridors which could lead to increased poaching	• Fencing (game fence) of the rail link for safety and access control.
		Killing of animals crossing the rail line	• The rail link will be fenced off to prevent animals from going onto the track. • Animal crossings (underpasses or level-crossings with cattle grid) will be created along the rail link for animals and domestic livestock.
Off-site conveyance of product by truck (in	**Safety**	Road transport of product will impact on the traffic along the route, safety risk to road users	• Implementation of Community Safety and Traffic Management Procedure, including: ○ Upgrading of road intersections. ○ Other traffic calming measures identified during the LOM.

Activity	Environmental Aspect	Potential Impact	Mitigation Measures
emergencies)			○ Maintaining vehicle speeds. ○ Covering of vehicles when in motion, both for loaded and unloaded vehicles. ○ Switching on head lights of trucks. • Due notification to the surrounding landowners and communities in the event of emergency trucking. • Implement a Traffic Awareness Programme within the surrounding communities.
Off-site conveyance of product by truck (in emergencies)	**Biodiversity**	Killing of animals and avifauna on the roads, especially nocturnal animals/birds	• Maintaining vehicle speeds. • Trucking during daylight hours only. • Implement an Environmental Awareness Programme for trucking contractor.
Off-site conveyance of product by truck (in emergencies)	**Surface water**	Potential for water quality impacts due to spillages and dirty runoff into the streams	• Regular inspections will be done along the route to detect and clean any spillages from the trucks. • Emergency procedure to be developed and implemented in the event of any spillage / accident along the route. • Covering of vehicles when in motion, both for loaded and unloaded vehicles.
Off-site conveyance of product by truck (in emergencies)	**Air quality**	Material and product loss from trucks	• Gravel roads to be surfaced or treated with dust palliatives such as Dustex. • Covering of vehicles when in motion, both for loaded and unloaded vehicles. • Regular inspections will be done along the route to detect and clean any spillages from the trucks.
Off-site conveyance of product by truck (in emergencies)	**Noise**	Increase of ambient noise levels along the route	• Noise suppression devices on transport trucks. • Trucking during daylight hours only.

Table 50: List of all potential socio-economic impacts for the Chapudi Project with proposed mitigation measures

Social Aspect	Potential Impact	Proposed Mitigation measures
Demographic and Population Impacts	Influx of work seekers into the area	• Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally. • Development and Implementation of an Influx and Land Use Management Plan. • Develop a code of conduct with which contractors and their employees must comply. The code should deal with the interaction with local communities and substance abuse among other things. • Develop a Stakeholder Engagement Plan (SEP) which clarifies the principles of engagement with community and other stakeholders, sets in place appropriate liaison forums (a community forum is recommended), and describes the grievance management procedure to be adopted by the Chapudi Project. Establishment of a local labour recruitment committee to monitor recruitment procedures and results. • Communicate through media the recruitment procedures and priorities to discourage work seekers from outside the area.
Demographic and Population Impacts	Influx of construction labour with pressure on services and social structures	• Facilitate the provision of housing and associated infrastructure. Establishment of a construction accommodation camp to house those employees that cannot be sourced from the local community due to a lack of skills. • Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally. • Development and Implementation of an Influx and Land Use Management Plan. • Develop a code of conduct with which contractors and their employees must comply. The code should deal with the interaction with local communities and substance abuse among other things. • Develop a Stakeholder Engagement Plan (SEP) which clarifies the principles of engagement with community and other stakeholders, sets in place appropriate liaison forums (a community forum is recommended), and describes the grievance management procedure to be adopted by the Chapudi Project. Establishment of a local labour recruitment committee to monitor recruitment procedures and results. • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Implementation of a programme of STD and HIV/AIDS screening, counselling and (where possible) treatment.

Social Aspect	Potential Impact	Proposed Mitigation measures
Demographic and Population Impacts	Influx of operational workforce with pressure on services and social structures	• Contribution towards the provision of housing, infrastructure and services for operational staff. • The establishment of partnerships with other private sector stakeholders, government authorities and civil society organisations to integrate planning around the provision of services and infrastructure, and to ensure that Mine inputs in this context compliment initiatives led by other players, especially the local and district municipality. • Development and Implementation of an Influx and Land Use Management Plan. • Optimise the use of local labour as far as possible. Establishing early on skills development programmes in the local area will support to possibility of finding skilled people locally. • Induction of contractors and workforce with regard to their code of conduct in the local communities. • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Implementation of a programme of STD and HIV/AIDS screening, counselling and (where possible) treatment. • Continuous assessment and monitoring of infrastructure and services capacity in focal points (assessment every 5 years). • Determine scale of assistance required at focal points and enter into an agreement with the municipality. • Establish a development, infrastructure and service monitoring forum with the municipality to continuously assess and monitor capacity, determine assistance required and oversee implementation.

Social Aspect	Potential Impact	Proposed Mitigation measures
Demographic and Population Impacts	Influx of people and the development of spontaneous settlements near project facilities, in the Waterpoort Town and surrounding areas	• Develop a Community Development Plan which addresses issues relating to provision of housing for the workforce through on-going communication and engagement between the mine and local authorities for implementation of this plan. • Develop and adoption of an Influx Management Plan in consultation with the local government that outlines proactive management measures to discourage and manage influx, outlines and refines relevant stakeholders and their roles and responsibilities and the way in which each role-player intends to manage influx and spontaneous settlements. • Support the compilation of a development master plan, in cooperation with relevant local and regional authorities for the Musina and Makhado areas, whereby new development areas for workers' and new arrivals' accommodation will be catered for and duly planned. • Support local government capacity for integrated development planning. • Develop and communicate a clear and concise employment and recruitment policy to prevent opportunistic job seekers from settling in the area. • Continuous assessment and monitoring of infrastructure and services capacity in focal points (assessment every 5 years). • Determine scale of assistance required at focal points and enter into an agreement with the municipality. • Establish a development, infrastructure and service monitoring forum with the municipality to continuously assess and monitor capacity, determine assistance required and oversee implementation.
Demographic and Population Impacts	Conflicts arising at the end of construction due to the termination of job opportunities for contractors	• Investigate the possibility of transferring labour from one operation to another – depending on the phasing of the projects. • Develop the MbeuYashu grievance procedure to capture and address grievances arising due to retrenchments and downscaling. • Ensure compliance with all applicable Labour Regulations of South Africa. • Consider compliance with Best Practice , i.e. IFC's Performance Standard 2 "Labour and Working Conditions". • Monitoring of all contractors and sub-contractors for compliance with the above standards, with contractually-established financial sanctions for observed non-compliances. • Communicate the termination conditions to the communication structure established. • Communicate the termination conditions to all employees – including contractors and sub-contractors.

Social Aspect	Potential Impact	Proposed Mitigation measures
Health and Social Wellbeing	Increased chances of the spread of communicable diseases such as HIV/AIDS and STDs linked to influx of predominantly male job-seekers and workers	• Develop a comprehensive HIV/AIDS and STD program to employees through employee wellness programmes which should include prevention, voluntary counselling for HIV testing, as well as anti-retroviral treatment for employees. • Develop a Community Health Action Plan which focuses on HIV/AIDS, tuberculosis. • Repeated awareness campaigns that is focused beyond employees and includes contractors and the communities near project facilities.
Health and Social Wellbeing	Safety and Risk Exposure through an increase in crime	• Increased security on mine premises. • Construction and permanent workers are identified and marked with clear identifiable clothing. • Code of Conduct to form part of induction of new workers with a clear statement and procedure regarding access, conduct and identification. All construction workers should wear clothing marked (and reflective vests) with the logo of the construction firm/contractor or sub-contractor as well as identification cards that cannot be easily forged, so that they can be easily recognized as being legitimate. • Workers to be screened including criminal background checks. • Properly constructed and secured fences can control access to construction sites. Implementing strict access control of the project site and specifically the contractors' workforce camp. • Workers should be urged to recognize and report suspicious activity and signs of burglary and be informed of crime prevention measures that they themselves can take. • Employment of local people on the mine to improve the poverty levels in the host and neighbouring communities. • MbeuYashu to liaise with existing community policing forums and project security to properly secure the project area and surrounding area. • Investigate the implementation of an anti-poaching unit in collaboration with local stakeholders, policing forums and police.

Social Aspect	Potential Impact	Proposed Mitigation measures
Health and Social Wellbeing	Safety and Risk Exposure due to an increase in poaching on neighbouring game farming properties	• Establishment of an anti-poaching unit available to adjacent land owners, and establishing a security forum in collaboration with these land owners. Land owners are to be actively involved in the selection of the contracting company employed to conduct anti-poaching in the area. • Increased security measures (fencing, access control and monitoring) on mine premises. Properly constructed and secured fences can control access to construction sites. Implementing strict access control of the project site and the contractors' workforce camp. Curfew times to be established in accommodation areas. Construction workers accommodated on mine are identified and marked with clear identifiable clothing. • Code of Conduct to form part of induction of new workers with a clear statement and procedure regarding access, conduct and identification. All construction workers should wear clothing marked (and reflective vests) with the logo of the construction firm/contractor or sub-contractor as well as identification cards that cannot be easily forged, so that they can be easily recognized as being legitimate. • Workers to be screened including criminal background checks. • Employment of local people on the mine to improve the poverty levels in the local communities.
Quality of Living Environment	Change in "sense of place"	• Regular and effective engagement with stakeholders through the SEP. • An effective grievance management procedure managed within the framework of the SEP. Grievance mechanisms must be in place throughout the life of the mine, including for a determined period post-closure, to address any impact for affected communities. • Implementation of traffic management measures. • Implementation of mitigation measures for noise. • Implementation of visual barriers and other mitigation measures as recommended in the visual study. • Colour schemes must complement the local environment. • Minimising disturbance to vegetated areas outside the critical development areas where possible. • Revegetation/rehabilitation of disturbed sites in parallel with development. • Successful mitigation interventions can reduce the intensity of the impact to at least moderate and ultimately moderate-low levels. If grievances are addressed adequately, and communication and engagement is effective affected communities may be able to adjust more easily to the changes.

Social Aspect	Potential Impact	Proposed Mitigation measures
Quality of Living Environment	Disruption of Social Networks and decrease in Social Capital	• Employment of local people already part of the community. • Code of conduct to form part of induction for all new workers. • Grievance Procedure within the local communities.
Quality of Living Environment	Perceptions of and Feelings in relation to the project	• Establish on-going Consultative Forums with concerned groups to air concerns, find possible mitigation measures for their perceived impacts, solutions to co-existence and monitor implementation and effectiveness of mitigation measures. • Continuous communication with all stakeholders providing information on anticipated impacts and planned mitigation measures.
Family and Community Impacts	Impacts on land owner and labourers	• Development of a land acquisition and lease policy defining the negotiation process to minimize the feelings of uncertainty. • Financial compensation of affected property owners/tenants, employees and their families in terms of the relevant legislation. • Displacement of workers and their dependents requires an equitable policy, principles, financial guidelines and clarification of operational approaches. • Land Acquisition, lease and compensation agreements reached with affected landowners that include arrangements and measures for labour tenants.
Family and Community Impacts	Change processes and impacts related to daily movement patterns	• The project description defines that no hauling will take place along existing farm roads or regional / national roads. It is planned that the run-of-mine (ROM) coal will be transported for short distances by truck, on the in-pit haul roads to the crushing and screening facilities. The crushed and screened ROM product will be transported to the coal beneficiation plant via conveyor. It is further planned that the product will be loaded directly onto trains at the Rail Load-out Terminal which links up with the existing Musina-Makhado railway line. • Therefore only supplier light-vehicles and employee busses will disrupt movement patterns, these will stabilize once the mine is fully operational.

Social Aspect	Potential Impact	Proposed Mitigation measures
Family and Community Impacts	Conversion of land use	• Acquisition and or leasing of directly impacted land. • Fair compensation negotiated and agreed with land owners that will lose agricultural land. • Continuous consultation with landowners discussing co-existence and feasibility. • Educate landowners in terms of their rights and responsibilities prior to the construction phase. • Assist landowners in identifying ways to adapt their land uses, to the benefit of both the landowner and MbeuYashu. • Implement a consultation programme with regional stakeholders in the development of a closure plan and rehabilitation programme. • Determine the regional needs and characteristics to ensure post mining use of land enhances the regional characteristics.
Institutional/Legal/Political/ Equity Impacts	Challenge to local government capacity	• Intensive engagement between MbeuYashu / CoAL and the municipality well in advance of construction. In this context the responsibilities of local government should be well understood, and potential problems defined and addressed as early as possible. • Establishment of a limited and time-bound municipal support function. MbeuYashu / CoAL should contribute funding and appropriate technical resources. The participation of other major mines and industries in the area should be promoted by both MbeuYashu / CoAL and the local municipality.
Institutional/Legal/Political/ Equity Impacts	Participation and Consultation in process	• Provide transport and/or reimbursement to the Historical Disadvantaged Communities. • During the Operational phase, the structures established for participation should have a proper constitution that addresses reimbursement of costs. • Arrangement of meetings in proximity to the mine or in affected communities to minimize the distance of directly affected parties to travel. Cluster meetings together on the same day or over 2 days to minimize disruption of personal schedules.
Institutional/Legal/Political/ Equity Impacts	Impact equity	• Tax and Profit benefits must be ploughed back into the Local Municipal areas and immediate communities. • Employment should be prioritized to local communities. • Local beneficiation programmes to be investigated and implemented.
Socio-economic Wellbeing	Increase in South African GDP and Trade Balance	• Procure goods and services from South African suppliers as far as possible. • Procure ancillary services for goods procured abroad, such as installation, customisation and maintenance, from South African companies as far as possible.

Social Aspect	Potential Impact	Proposed Mitigation measures
Socio-economic Wellbeing	Increase in provincial and local GDP	• Procure goods and services from local or provincial suppliers as far as possible. • Procure ancillary services for goods purchased from outside of the Limpopo Province, such as installation, customisation and maintenance, from local or provincial companies as far as possible.
Socio-economic Wellbeing	Increase in government revenue	• None
Socio-economic Wellbeing	Increase in employment, income and skills development	• Aim to use local workers as far as possible and formalise this policy in contracts. • Consider implementing labour-intensive rather than capital-intensive work methods wherever possible. • Procure resources from local sources wherever possible. • Establish a database of local people with information on qualifications and skills, utilize this database to develop skills plans and recruit local people. • Implement early on skills development programmes in the areas where most job opportunities will be created, i.e. operators and drivers. • Include training for general life skills such as financial management and health. • Implement portable skills development programmes. • Design and implement economic development programmes that will assist people being retrenched in sustaining their livelihoods. • Establish a future forum with representation from the workforce to discuss potential difficulties and solutions. • Implementation of programmes to minimize and mitigate the impact of downscaling and retrenchment.
Socio-economic Wellbeing	Impact on existing businesses in surrounding areas	• Devise a compensation plan for direct impacts of mining on adjacent farms, such as loss or pollution of land. • Screen mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place and tourists. • Identification of employees that may lose their employment and enrol in skills programme.

Social Aspect	Potential Impact	Proposed Mitigation measures
Socio-economic Wellbeing	Change in property values	• Attempt to minimize impacts through implementation of mitigation strategies focusing on aspects that may affect tourism characteristics including traffic, noise, and visual aspects such as screening mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place. • Establish a baseline of property values by conducting baseline valuations on representative properties and providing such to landowners, thereafter conducting monitoring valuations in periods of 5 years or as may be agreed with landowners. • Establish a communication channel with direct adjacent land owners to address impacts and grievances. • Adopting principles of good corporate citizenship focused on conservation of natural resources such as water, biodiversity, etc. Inclusion of these principles and actions into information disseminated in the local area ("how mining can be done differently").
Socio-economic Wellbeing	Decrease of visitors, tourists and hunting parties	• Attempt to minimize impacts through implementation of mitigation strategies focusing on aspects that may affect tourism characteristics including traffic, noise, and visual aspects such as screening mining activities from the adjacent farms and the main access road to minimize the impact on the general sense of place. • Collaborate with local stakeholders in terms of regional planning to ensure certain areas are protected for tourism and hunting activities. • Adopting principles of good corporate citizenship focused on conservation of natural resources such as water, biodiversity, etc. Inclusion of these principles and actions into information disseminated in the local area ("how mining can be done differently").
Socio-economic Wellbeing	Equity Participation of the Local Communities	• Ensure communities are fully involved and properly represented in the structures. • Ensure capacity is built at an early stage for communities to understand how equity and dividends work. • Place protective measures in place that will shield the communities from any business risk or liabilities.
Socio-economic Wellbeing	Participation of local business in procurement opportunities	• Ensure communities are fully involved and understand the local procurement policy and procedure. • Ensure capacity is built at an early stage through enterprise development to enable local business to participate in opportunities. • Identify local only opportunities that is reserved for local business.
Socio-economic Wellbeing	Decline in South African GDP and Trade Balance at Decommissioning	• None

Social Aspect	Potential Impact	Proposed Mitigation measures
Socio-economic Wellbeing	Decline in provincial and local GDP at decommissioning	• Actively promote the development of different economic sectors from an early stage, e.g. through incentivising other industries to locate in the area, providing adequate infrastructure and promoting an increase and diversity of skills in the local population. • Actively engage with a range of stakeholders throughout the life-of-mine to discuss potential consequences of mine closure and possible mitigation. • Incorporate measures to retrain workers in the Social and Labour Plan.
Socio-economic Wellbeing	Decline in government revenue at Decommissioning	• None
Socio-economic Wellbeing	Decline in employment, income and skills development at decommissioning	• Aim to use local workers as far as possible and formalise this policy in contracts. • Consider implementing labour-intensive rather than capital-intensive work methods wherever possible. • Purchase resources from local sources wherever possible. • Institute training programmes for local workers to raise skills levels. • Include training for general life skills such as financial management and health.
Vulnerable Group Impacts	Gendered Division of labour	• Women must have equal employment opportunities. • Training and skills development for women. • Salaries of women must be equal to that of men. • Establish opportunities that are suitable for women employment. • Implement measures to enable working environment for women. • Establishing gender-sensitive policy positions, such as for cultural heritage, employment and business development. • Mainstreaming gender into project planning, particularly for community development. • Using gender-sensitive indicators, such as employment data disaggregated by gender. • Consultation with national women's organizations.
Vulnerable Group Impacts	Potential Infringements on Historically Disadvantaged People's Human Rights	• Focusing local benefits on those communities previously disadvantaged to ensure upliftment. • Enter into agreements with local communities to address post closure land use and sustainability. • Optimization of local employment to minimize impacts of external or migrant workers on the local communities.

9 STAKEHOLDER ENGAGEMENT

The report on the results of consultation with communities and interested and affected parties (IAPs) is attached as ANNEX-11 (Naledi Development, 2013). This document presents the results of the consultation with landowners, lawful occupants, communities and IAPs in terms of the MPRDA for the Chapudi Project NOMR application. Compliance with other South African legislation will not be done in parallel but will follow a staggered process, which will only commence after compliance with the MPRDA is complete.

The consultation process of the GSP is subject to a newly developed MbeuYashu Stakeholder Policy, whose primary aim is to create sustainable value for all stakeholders, while recognising that stakeholders contribute, create and develop, together with the MbeuYashu's management, the company for its advantage and success. The company seeks to earn its social licence to operate through its engagement processes with its key stakeholders.

This policy was benchmarked against international best practice, and included the principles of inclusivity, mutuality, materiality and open and collaborative engagement. The adherence to ensure compliance has not been compromised through the process.

The following aspects are addressed in the Stakeholder Engagement Policy and are only highlighted here:

- The foundation for the policy is the Company Vision and the Management Commitment to sustainable development and participatory co-operative governance;
- The policy is based on global and local frameworks (compliance with South African legislation), guidelines and standards;
- Changing expectations and the role of business in society;
- Emerging and latest thinking on Stakeholder Engagement theory and practice;
- Changes in cultures and behavior; and
- Reflections, thinking and discussion with internal roleplayers.

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. In so doing, a sense of ownership of the project is vested in both the project proponent and interested or affected parties. The Public Participation Process is aimed at achieving the following:

- Striving for adherence to best practice and international standards;
- Compliance with the MPRDA and its Regulations;
- Encourage involvement and participation in the Environmental Specialist Studies and process for authorization;
- 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 MbeuYashu 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.

The following methodology was utilised:

- Establishment and Maintenance of the IAP Register and Landowner Register (ANNEX-11: Appendix A1).
- Announcement of Project Activities via letters (emailed, faxed, posted and hand-delivered), SMSs, advertisements, and on-site notices (ANNEX-11: Appendix A2, A3 & A4).
- Notification of the availability of Project Documentation such as the Background Information Document, Scoping Report and EIA/EMP Report (ANNEX-11: Appendix A2, A3 & A4).
- Arrangement and Facilitation of Engagement Sessions and Public Meetings (ANNEX-11: Appendix A5) which included Landowners meetings, Landowner structure meetings (i.e. Waterpoort Farmers Association Mining Committee and Vhembe Mineral Resources Stakeholder Forum, Community meetings, Land Claimant meetings and meetings with other IAPs (i.e. Waterpoort Community Development Trust).
- Recording, Considering and Responding to Comments, Issues and Inputs from Interested and Affected Parties (ANNEX-11: Appendix A6 & A7).

The main comments and responses raised throughout the Public Participation Process focused on the following aspects:

- Water scarcity / availability for mining
- Surface & groundwater impacts (quantity & quality)
- Wetlands & springs (fountains)
- Ecological impact (destruction)
- Biodiversity and Sensitive Areas
- Protected areas
- Conservation value and initiatives of the area
- Cumulative impacts
- Heritage and Cultural Resources
- Sensitivity of Graves / Consultation with next of kin
- Noise & dust pollution
- Visual and aesthetic value of the area
- Sense of place
- Impacts on existing land use, intensive irrigation, winter vegetable basket of SA, hunting and eco-tourism
- Land value, compensation
- Impact on Property Values of neighbouring properties
- Consultation process

- Phasing of project (schedule of larger GSP) Sustainability of land use options in the short and long term
- Potential selling of rights –EMP commitments
- Potential changes in social structure and character of the area, due to the influx of work-seekers and illegal immigrants to the area
- Labour and accommodation (squatting)
- Job creation, procurement opportunities
- Equity / Community ownership in project
- Finalisation of land claim validation process
- Safety and Security

10 ADEQUACY OF PREDICTIVE METHODS AND KNOWLEDGE GAPS

10.1 ACCESS CONSTRAINTS

A number of properties (60% of MRA area) could not be accessed for specialist surveys for a number of reasons. In total, only 40% of the MRA area and 43% of the planned mining and infrastructure footprint area could be accessed for specialist surveys as indicated in the figure below.

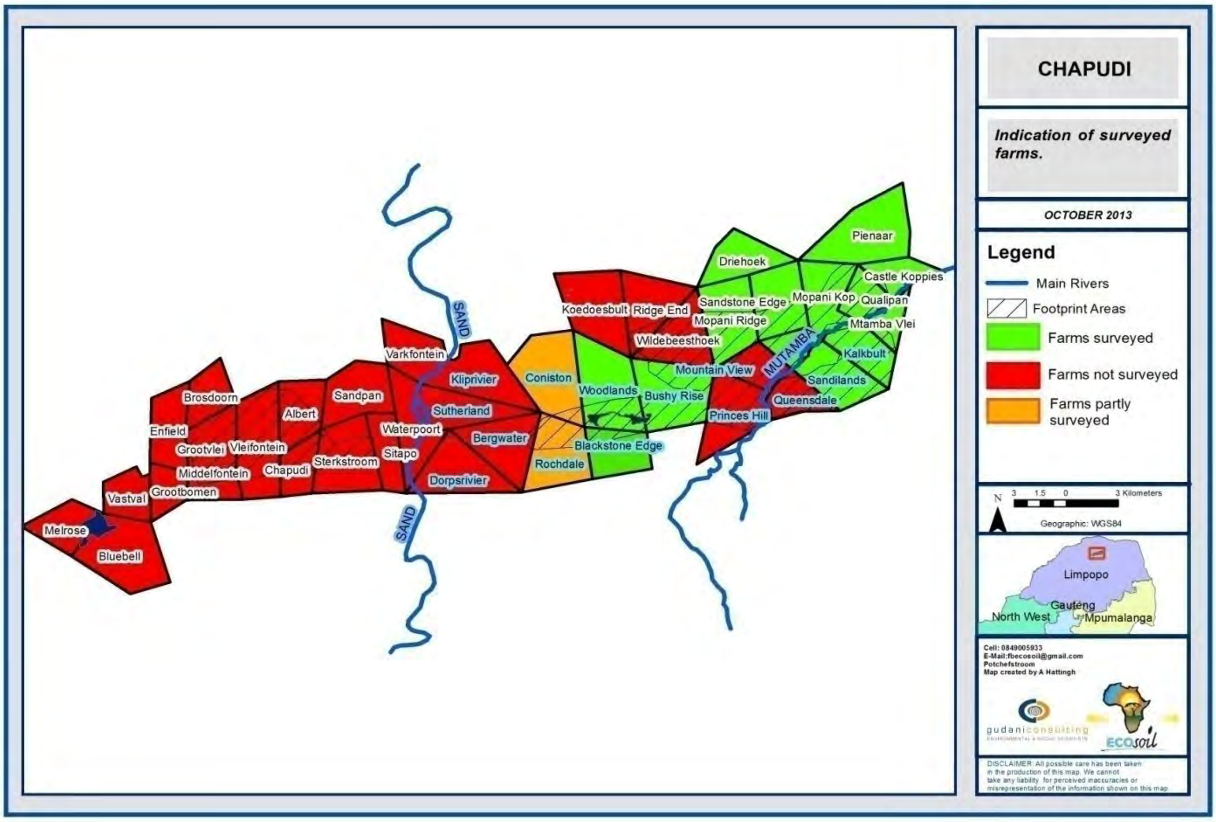


Figure 101: Properties accessed during specialist investigations

10.2 TIME CONSTRAINTS

In order to obtain a comprehensive understanding of the dynamics of the communities and status of the endemic (rare or threatened species in an area), ecological studies should be ideally replicated over several seasons and over a number of years. However, due to time constraints imposed by the MPRDA, such long-term studies are not always feasible and the specialist surveys were only conducted in one season (dry winter season).

Due to the arid climate with a very dry winter, the vegetation is deciduous, with only a few tree species retaining leaves. The herbaceous layer is absent, which limits the effectiveness of conducting vegetation surveys. An early spring (within a few weeks of the first rainfall) and mid to late summer survey is strongly recommended due to the scale of the project. This resulted in numerous constraints to sampling and the effectiveness of a applying a multivariate community analysis as per the terms of reference. Data collected is thus considered to be incomplete at this point in time.

Aquatic, wetland and riparian ecosystems are dynamic and complex. Some aspects of the ecology of these systems, some of which may be important may have been overlooked. The findings of this study were largely based on a single site visit undertaken late in the low flow season at a time when extremely low flows were being experienced. A more reliable assessment would have required that seasonal assessments take place with at least one assessment in the high flow season also undertaken.

It is therefore recommended that further detailed biodiversity surveys be conducted during the Feasibility Phase to determine additional species that may have been omitted and to clarify indeterminate species that may be resolved during their flowering seasons, i.e. early-mid spring (September – November, after first rains) and late summer (March - April). The same applies for the surface water and aquatic surveys in order to collect intermediate-high flow data/events.

10.3 LIMITATIONS ON AVAILABLE DATA AND IMPACT MODELLING

10.3.1 GROUNDWATER FLOW

Although, all available data was collected and utilised to develop the groundwater model, and ensure that the model presents the actual situation as accurately as possible, some limitations can be noted:

- Limited and inaccurate data on actual groundwater usage, hence abstraction estimates are based on hectares observed under irrigation. Registered and claimed water uses do not correlate with observed water use based on lands under irrigation. Since recharge to the area is low, abstraction estimates have a significant impact on water levels.
- Current water levels were only obtained from a local hydrocensus. Due to the cumulative impacts of several mining projects, current water levels need to be obtained over a broad area covering the entire impacted area.
- Data collected in a relatively wet period.
- Aquifer storage data based solely on best estimate and inflows into the bulk sample pit undertaken at Makhado. Similar data is required at the Chapudi Project to calibrate projected inflows.

To further improve the conceptual groundwater model and validate the conclusions made in this report, several items require additional work:

- Monitoring: Establishment of monitoring piezometers near where initial mine workings will commence. Transient state parameters of mining are at present best estimates based on data collected during the box-cut exploration at Makhado. Predictions cannot be calibrated without data collected after mining commences. Water level changes once open bit mining begins should be used to further refine storage parameters in the groundwater model and drain conductance's used for the mine workings. These estimates will affect projections of inflows at other mines and the cumulative impacts of all mining operations in the region.

- Verification of inflows and water levels by monitoring is required to validate model after mining commences.
- Verification of abstractions especially from irrigation farmers.
- Derivation of local more detailed multilayer models at a monthly time scale for each mine once a more detailed mining plan becomes available.
- Model Sensitivity analysis: Once the model is complete with all the required information, supported by monitoring data, a sensitivity analysis needs to be undertaken to determine how sensitive the model results are to parameters with some uncertainty. This involves simulations with parameter values increased and reduced to determine how it affects the calibration results, and the confidence in the selected parameter values
- Model Verification: Model verification means comparing model results against an independent data set from that which the model was calibrated against. Monitoring data can be used, as well as the extended model data, and additional data to be obtained from farmers private records not previously submitted to the consulting team.

10.3.2 SURFACE WATER

Similarly, limited surface water flow and quality data are available for the area and due to the season (no flow) limited additional data could be gathered. Further monitoring is therefore proposed during the Feasibility Phase.

10.3.3 GROUNDWATER QUALITY

No pollution plume modelling has been performed as part of this EIA.

In addition, no geochemical testing has been done during the current EIA and the brief evaluation on the potential for AMD (Section 3.3) is based on the results of tests done previously for the Chapudi Project (SRK report Chapudi Project: Environmental baseline study, September 2009). The conclusions drawn can only be fully confirmed with the completion of detailed testing including long-term kinetic test work.

10.3.4 SOCIO- AND MACRO-ECONOMIC ASSESSMENTS

Due to a number of properties where field workers could not gain access, the necessary current land use calculations for such farming enterprises were based on assumptions made for the possible crops cultivated, or beef production according to the land carrying capacity and/or game reared for trophy or biltong hunting with or without accommodation facilities. The required information was, as far as possible, acquired, but could not be verified. Therefore, more detailed surveys are proposed for the Chapudi Project area in order to validate the macro-economic result.

11 MONITORING AND MANAGEMENT OF ENVIRONMENTAL IMPACTS

A comprehensive monitoring system was developed for the Chapudi Project in line with the proposals of the specialists. The objective of the environmental monitoring system is to:

- Prevent and/or minimise the environmental impact associated with the proposed mining operation;
- Ensure that the environmental management system at the Chapudi Project performs according to specifications;
- Ensure conformance with the environmental objectives;
- Ensure timeous implementation of the environmental strategies and implementation programme;
- Act as a pollution early-warning system;
- Obtain the necessary data required to address knowledge gaps;
- Check compliance with license requirements; and
- Ensure consistent auditing and reporting protocols.

11.1 MONITORING REQUIREMENTS

Based on the impact assessment and risk assessment, the following aspects were identified that require monitoring.

Aspect	Issue	Purpose
Climate	Weather station	To obtain detailed weather records for the LOM
Surface water	Surface water quality	Determine any deterioration in water quality as a result of the mining related activities
	Potable water	Determine quality of drinking water
	Sewage effluent	Determine water quality of sewage effluent
	Clean water canals	Determine the sediment levels or any other contamination prior to discharge into the Sand River and its tributaries
	Water management infrastructure	Monitoring of condition, identifying areas that require maintenance
	Dirty water systems	Determine the water quality and long-term chemical changes in the dirty water systems
	Haul road crossings	To identify and mitigate any spillages into the clean water system
	Aquatic monitoring	To determine the impact on the aquatic ecosystems
	Riverine vegetation	To early detect impact on riverine vegetation as a result of dewatering and reduced surface runoff
Groundwater	Groundwater quality	To determine any impact on the groundwater quality as a result of mining
	Groundwater levels	To determine any impact on the groundwater levels as a

Aspect	Issue	Purpose
		result of mining
	Geochemical	To collect sufficient geochemical data to verify and quantify the geochemical models during mining
	Surface-groundwater interaction	To quantify the interaction between surface and groundwater to determine possible seepage volumes
Mine water balance	Water levels in dams	To verify water balance and volume of water stored
	Dirty water recycled	To determine volume of dirty water abstracted & recycled for processing and dust suppression
	Clean water abstraction	To determine volume of clean water abstracted
	Process flow	To determine accurate process water balance
Land use management	Concurrent rehabilitation	To determine conformance with environmental objectives for concurrent rehabilitation
	Rehabilitation plan	To ensure conformance with final rehabilitation plan
	Soil analysis	To determine any deficiencies in soil fertility prior to seeding
	Soil erosion	To pro-actively identify soil erosion in order to rectify prior to serious degradation
Biodiversity	Land use coverage / Vegetation health	To determine effectiveness of reclamation plan and long-term sustainability of vegetated areas
	Species diversity	To determine species diversity (fauna & flora)
	Landscape Function Analysis	To establish ecosystem functionality of rehabilitated areas
	Riparian condition assessment	To determine the impact on the riverine forest as a result of mining
	Alien vegetation	To monitor conformance with alien vegetation programme
Air quality	Dust outfall	To determine the levels of dust outfall as a result of the mining activities
	Particulate Matter	To determine the particular matter levels for PM_{10} and $PM_{2.5}$
Environmental noise	Noise levels	To determine the noise levels within the communities and sensitive areas
Blasting	Air blast and ground vibration	To determine the effectiveness of the blasting procedure
Waste	Waste generation & management	To determine volume of waste generated & disposed
Heritage	Heritage/cultural resources	To capture all heritage/cultural resources exposed by mining

11.2 ROLES AND RESPONSIBILITY

The Action Plan for Implementation, together with frequency and responsibility is given below:

Activity	Implementation Phase	Review / Repeat Frequency	Responsibility
Implement Rescue and Relocation Plan (flora)	Prior to mining	Annual rescue operation for areas to be disturbed in the next 12 months	Specialist to be appointed
Develop and implement Biodiversity Action Plan, including avifaunal plan	Within one year of mining	Annual review	Specialist to be appointed
Develop Rehabilitation Plan and Materials Placement Plan in line with the final mining plan	Feasibility Phase	Annual review or if major change in scheduling	Mining Dept
Reporting of rehabilitation plan • Areas disturbed • Areas levelled • Areas topsoiled/capped • Areas vegetated	Construction Phase	Monthly	Environmental Dept
Initiate alien vegetation programme	Construction Phase	Annual review	Environmental Dept
Phases 1B and 2 heritage studies	Prior to Construction Phase	Prior to new areas being disturbed	Specialist to be appointed
Heritage monitoring	Construction phase	Prior to new areas being disturbed	Archaeologist to be appointed
Identify offset programmes	Construction Phase	Annual review	Env Dept with the necessary inputs from stakeholders and specialists, as required
Revision of groundwater flow & geochemical model	During Feasibility Phase in line with final mining plans	Revise every 5 years	Specialist to be appointed
Develop detail blasting procedure in line with specialist advise	Prior to opencast mining	Ongoing review based on monitoring data	Blasting contractor
Stipulate best practice requirements in tender documentation iro emissions, noise, equipment, transport, etc.	Prior to appointment of contractors	Ongoing review as new technology becomes available	Procurement Dept
Implement environmental awareness programme	Construction Phase	Ongoing review Include in annual induction programme	Environmental Dept Human Resources
Maintenance of clean and dirty water system	Operational Phase	Weekly	Engineering Dept
Dam safety inspections of clean and dirty water dams	Operational Phase	Annually	Specialist to be appointed
Identify and clean-up of any spillages along transport routes (haul roads / rail line / overland conveyors)	Operational Phase	Weekly	Engineering Dept
Identify and report any road maintenance issues	Operational Phase	Ongoing	Engineering Dept RAL
Implement aftercare and maintenance programme for rehabilitated areas	Within 2 years of mining	Ongoing implementation as per specialist recommendations	Environmental Dept
Implement monitoring programme	Prior to mining	Annual review of monitoring programme or if major change in scheduling	Environmental Dept

Activity	Implementation Phase	Review / Repeat Frequency	Responsibility
Review and analyses of monitoring data for: • Surface & groundwater • Mine water balance • Land use management • Air quality • Environmental noise • Blasting • Natural resources, including riverine forest • Waste management	Commencement of mining	Monthly	Environmental Dept HSEC Committee
Internal review of EMP compliance, conformance to environmental objectives and strategies and their implementation	Commencement of mining	Bi-annually (6-monthly)	Environmental Dept HSEC Committee
EMP performance assessment to determine conformance with the EMP, including effectiveness and appropriateness of EMP	Commencement of mining	Annually	External appointment
Vegetation audit to determine effectiveness of land use management plan and long-term sustainability	Commencement of rehabilitation	Annually	External appointment
Environmental legal compliance audit	Commencement of mining	Bi-annually (2-yearly)	External appointment
Revision of closure cost assessment	Commencement of mining	Annually	Engineering Dept
Stakeholder Engagement Forum	Commencement of mining	Quarterly	Mine Management
Establish and update Recruitment database	Commencement of construction	Upfront and then Annually updated	Human Resource Manager
Compile and workshop of recruitment procedure	Commencement of construction	Prior construction Prior operations	Human Resource Manager
Define and communicate the Community Safety and Traffic Management Plan	Prior to construction	Prior construction	Community Engagement Manager
Compilation of an existing and future land use plan	Commencement of construction	Annually	Community Engagement Manager
Awareness Newsletters	Commencement of construction	Bi-annually (6-monthly)	Community Engagement Manager
Establish a Grievance and Issue Management Procedure	Construction and Operational Phase	Continuously	Community Engagement Manager

11.3 MONITORING MANAGEMENT AND REPORTING

A proper data management system will be set up to facilitate trend analyses and preparation of reports. All the monitoring data will be collated and analysed on a bi-annual basis and included in management reports.

It must be noted that the monitoring programme is a dynamic system changing over the different life-cycle phases of the mine. The programme will be reviewed on a bi-annual basis and revised if necessary.

12 TECHNICAL AND SUPPORTING INFORMATION

12.1 SPECIALIST REPORTS

The EIA specialist reports are attached as Annexures, as indicated below.

Annexure	Aspect	Independent Consultant
ANNEX-1	Soils, Land Use & Capability	Gudani Consulting - EcoSoil Consortium
ANNEX-2	Surface Water Groundwater	WSM Leshika Consulting (Pty) Ltd
ANNEX-3	Groundwater	WSM Leshika Consulting (Pty) Ltd
ANNEX-4	Biodiversity	Phaki Phakanani Environmental Consultants
ANNEX-5	Aquatic Systems	Scientific Aquatic Services
ANNEX-6	Ambient Noise	Gudani Consulting
ANNEX-7	Air Quality	Royal Haskoning DHV
ANNEX-8	Heritage Resources	Mbofho Consulting and Projects
ANNEX-9	Socio-Economic Aspects	Naledi Development Restructured (Pty) Ltd
ANNEX-10	Macro-Economic Aspects	Mosaka Economic Consultants cc

12.2 REFERENCES

ADAMSON, P.T. 1981. Report No TR102. Southern African Storm Rainfall, Department of Water Affairs and Forestry, Pretoria.

ALEXANDER, G. & MARAIS, J. 2007. A Guide to the Reptiles of Southern Africa, Struik Publishers. Cape Town, 408 pp.

ANON. UNDATED. Birds of the Greater Kuduland Conservancy. Unpublished.

ARC-ISCW (2004) Overview of the Agricultural Natural Resources of South Africa. ARC-ISCW Report No. GW/A/2004/13, ARC-Institute for Soil, Climate & Water.

ARC-ISCW (2011). National Soil Profile Information System. Arc-Institute for Soil, Climate and Water, Pretoria, South Africa.

BRANCH, W.R. (ED.) 1988. South African Red Data Book - Reptiles and Amphibians. S. Afr. Nat. Sci. Prog. Rpt 151: I-Iv, 242pp.

BRANCH, W.R. 1998. Field Guide to the Snakes and other Reptiles of Southern Africa. Rev. ed. Struik Publ., Cape Town, 399pp.

BRANCH, W.R, 2002. The Conservation Status of South Africa’s Threatened Reptiles. Pp 89-103. In: "The State of South Africa's Species" Proceedings of a Conference held at the Rosebank Hotel in Johannesburg 4 - 7 September 2001, Endangered Wildlife Trust and WWF-SA.

BREDENKAMP, G. 2009. A report on the status quo of the vegetation in the Chapudi area. SRK Consulting.

BROADLY, D. G. 1990. Fitzsimons’ Snakes of Southern Africa. Delta Books (PTY) LTD, Johannesburg.

CACHIER, H., LIOUSSE, C., BUAT-MENARD, P. AND GAUDICHET, A. 1995. Particulate Content of Savanna Fire Emissions. J. Atmos. Chem., 22(1-2), 123-148.

CEPA/FPAC WORKING GROUP, 1999. National Ambient Air Quality Objectives for Particulate Matter. Part 1: Science Assessment Document. Minister, Public WORKS AND GOVERNMENT SERVICES, ONTARIO. Available at URL: http://www.hc-sc.gc.ca/bch.

CHIEF DIRECTORATE: NATIONAL GEO-SPATIAL INFORMATION (CD:NGI). Topographic and Orthographic vector data and basemaps of South Africa.

CHUTTER, F. M. 1998. Research on the Rapid Biological Assessment of Water Quality Impacts in Streams and Rivers. Report to the Water Research Commission by Environmentek, CSIR, WRC Report No 422/1/98. Pretoria: Government Printer.

COAL OF AFRICA LIMITED, 2011. Proposed Makhado Colliery Project - Environmental Impact Assessment and Environmental Management Programme.

CONNINGARTH ECONOMISTS, 2007a. A Manual for Cost Benefit Analysis in South Africa with specific Reference to Water Resource Development, Second Edition (Updated and Revised). Water Research Commission. TT305/07.

CONNINGARTH ECONOMISTS, 2007b. Development and Construction of the South African and Provincial Social Accounting Matrix. (Updated 2013). Compiled under the auspices of the Development Bank of Southern Africa.

COUNCIL FOR GEOSCIENCE, 2000. 1:250 000 Geological Map Series, 2228, Alldays.

DADA, R., KOTZE D., ELLERY W. AND UYS M. 2007. WET-Roadmap: A Guide to the Wetland Management Series. WRC Report No. TT 321/07. Water Research Commission, Pretoria.

DALLAS, H.F. 1997. A Preliminary Evaluation of Aspects of SASS (South African Scoring System) for the Rapid Bio-assessment of Water in Rivers with particular reference to the Incorporation of SASS In a National Bio-monitoring Programme. South African Journal of Aquatic Science, 23: 79-94.

DAVIES, B., & DAY, J. 1998.Vanishing Water. Cape Town: UCT Press.

DEACON, H.J. & DEACON, J. 1999. Human Beginnings in South Africa. Cape Town: David Philip.

DEACON, J. and N. LANCASTER. 1986. Later Quaternary Palaeo-environments of Southern Africa. Oxford: Oxford University Press.

DE GRAAFF, G. 1981. The Rodents of Southern Africa. Butterworth, Pretoria.

DEPT OF AGRICULTURE, PRETORIA. 1984. Land types of the Maps, hard copy: 2228 (Alldays), 2328 (Pietersburg), 2230, (Messina), and 2330 (Tzaneen). Soil and Irrigation Research Institute.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, 1999. South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources [Appendix W3].

DEPARTMENT OF WATER AFFAIRS AND FORESTRY 2001. Report No. P/01000/00/0101. Limpopo Water Management Area: Water Resources Situation Assessment. WSM (Pty) Ltd.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY 2004. Report No. P WMA 01/000/00/0304. Internal Strategic Perspective: Limpopo WMA. Water Resources Planning of the Nzhelele River Basin - Study of the water resources. Tlou and Matje.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY 2004. Report No. P WMA 01/000/00/0304. Internal Strategic Perspective: Limpopo WMA. Water Resources Planning of the Sand River Basin Study of the water resources. Tlou & Matji and Goba Moahloli Keeve Steyn.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, 2006. Groundwater Resource Assessment Phase II.

DICKENS, C. & GRAHAM, M. 2001. South African Scoring System (SASS) Version 5. Rapid Bio Assessment For Rivers May 2001. CSIR.Http.//Www.Csir.Co.Za/Rhp/Sass.Html

DORST, J. & DANDELOT, P. 1983. A field guide to the larger mammals of Africa. Macmillan. Johannesburg.

DRIVER, A., SINK, K.J., NEL, J.N., HOLNESS, S., VAN NIEKERK, L., DANIELS, F., JONAS, Z., MAJIEDT, P.A., HARRIS, L. & MAZE, K. 2012. National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria.

DUBEL INTEGRATED ENVIRONMENTAL SERVICES CC, 2012. Description of the Natural Environment and Biodiversity Assessment of the Farm Voorburg 503 MS on Sheldrake Game Ranch.

ENPAT INFORMATION, Undated. Land cover, Land use, Land Types of South Africa (Based on Memoirs on the Agricultural Resources of South Africa.: Erosivity, Clay content, Land types, soil depth, soil potential and plant available water).

EVERS, T. M. 1988. Recognition of Groups in the Iron Age of Southern Africa.Unpublished PhD Thesis, University of Witwatersrand.

FRIEDMANN, Y. & DALY, B. (EDS.) 2004. Red Data Book of the Mammals of South Africa: A Conservation Assessment. CBSG Southern Africa, Conservation Breeding Specialist Group (SSG/IUCN), Endangered Wildlife Trust, South Africa. 722 pp.

G&A HERITAGE, 2011. Environmental Impact Assessment: Sheldrake Game Ranch, Voorburg 503 MS. Unpublished report.

GHAZOUL, J. 2006. Mopane Woodlands and the Mopane Worm: Enhancing Rural Livelihoods and Resource Sustainability. Final Technical Report. London: Division of Biology, Imperial College London.

GOLDING, J. 2002. Workshop Proceedings: Revision of the National list of Protected Trees as per Section 12, National Forests Act of 1998. Roodeplaat. Pretoria.

HAHN, N. 1994. Tree list of the Soutpansberg. Fantique Publishers, Pretoria.

HAHN, N. 2002. The Endemic Flora of the Soutpansberg. MSc Thesis University of Natal, South Africa.

HAHN, N. 2003. Endemic Flora. In: Berger, K., Crafford, E., Gaiger, I., Gaiger, M.J., Hahn, N. & MacDonald, I. (eds.). A first synthesis of the environmental, biological and cultural aspects of the Soutpansberg. Leach Printers and Signs, Makhado.

HAHN, N. 2006. Floristic diversity of the Soutpansberg, Limpopo Province, South Africa. PhD thesis, University of Pretoria, Pretoria.

HARRISON, J. A., ALLAN, D. G., UNDERHILL, I. G., HERREMANS, M., TREE, A. J., PARKER, V. & BROWN, C. J. (ESD). The atlas of Southern African birds. Vols i & ii. Birdlife South Africa, Johannesburg.

HENNING, G.A., TERBLANCHE, R.F. & BALL, J.B. 2009. South African Red Data Book: Butterflies. SANBI Biodiversity Series 13. Pp. 158. South African National Biodiversity Institute, Pretoria.

HUFFMAN, T. N. 2007. A Handbook of the Iron Age: The Archaeology of Pre-colonial Farming Societies in Southern Africa. Scottsville: University of KwaZulu Natal Press.

KEMPER, N. 1999. Intermediate Habitat Integrity Assessment for use in Rapid and Intermediate Assessments. RDM Manual Version 1.0.

KLEIN, H. 2002. Legislation regarding harmful plants in South Africa. PPRI Leaflet Series: Weeds Biocontrol , 12, pp 1-4.

KLEYNHANS, C. J. 1996. A Qualitative Procedure for the Assessment of the Habitat Integrity Status of the Luvuvhu River (Limpopo System, South Africa). Journal of Aquatic Ecosystem Health. 5: 41-54.

KLEYNHANS, C.J. 1999. A Procedure for the Determination of the Ecological Reserve for the Purposes of the National Water Balance Model for South African River. Institute of Water Quality Studies, Department of Water Affairs and Forestry, Pretoria.

KLEYNHANS, C.J., THIRION, C. AND MOOLMAN, J. 2005. A Level 1 Ecoregion Classification System for South Africa, Lesotho And Swaziland. Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria.

KOTZE, D.C., MARNEWECK, G.C., BATCHELOR, A.L., LINDLEY, D.S. AND COLLINS, N.B. 2008. WET-Ecoservices: A Technique For Rapidly Assessing Ecosystem Services Supplied By Wetlands. WRC Report No. TT 339/09. Water Research Commission, Pretoria.

KOVAĆS, Z., 1988. Regional maximum flood peaks in southern Africa. Rep No TR137. DWAF. Pretoria.

KRUGER, E (ED) (2006). Drainage Manual. SANRAL. Pretoria.

KUPCHELLA, C.E. AND M.C. HYLAND, 1993. Environmental Science. Living within the System of Nature. Prentice Hall, New Jersey.

LOUBSER, J.H.N., 1991. The Ethnoarchaeology of the Venda-speakers in Southern Africa. Navorsinge van die Nasionale Museum, Bloemfontein 7(8): 145 – 464.

LOW, A.B. AND REBELO, A.G. 1996. Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.

MACFARLANE, D.M., KOTZE, D.C., ELLERY, W.N., WALTERS, D., KOOPMAN, V., GOODMAN, P. AND GOGE, C. 2008. WET-Health: A Technique for Rapidly Assessing Wetland Health. WRC Report No. TT 340/08. Water Research Commission, Pretoria.

MARAIS, E. UNDATED. A guide to the birds of Ben Lavin Nature Reserve. Unpublished.

MARAIS, J. 2004. A Complete Guide to the Snakes of Southern Africa, Struik Publishers. Cape Town.

MCMILLAN, P. H. 1998. An Integrated Habitat Assessment System (IHAS V2) for the Rapid Biological Assessment of Rivers and Streams. A CSIR Research Project. Number ENV-P-I 98132 for the Water Resources Management Programme. CSIR.Ii +44 Pp

MIDDLETON, B.J.& BAILEY, A.K. 2009. Water Resources of South Africa, 2005 study. WRC Rep No TT381. Pretoria.

MIDGLEY, D.C., PITMAN W.V. AND MIDDLETON, B.J. 1994. Surface Water Resources of South Africa 1990. (WR90 study). Vol V Appendices, WRC Report No 298/5.1/94. Pretoria.

MINTER, L.R., BURGER, M., HARRISON, J.A., BRAACK, H.H., BISHOP, P.J. & KLOEPFER, D. 2004. (eds.). Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. SI/MAB Series #9.Smithsonian Institution, Washington, DC.

MOSTERT, T.H.C. 2006. Vegetation Ecology of the Soutpansberg and Blouberg area in the Limpopo Province. PhD thesis, University of Pretoria, Pretoria.

MOSTERT, T.H.C., BREDENKAMP, G.J., KLOPPER, H.L., VERWEY, C, MOSTERT, R.E. & HAHN, N. 2008. Major vegetation types of the Soutpansberg Conservancy and the Blouberg Nature Reserve, South Africa. Koedoe 50 (1): 32-48.

MUCINA, L. & RUTHERFORD, M.C. (EDS). 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria, RSA.

NATURAL SCIENTIFIC SERVICES, 2009. Faunal assessment for the proposed Chapudi coal project near Waterpoort, Limpopo province. SRK Consulting.

NOISE QUEST, How does noise affect domestic animals and wildlife? http://www.noisequest.psu.edu/pmwiki.php?n=NoiseAffect.Animals.

NORTON, M.P. AND KARCZUB, D.G. 2003. Fundamentals of Noise and Vibration Analysis for Engineers, Second Edition.

OLLIS, D.J., JOB N., MACFARLANE, D. AND SIEBEN, E.J. 2009. Further Development of a Proposed National Wetland Classification System for South Africa. Supplementary Project Report: Application and Testing of Proposed National Wetland Classification System. Prepared for the South African National Biodiversity Institute, Pretoria.

PHILLIPSON, D. W. 2005. African Archaeology. Cambridge: University of Cambridge Press: 249.

PUTNAM, D. 2000. Bowling Alone: The Collapse and Revival of the American Community

R&R CULTURAL RESOURCE CONSULTANTS. 2012. Phase 1 Heritage Impact Assessment Sheldrake Game Ranch.

RADLE, A.L. 2001. The Effect of Noise on Wildlife: A Literature Review. World Forum for Acoustic Ecology, University of Oregon.

RAUTENBACH, I. L. 1978. The mammals of the Transvaal. Ph.d. Thesis, University of Natal.

REPUBLIC OF SOUTH AFRICA. 1999. The National Heritage Resources Act, No 25.

ROSEN, L. 1980. The excavation of American Indian Burial Sites: A problem in law and professional responsibility. American Anthropologist, New Series, Vol 82 No 1.

ROWNTREE K.M. & WADESON R.A. 2000. An Index of Stream Geomorphology for the Assessment of River Health. Field Manual for Channel Classification and Condition Assessment. NAEBP Report Series No. 13, Institute of Water Quality Studies, Department of Water Affairs and Forestry, Pretoria. Available: Http://Www.Csir.Co.Za/Rhp/Reports/Reportseries13.Html.

RUTHERFORD, M.C. & WESTFALL, R.H. 1994. Biomes of Southern Africa - An Objective Categorization. Memoirs of the Botanical Survey of South Africa 63.

SANBI. 2009. Further Development Of A Proposed National Wetland Classification System For South Africa. Primary Project Report. Prepared By The Freshwater Consulting Group (FCG) For The South African National Biodiversity Institute (SANBI).

SANBI - BIODIVERSITY GIS (BGIS) [Online]. Retrieved 2013/05/03 URL: Http://Bgis.Sanbi.Org

SANS 0103:2004. The measurement and rating of environmental noise with respect to annoyance and to speech communication.

SANS 0210:2004. Calculating and predicting road traffic noise.

SANS 10328:2003. Methods for environmental noise impact assessments.

SANS 10357:2004. The calculation of sound propagation by the Concave Method.

SCIENCE IN AFRICA [Online] Retrieved 2013/06/08 URL: http://scienceinafrica.com/old/index.php?q=2003/june/mopane.htm

SCHMIDT, E., M. LÖTTER, AND W. MCCLELAND. Trees and shrubs of Mpumalanga and Kruger National Park, Johannesburg, S Africa.

SKINNER, J.D. & SMITHERS, R. H. N., 1990. The Mammals of the Southern African sub-region. New ed. University of Pretoria, Pretoria. 769p.

SMITHERS, R. H. N., 1986. South African Red Data Book - Terrestrial Mammals. S. Afr. Nat. Sci. Prog. Rpt. 125, 214p.

SRK CONSULTING (SOUTH AFRICA) (PTY) LTD, 2009. Report No 395099/LU/02. Chapudi Coal Project Environmental Baseline Study: Land Use.

SRK CONSULTING (SOUTH AFRICA) (PTY) LTD, 2009. Report No 395099/Air/1. Chapudi Coal Project Baseline Climate and Air Monitoring Report.

SRK CONSULTING (SOUTH AFRICA) (PTY) LTD, 2009. Report No 395099/SW/1. Chapudi Coal Project Report for the Surface Water Baseline Aspects.

STEWART, C. T., STEWART, T., GAIGHER, I. G., GAIGHER, M. J. 2001. Checklists for the fauna of the western Soutpansberg. Soutpansberg Conservancy, Louis Trichardt.

STUART, C. & STUART T. 2001. Field guide to the mammals of southern Africa. Struik Publishers, Cape Town.

STUART, C.T & STUART, M.D. 2000. A Field Guide to the Tracks and Signs of Southern and East African Wildlife. 3rd ed. Struik Publishers, Cape Town.

TARBOTON, W. R., KEMP, M. I. & KEMP, A. C. 1987. Birds of the Transvaal. Transvaal Museum, Pretoria.

THIRION, C.A., MOCKE, A. & WOEST, R. 1995. Biological Monitoring of Streams and Rivers Using SASS4. A Users Manual. Internal Report No.N 000/00REQ/1195. Institute for Water Quality Studies. Department of Water Affairs and Forestry. 46.

TYSON, P.D., R.A. PRESTON-WHYTE, 2000. The Weather and Climate of Southern Africa. Oxford University Press, Cape Town.

U.S ENVIRONMENTAL PROTECTION AGENCY (USEPA), 1996. Compilation of Air Pollution Emission Factors (AP-42), 6th Edition, Volume 1, as contained in the AirCHIEF (AIR Clearinghouse for Inventories and Emission Factors) CD-ROM (compact disk read only memory), US Environmental Protection Agency, Research Triangle Park, North Carolina. Also available at URL: http://www.epa.gov/ttn/chief/ap42/.

UNESCO. 2003. Intangible Heritage Convention. Paris: World Heritage Centre.

UNESCO. 2005. Operational Guidelines for the Implementation of the World Heritage List. Paris: UNESCO.

UNESCO. 2009. World Heritage Cultural Landscapes. World Heritage Papers 26. Paris: World Heritage Centre.

UYS, M. C., GOETCH, P. A.&O'KEEFFE, J. H. 1996. National Bio-monitoring Program for Riverine Ecosystems: Ecological Indicators, A Review and Recommendations. NBP Report Series No 4. Institute for Water Quality Studies, Department of Water Affairs and Forestry, Pretoria.

VAN WYK, B. & VAN WYK, P. 1997. Field Guide to Trees of Southern Africa. Struik Publishers. Todkill.

VAN WYK, B. & MALAN, S. 1998. Field guide to the wild flowers of the Highveld. Cape Town: Struik Publishers.

VAN WYK, E. & OUDTSHOORN, F. 2006. Guide to grasses of Southern Africa. Briza Publications, Pretoria. 288 pp.

World Health Organisation, 1999: Guidelines for Community Noise, Geneva.

World Health Organisation, 2009: Night noise guidelines for Europe.

WORLD ARCHAEOLOGICAL CONGRESS, 1989. Vermillion Accord on Human Remains.

WORLD ARCHAEOLOGICAL CONGRESS, 1990. First Code of Ethics on Human Remains.

WSM LESHIKA, 2012. Voorburg Baseline Groundwater Study.

http://archaeology.about/od/bterms/g/bordercave.htm

http://www.krugerpark.co.za/africa_marula.html

https://en.wikipedia.org/wiki/Dzata_ruins

13 ANNEXURES

ANNEX-1	Soils, Land Use & Capability	Gudani Consulting - EcoSoil Consortium
ANNEX-2	Surface Water Groundwater	WSM Leshika Consulting (Pty) Ltd
ANNEX-3	Groundwater	WSM Leshika Consulting (Pty) Ltd
ANNEX-4	Biodiversity	Phaki Phakanani Environmental Consultants
ANNEX-5	Aquatic Systems	Scientific Aquatic Services
ANNEX-6	Ambient Noise	Gudani Consulting
ANNEX-7	Air Quality	Royal Haskoning DHV
ANNEX-8	Heritage Resources	Mbofho Consulting and Projects
ANNEX-9	Socio-Economic Aspects	Naledi Development Restructured (Pty) Ltd
ANNEX-10	Macro-Economic Aspects	Mosaka Economic Consultants cc
ANNEX-11	Stakeholder Engagement	Naledi Development Restructured (Pty) Ltd