THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENTAL MANAGEMENT PLAN FOR THE PROPOSED PLATREEF UNDERGROUND MINE

PLATREEF RESOURCES (PTY) LTD

JANUARY 2014

NEMA REF NO's:

PROJECT REF NO. 12/1/9/2-W32

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12/9/11/L1224/5

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This document has been prepared by Digby Wells Environmental.

Report Title: THE PROPOSED PLATREEF UNDERGROUND MINE EIA/EMP

Project Number: PLA1677

Name	Responsibility	Signature	Date
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EXECUTIVE SUMMARY

Digby Wells Environmental (hereafter Digby Wells) has been appointed by Platreef Resources (Pty) Ltd (hereafter Platreef), as the independent Environmental Assessment Practitioner (EAP) to conduct an Environmental and Social Impact Assessment (ESIA) and associated specialist studies for the proposed Platreef Underground Mining Project (hereafter the Project). Platreef is investigating the construction and operation of an underground platinum mine on the farms of Turfspruit 241 KR; Macalacaskop 243 KR; and Rietfontein 2 KS (see Plan 1, Appendix A). The Project will be conducted in conformance with the framework provided in the World Bank Group (WBG), the International Finance Corporation (IFC) policies and guidelines for Environmental Assessment (EA) and the Equator Principles used for conformance with the IFC policies and guideline.

Furthermore, Platreef is currently following the necessary processes to obtain environmental authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) for associated listed activities as stipulated in the NEMA Regulations. In conjunction with the NEMA application, Platreef has submitted a Mining Right Application (MRA) in terms of the Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA). As part of this Project, Platreef also intends to apply for an Integrated Water Use Licence (IWUL) in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) and a Waste Management Licence (WML) in terms of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEMWA).

This report is being prepared in support of the NEMA application to be submitted to the Limpopo Department of Economic Development and Environmental Tourism (LDEDET) and in support of the WML application to be submitted to the Department of Environmental Affairs (DEA).

Project Location and Description

The Project site is located approximately 8 km northwest of the town of Mokopane (previously known as Potgietersrus), which is situated in the magisterial district of the Mogalakwena Local Municipality and within the Waterberg District Municipality. Platreef plans to mine Platinum and other Platinum Group Metals (PGMs) such as Palladium (Pd); Rhodium (Rh); Iridium (Ir); Ruthenium (Ru); and Osmium (Os) with the Life of Mine (LoM) expected to be 30 years with the potential to extent this period by another 30 years.

An underground mine is planned and the Project aims to make use of the sublevel blast hole stoping method for mining the target Platinum Group Metals (PGMs).

Platreef which is a subsidiary of Ivanhoe Mines Limited (formerly Ivanplats Limited) holds exclusive prospecting rights for base and precious metals on the Turfspruit and Macalacaskop Farms. Platreef acquired a prospecting right for both Turfspruit and Macalacaskop farms in February 1998 and was granted a five-year Prospecting Right for Turfspruit and Macalacaskop in 2006 (Prospecting Right LP30/5/111/2/872PR). Platreef recently renewed the prospecting right, which now expires 31 May 2014. Platreef has submitted a MRA in accordance with section 22 of the MPRDA to the Limpopo Region of the Department of Mineral Resources on 06 June 2013 (DMR Ref No. LP30/5/1/2/2/10067MR).

Prospecting on the Project site dates back to the 1960s, after which Rustenburg Platinum Holdings Limited (now a wholly-owned subsidiary of Anglo American Platinum Corporation) began exploration over the Platreef in the 1970s (AMEC, 2013).

The initial exploration focus was on the delineation of mineralisation amenable to open-pit mining. Ivanplats contracted a series of consultants to provide various studies involving concentrator/smelter options (Hatch in 2003), metallurgical test work (Mineral Development Services Ltd. in 2003), and conceptual mining studies, to assess reasonable prospects of developing an open-pit operation (African Minerals and AMEC in 2004). Mining cost assumptions were also updated to the end of 2006, and capital and operating costs were updated in 2007 to support the mineral resource assessments (AMEC, 2013).

In 2007, Platreef commenced a deep drilling program to investigate the continuity and grade in an area targeted as having underground mining potential. This resulted in a series of unpublished Mineral Resource estimates assuming underground mining methods and updates being prepared at various times between September 2010 and January 2011. A March 2011 resource update was published in September 2012 (AMEC, 2013).

According to the Technical Report on Updated Mineral Resource Estimate, work completed on the Project to date includes geological mapping, airborne and ground geophysical surveys, limited trenching, percussion drilling over the Platreef sub-crop, core drilling, petrography, density determinations, metallurgical test work, preliminary mineralogical studies, and Mineral Resource estimation. Preliminary mining and supporting studies have commenced (AMEC, 2013).

The Project is accessible all year round by the N11 national highway, and a developed rail network goes through Mokopane, the closest railhead to the Project.

A large, unskilled labour force lives in urban areas and farms around the Project area. Local town facilities and infrastructure exist to handle an influx of personnel.

The list of activities for which environmental authorisations in terms of NEMA and NEM:WA are required, are set out in Sections 3.2 (Table 3-1) and 3.3 (Table 3-2) of this report.

Purpose of this report

The overarching objectives of this EIA/EMP report are to:

- Prepare integrated sensitivity maps for the Project area based on the findings of environmental, socio-economic and cultural assessments as input into the Project design process;
- Identify and assess the significance of potential impacts associated with the all the listed activities in terms of NEMA and waste management activities in terms of NEM:WA (Table 3-1 and Table 3-2); and to

- Recommend mitigation and management measures to ensure that the development is undertaken in such a way as to promote the positive impacts and to minimise the negative impacts.

This report also describes the current environment of the Project area and evaluates all the impacts (Sections 9, 10 and 11) that have been identified during the specialist studies undertaken. Furthermore an Environmental Management plan has been developed (Sections 13.1, 13.2 and 13.3) to mitigate and manage all environmental impacts associated with each Project activity.

Specialist Studies conducted as part of this EIA Report

The following specialist studies have been conducted as part of this EIA/EMP report:

- Terrestrial Ecology Assessment;
- Topographical and Visual Assessment;
- Wetlands and Aquatic Assessments;
- Geohydrological (Groundwater) Assessment;
- Hydrological (Surface water) Assessment;
- Air Quality Assessment;
- Noise Assessment;
- Health Impact Assessment;
- Social-economic Impact Assessment; and
- Heritage Impact Assessment; and
- Traffic Impact Assessment.

Potential Impacts identified during the Various Specialist Studies

The table below is a summary of the significant environmental impacts that have been identified during the specialist studies conducted on the Project site:

Aspect	Impact Description
Topography	
Change in the Project surface area due to site clearing activities for the preparation of construction of infrastructure.	The removal of vegetation and topsoil will change the surface of the Project area and will therefore change the topography. The areas to be cleared include the infrastructure area, Tailings Storage Facility (TSF) Site 2 and the tailings pipeline servitude.
Change to topography due to construction of surface infrastructure.	The construction of surface infrastructure will add features to the topography thereby changing it.
Changes to the topography due to drilling,	The development of surface infrastructure will add

Aspect	Impact Description
blasting and development of infrastructure for mining.	features to the topography while drilling and blasting will create voids thus changing the topography.
Change in local topography due to the operation of surface infrastructure.	Operation of the stockpiles, waste rock dumps and the TSF will add to the surface and thereby change the topography of the Project area.
Visual	
Site clearing activities influencing the visual Environment.	The removal of topsoil and vegetation will have a negative visual impact on the receiving environment. Furthermore, the infrastructure (especially the TSF) will become noticeable to the surrounding receptors.
Construction of surface infrastructure influencing the visual environment.	The construction of the mine's surface infrastructure will have a negative visual impact on the receiving environment.
Drilling, blasting and development of infrastructure and shafts for mining will Influence the visual aspects of the project area.	The drilling, blasting (generation of dust) and development of infrastructure and shafts for mining will have a negative visual impact on the receiving environment.
Adding material to the waste rock dumps, stock piles and TSF.	Operation of the ore stockpile, waste rock dumps and TSF will have a negative visual impact on the receiving environment. This will be as a result of continuously adding material to these waste rock dumps and stockpiles.
Flora and Fauna	
Loss of Ridges, Bushveld and Impacted Ridge Bushveld Vegetation due to construction activities.	Mine construction activities will lead to the loss of Ridge Bushveld and impacted Ridge Bushveld vegetation thus impacting the biodiversity value of the areas affected.
Loss of Degraded Mixed Bushveld.	Mine construction activities will lead to the loss of Mixed Bushveld vegetation thus impacting the biodiversity value of the areas affected
Loss of general biodiversity.	The construction and operation of the mining infrastructure will lead to the potential loss of general biodiversity within the Project Area, thus decreasing the biodiversity value of the areas

Aspect	Impact Description
	affected.
Loss of flora and fauna Species of Special Concern.	The construction and operation of the mining infrastructure will lead to the potential loss of flora and fauna Species of Special Concern (SCC).
Influx of alien invasive species.	Construction , operation and decommissioning activities may cause the uncontrolled influx of alien invasive species within and around the Project area
Aquatic Impact Assessment	
Surface water run-off from mining activities.	Increased run-off due to large concrete terraces and roads and poor quality run-off from mining activities could impact the surface water quality.
Surface Water	
Surface water run-off	Refer to the impact described in the aquatics section above on surface water run-off.
Soil	
Soil compaction and topsoil loss due to erosion	Activities during early works, construction and operational phase in the Project area could lead compaction of soils and soil erosion.
Impact of site rehabilitation on soil and land capability	During the decommissioning activities, impacts to soil resources may include compaction and contamination which may be significant only in the short term.
Air Quality	
The crushing of ore	The crushing process releases fugitive dust, especially if there is no enclosure and are no water sprays.

The table below is a summary of the potential social impacts identified and anticipated for the Project:

Receiving Environment	Receiving Potential Impact description
Construction phase	Job creation during construction
	Multiplier effects on the local economy

Receiving Environment	Receiving Potential Impact description
	Economic empowerment of communities
	Skills transfer and development
	Community development induced by Local Economic Development (LED) and Corporate Social Initiatives (CSI) projects
	Economic displacement
	Disruption of movement patterns
	Construction-related health and safety impacts
	Visual/acoustic/vibration and air quality impacts
	Increase in spread of communicable diseases and social pathologies
	Conflict/competition between newcomers and incumbent population
	Increased pressure on local services/ resources
	Establishment and growth of informal settlements
	Opposition because of perceived negative impacts
Operational phase	Job creation during operation
	Regional economic development
	Dependency on mine for sustaining local economy
	Operation-related health and safety impacts
Decommissioning phase	Impacts on the work force
	Impacts on the local community
	Impacts on the wider community
	Job creation

The table below is a summary of the potential heritage impacts identified anticipated for the Project:

Receiving Environment	Potential Impact Description
Burial Ground / single graves	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers

Receiving Environment	Potential Impact Description
	on site, accidental destruction or alteration of burial site by construction workers on site.
Isolated occurrences (Refer to Table 10-1)	The construction of the proposed mine infrastructure will destroy these sites known as isolated occurrences of heritage significance.

LIST OF ACRONYMS

$\mu g/m^3$	Micro grams per cubic meter
AAMM	Anglo American Mogalakwena Mine
ABA	Acid Base accounting
AEMW	African Eurasian Migratory Waterbirds
Ag	Silver
Al	Aluminium
AMEC	AMEC E&C Services, Inc.
ARD	Acid Rock Drainage
ARV	Antiretroviral drugs
Au	Gold
AWS	Automatic Weather Station
B-BBEE	Broad Based Black Economic Empowerment
BIC	Bushveld Indigenous Complex
BID	Background Information Document
BIF	Banded Ironstone Formation
BV	Biodiversity Value
CARA	Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
CBD	Central Business District
CD	Compact Disc
CEC	Cation Exchange Capacity
CMMB	Catholic Medical Mission Board Inc.
CO	Carbon Monoxide
Co	Cobalt
Cr	Chrome

CRR	Comments and Response Report
CSI	Corporate Social Initiatives
CSR	Corporate Social Responsibility
Cu	Copper
DAFF	Department of Agriculture, Forestry and Fisheries
dBA	Unit of sound level. The weighted sound pressure level by the use of the A metering characteristic, which allows the sound pressure level to be measured at the approximate sensitivity as the human ear
DEA	Department of Environmental Affairs
Digby Wells	Digby Wells Environmental
DMR	Department of Mineral Resources
DO	Dissolved Oxygen
DoH	Department of Health
DoHSD	Department of Health and Social Development
DoL	Department of Labour
DPWRT	Department of Public Works, Roads and Transport
DS	Downstream
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
ED	Enterprise Development
EFF	Economic Freedom Fighters
EGL	Effective Grinding Length
EHA	Environmental Health Areas
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EP	Equator Principles

ESA	Early Stone Age
ESIA	Environmental and Social Impact Assessment
FBS	Free Basic Services
Fe	Iron
FRAI	Fish Response Assessment Index
FROC	Frequency of Occurrence
GAA	Golder Associates Africa (Pty) Ltd.
GCL	Geosynthetic Clay Liner
GDP	Gross Domestic Project
GGP	Gross Geographic Product
GN	Government Notice
GN R.	Regulation published in a Government Notice
GPS	Global Positioning System
GRP	Grave Relocation Plan
Ha	Hectare
HDSAs	Historically Disadvantaged South Africans
HIA	Heritage Impact Assessment
HIV	Human Immunodeficiency Virus
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
I&APs	Interested and Affected Parties
IDP	Integrated Development Plan
IFC	International Finance Corporation
IHAS	Invertebrate Habitat Assessment System
IHI	Index of Habitat Integrity
Ir	Iridium

IPILRA	Interim Protection of Informal Land Right Act, 1996
IUCN	International Union for Conservation of Nature
IWMP	Integrated Waste Management Plan
IndWMPs	Industry Waste Management Plans
IWUL	Integrated Water Use Licence
IWULA	Integrated Water Use Licence Application
JWF	Joint Water Forum
kg	Kilogramme
km	Kilometre
km^2	Kilometre squared
$L_{Aeq,T}$	Is the value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval T_m, has the same mean-square sound pressure as a sound under consideration whose level varies with time
LDEDET	Limpopo Department of Economic Development, Environment and Tourism
LED	Local Economic Development
LEMA	Limpopo Environmental Management Act, 2003.
LHD	Load-Haul-Dumper
LIA	Late Iron Age
LIHRA	Limpopo Heritage Resource Authority
LM	Local Municipality
LoM	Life of Mine
LSA	Later Stone Age
m	Meter
m^2	Square meter
mamsl	Meters above mean sea level
mg/m^2	Milligrams per square meter

MIRAI	Macroinvertebrate Response Assessment Index
MLM	Mogalakwena Local Municipality
MMC	Medical Male Circumcision
mm	Millimetres
MPRDA	The Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
MRA	Mining Right Application
MSA	Middle Stone Age
Mtpa	Million tonnes per annum
MWFP	Mine Water Filter Plant
N1	National Highway No. 1
N11	National Highway No. 11
NAAQS	National Ambient Air Quality Standards
NEM:AQA	National Environment Management: Air Quality Act, 2004 (Act No. 39 of 2004)
NEM:WA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NEMA	The National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act , 2004 (Act No. 10 of 2004)
NHRA	National Heritage Resources Act, 1999 (Act No.25 of 1999)
No.	Number
NonPAG	Not Potentially Acid Generating
NPAES	National Protected Areas Expansion Strategy
NQF	National Qualifications Framework
NWA	National Water Act, 1998 (Act No. 36 of 1998)
O_3	Ozone
ORWRDP	Olifants River Water Resource Development Project

Os	Osmium
PAC	Potentially Affected Community
PAG	Potentially Acid Generating
PCD	Pollution Control Dam
Pd	Palladium
PGM	Platinum Group Metals
Platreef	Platreef Resources (Pty) Ltd
PM_{10}	Particulate Matter less than 10 microns in diameter
$PM_{2.5}$	Particulate Matter less than 2.5 microns in diameter
PPP	Public Participation Process
PRECIS	Pretoria Computerised Information System
Project	Platreef Underground Platinum Mine
Pt	Platinum
Pto	Permission to Occupy
PWTP	Process Water Treatment Plant
R101	Regional Road No. 101
R518	Regional Road No. 518
RAP	Resettlement Action Plan
Rh	Rhodium
RHP	River Health Programme
RoM	Run of Mine
RLS	Rusternburg Layer Suite
Ru	Ruthenium
SAAQIS	South African Air Quality Information System
SABAP2	South African Bird Atlas Project 2

SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SANS	South African National Standards
SASS5	South African Scoring System (version 5)
SASSA	South African Social Security Agency
SAWIS	South African Waste Information System
SDF	Spatial Development Framework
SIA	Social Impact Assessment
SIBIS	South African Integrated Biodiversity Information System
SLP	Social and Labour Plan
SMME	Small, Medium and Micro-sized Enterprises
SMS	Short Messages Service
SO_2	Sulphur Dioxide
SSC	Species of Special Concern
SSFU	Single Striker Filter Unit
StatsSA	Statistics South Africa
STI	Sexually Transmitted Infections
STP	Sewage Treatment Plant
TA	Traditional Authority
TB	Pulmonary Tuberculosis
TCLEC	Transvaal Consolidated Land and Exploration Company (Ltd).
TDS	Total Dissolved Solids
TSF	Tailings Storage Facility
TSP	Total Suspended Particulates
UNESCO	United Nations Educational, Scientific and Cultural Organization

US	Upstream
US EPA	United States Environmental Protection Agency
VIP	Ventilated Improved Pit-latrine
WAD	Witwatersrand Archaeological Database
WBPA	Waterberg-Bojanala Priority Area
WDM	Waterberg District Municipality
WHO	World Health Organisation
WHS	World Heritage Site
WMA	Water Management Area
WMIS	Waste Management Information System
WML	Waste Management License
WRB	Waste Rock Berm
WRD	Waste Rock Dump
WUL	Water Use Licence

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1 INTRODUCTION

Platreef Resources (Pty) Ltd (hereafter Platreef), a subsidiary of Ivanplats Limited, is the holder of a Prospecting Right registered in the Mineral and Petroleum Titles Registration Office under MPT 55/2006 PR (DMR Reference LP 872 PR) for base and precious metals on the farms Turfspruit 241 KR and Macalacaskop 243 KR. The Prospecting Right has been renewed for a period ending on 31 May 2014. A Mining Right Application (MRA) for the proposed mining development was submitted in accordance with the provisions of Section 22 of the Mineral and Petroleum Resources Development Act, 2002 (MPRDA) to the Regional Manager, Limpopo Region, of the Department of Minerals Resources (DMR) on 06 June 2013 (DMR Reference LP 30/5/1/2/2/10067 MR).

The MRA submitted by Platreef envisages the construction and operation of an underground platinum mine on the above mentioned farms (the Project area) (see Plan 1).

The Project intends to mine Platinum Group Metals (PGMs) such as Platinum, Palladium, Rhodium, Iridium, Ruthenium, Osmium and other associated metals. The Life of Mine (LoM) is planned to be 30 years, with the possibility to extend this further. The mining method has been described in further detail in Section 4.2.1 of this report.

Platreef is currently following the necessary processes to obtain environmental authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) for associated listed activities as stipulated in the NEMA Regulations. In conjunction with the NEMA application, Platreef also intends to apply for an Integrated Water Use Licence (IWUL) in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) and a Waste Management Licence (WML) in terms of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA).

This report includes all specialist studies required to identify the potential environmental impacts identified for the Project and its related activities. A list of all the NEMA activities (in terms of Government Notice (GN) R. 544, 545 and 546) and Waste management activities (in terms of GN R. 718) are provided in Sections 3.2 (Table 3-1) and 3.3 (Table 3-2) of this report.

This document is prepared for submission to Limpopo Department of Economic Development, Environment and Tourism (LDEDET) in support of the NEMA application submitted in terms of the NEMA regulations as published in GN R. 543 and to the Department of Environmental Affairs (DEA) in support of the WML application in terms of the NEM:WA regulations published in GN R.718.

1.1 Applicant Details

The Applicant's details are provided Table 1-1 below:

Table 1-1: Particulars of the Applicant

Applicant Name:	Platreef Resources (Pty) Ltd
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1.2 Details of the Environmental Assessment Practitioner

Digby Wells was appointed by Platreef as the independent Environmetal Assessment Practitioner (EAP) responsible for undertaking the Environmental and Social Impact Assessment (ESIA) process for the proposed underground mine. Digby Wells is a South African company with international expertise in delivering comprehensive environmental and social solutions for clients in diverse sectors including the energy, minerals, and mining industries.

Particulars of the EAP are provided in Table 1-2 below.

Table 1-2: Particulars of the EAP

EAP Name:	Digby Wells Environmental
Contact Person:	Barbara Wessels
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Postal Address:	Private Bag X10046, Randburg, Gauteng, 2125

2 ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The South African Environmetnal Impact Assessment (EIA) framework is illustrated in Figure 2-1 below.

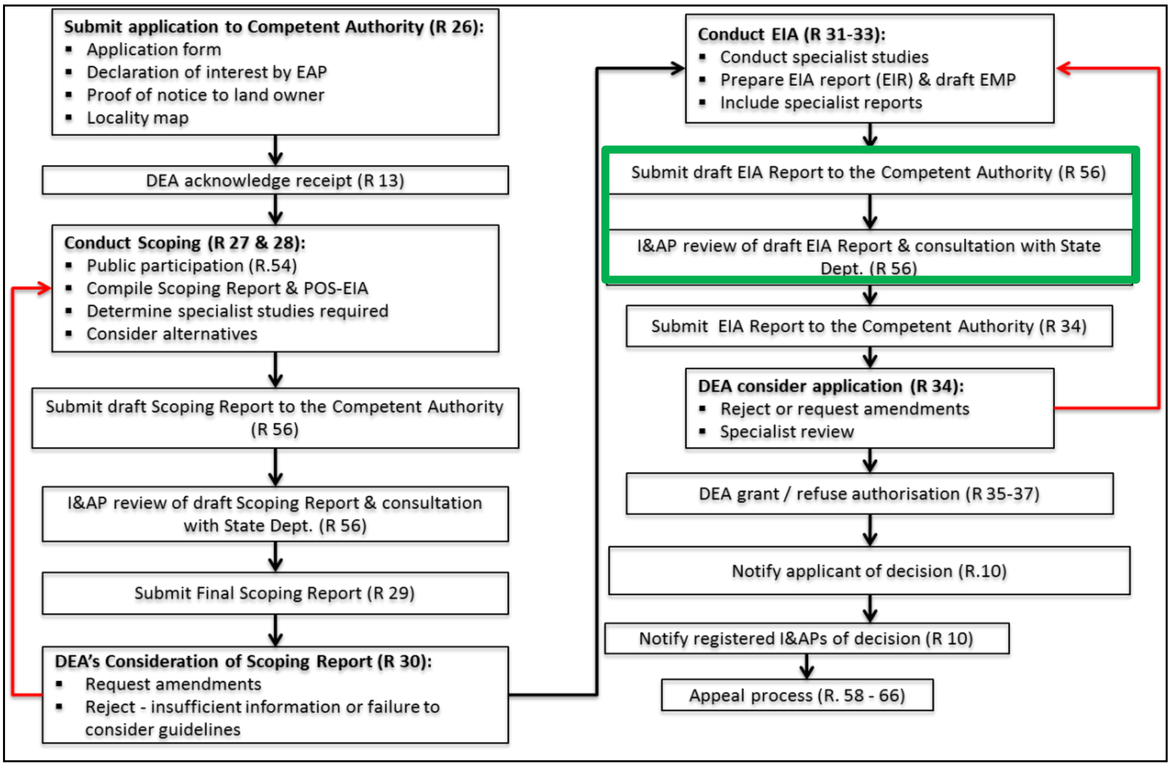

Figure 2-1: The South African legislative framework for EIA

2.1 Scoping Process

The Scoping Report forms part of the ESIA process and aims to identify those environmental issues and concerns that require investigation as well as determine feasible alternatives. This information is then used to determine the scope of work for the ESIA. During the scoping phase those persons interested or affected by the Project were informed of the Project and afforded the opportunity to provide their input in terms of issues and concerns they may have.

Potential positive and negative impacts that the Project may have on the environment were identified and discussed in the scoping phase and a description of further investigations required for the impact assessment studies were proposed.

A scoping report was compiled and the draft and final versions were submitted to LDEDET and DEA respectively for the NEMA and WML applications.

The aims of the Scoping Report were to:

- Provide information to the authorities and to other I&APs/stakeholders on the Project to allow them to comment and raise issues of concern;
- Consider alternatives to the Project;

- Provide stakeholders with the opportunity to contribute to the Project, and to allow them to verify that the issues they have raised have been recorded and considered;
- Provide a brief description of the baseline receiving environment; and
- Highlight potential impacts that should be investigated further during the ESIA process.

2.1.1 Environmental and Social Impact Assessment

An ESIA is a process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects or impacts identified for a proposed development prior to major decisions being taken and commitments made.

The purpose of an ESIA is to:

- Provide information for decision-making on the environmental consequences of a Project; and
- Promote environmentally sound and sustainable development through the identification of appropriate enhancement and mitigation measures.

During the ESIA phase for the Project the following activities were carried out:

- Specialist investigations;
- Compilation of a draft ESIA report;
- Compilation of this final ESIA report;
- Compilation of an Environmental Management Plan (EMP);
- Compilation and distribution of a letter announcing the availability of draft EIA report for comment and distribution of copies of the report to Interested and Affected Parties (I&APs) upon request;
- Conduct key stakeholder meetings;
- Compilation of a Proceedings Report as a Comments and Response Report (CRR);
- Distribution of copies of the Final EIA and EMP Report to relevant authorities; and
- Announcing authority decision to all registered I&APs.

2.2 Environmental Management Plan

An EMP can be defined as a plan or programme that seeks to achieve a required end state and describes how activities that have or could have an adverse impact on the environment, will be mitigated, controlled, and monitored.

The EMP will address the environmental impacts during the design, construction and operational phases of a Project. Due regard must be given to environmental protection during the entire Project. To achieve this, a number of environmental specifications/recommendations are made. These are aimed at ensuring that the project proponent maintains adequate control over the Project in order to:

- Minimise the extent of impact during the life of the Project;
- Ensure appropriate restoration of areas affected by the Project; and
- Prevent long term environmental degradation.

2.3 Decision-Making Authority

LDEDET will have jurisdiction on the consideration of the application for environmental authorisation under NEMA. The Integrated Water Use Licence Application (IWULA) will be submitted to the Department of Water Affairs DWA and the integrated waste management licence application to the DEA for consideration and approval.

3 LEGAL AND STATUTORY REQUIREMENTS

3.1 Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996)

Section 24 of the Constitution states that everyone has the right to an environment that is not harmful to their health or well-being and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures, that:

- Prevent pollution and ecological degradation;
- Promote conservation; and
- Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

In support of the above rights, the environmental management objectives of the Project are to protect ecologically sensitive areas and support sustainable development and the use of natural resources, whilst promoting justifiable socio-economic development in the Project areas.

3.2 National Environmental Management Act, 1998 (Act No. 107 of 1998)

The NEMA EIA Regulations were published on the 18 June 2010 in GN R.543 and came into effect on 2 August 2010 (the NEMA EIA Regulations). Together with the NEMA EIA Regulations, the Minister also published the following Regulations in terms of Sections 24 and 24D of the NEMA:

- Regulation GN R. 544 - Listing Notice 1: This listing notice provides a list of various activities which require environmental authorisation and which must follow the basic assessment process as described in Sections 21 to 25 of the NEMA Regulations;
- Regulation GN R. 545 – Listing Notice 2: This listing notice provides a list of various activities which require environmental authorisation and which must follow an environmental impact assessment process as describer in Sections 26 to 35 of the NEMA Regulations; and
- Regulation GN R. 546 – Listing Notice 3: This notice provides a list of various environmental activities which have been identified by provincial governmental bodies which if undertaken within the stipulated provincial boundaries will require environmental authorisation. The basic assessment process as described in Sections 21 to 25 of the NEMA Regulations will need to be followed.

Table 3-1 below gives a summary of the listed activities for which Platreef intends to apply for an Environmental Authorisation.

Table 3-1: The listed activities Platreef intends to apply for in terms of NEMA

Government Notice Regulation (GN R.)	Listed Activity Number	The Proposed Activity
GN R. 544, 18 June 2010	9	Platreef proposes to construct the following pipelines: ■ A pipeline for the transportation of sewage; and ■ Pipeline for the transportation of bulk water supply to the mining activities; and stormwater pipelines to prevent the pollution of stormwater by dirty water on site.
	11	Mining and associated infrastructure may be constructed within 32 metres of a water course. Such infrastructure may consist of bulk stormwater outlets, dams for water management functions. However, infrastructure placements will be determined during the EIA process. Currently there a few perennial and non-perennial streams within the Project area, which will be assessed and investigated during the EIA process.
	12	For the construction of Tailings Storage Facility (TSF).
	13	Infrastructure for the storage and/or handling of dangerous goods, including petroleum, explosives and oil will be constructed. Containers used for the storage of dangerous goods will have a combined capacity of between 80 and 500 cubic metres.
	22	Access roads to the mine and internal haul roads within the Project area with a reserve wider than 13.5 metres will be constructed.
	26	It is anticipated that the construction of mining and associated infrastructure as well as access roads and haul roads will be constructed in close proximity to water courses and potential wetland areas
	42	Existing facilities for the storage of dangerous goods, operated during prospecting, will be expanded where the increase capacity will be more than 80 cubic metres. Such facilities will cater for the storage of oil, lubricants and explosives.
GN R. 545, 18 June 2010	3	In addition to existing infrastructure used during prospecting, additional infrastructure will be constructed for the storage of dangerous goods, more specifically: fuel, lubricants, chemicals, gas, burning oils and explosives.
	15	The Project area currently consists of formal and informal housing, as well as subsistence farming and grazing. Thus, undeveloped land will be altered for mining infrastructure construction and operation.

Government Notice Regulation (GN R.)	Listed Activity Number	The Proposed Activity
	19	This activity will be triggered due to the combined area of disturbance in the construction of stormwater management facilities, pollution control dams and tailings storage facilities.
GN R. 546, June 2010 (Limpopo)	2	A bulk water reservoir will be constructed within 5 km of a protected area (Witvinger Nature Reserve).
	4	Access and haul roads will be constructed within 5km of a protected area (Witvinger Nature Reserve).
	9	The construction of above ground conveyors will be done within the Project area.
	10	A facility will be constructed for the storage and handling of dangerous goods, including petroleum, explosives and oil with a combined capacity of more than 30 cubic metres.
	13	To accommodate the construction of surface infrastructure, internal roads and waste storage facilities, clearance of indigenous vegetation will be required.
	14	To accommodate the construction of surface infrastructure and internal roads facilities, clearance of indigenous vegetation will be required.
	16	The construction of mining infrastructure, administrative buildings, change houses and servicing buildings will be constructed within the Project area, possibly within 32 metres of a water course, within 5 km of a protected area (Witvinger Nature Reserve). The exact location of such infrastructure will however, only be determine during the EIA process.
	19	The widening of existing access roads used during prospecting will be done within the Project area within 5 km of a protected area (Witvinger Nature Reserve).
	23	The expansion of existing infrastructure for the storage dangerous goods, operated during prospecting, may be done within the Project area, within 5 km of a protected area (Witvinger Nature Reserve). This existing infrastructure is used for the storage of oil, lubricants and petroleum.

3.3 National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)

NEM:WA regulates waste management in order to protect health and the environment, and provides measures for the prevention of pollution and ecological degradation.

As part of this Waste Act, all waste management facilities must be licenced, and this licencing procedure must be integrated with an environmental impact assessment process. On 3 July 2009, GN R.718 was published with stipulations regarding the waste management activities that require licensing. These activities are divided into Category A (activities requiring a Basic Assessment) and Category B (activities requiring a full EIA). The basic and full EIA processes to be followed are described in the EIA Regulations GN R.543.

The NEM:WA regulations include mining waste. However, residue deposits and residue stockpiles, which are regulated under the MPRDA, are excluded from NEM:WA. Also excluded are radio-active waste, which is regulated by the Hazardous Substances Act, 1973 (Act No. 15 of 1973), the National Nuclear Regulator Act, 1999 (Act No. 47 of 1999) and the Nuclear Energy Act, 1999 (Act No. 46 of 1999), and the disposal of explosives which is regulated by the Explosives Act, 2003 (Act No. 15 of 2003).

The waste management activities requiring a WML in accordance with Section 20(b) of the NEM:WA is indicated in two separate categories namely Category A and B:

- Category A describes waste management activities requiring a Basic Assessment process to be carried out in accordance with the EIA Regulations supporting an application for a waste management licence; and
- Category B describes waste management activities requiring an Environmental Impact Assessment process to be conducted in accordance with the EIA Regulations \ supporting a\ waste management licence application.

Table 3-2 below is a summary of all the potential waste management activities that might require a WML in terms NEM:WA.

Table 3-2: A summary of the waste management activities for the Project that might require a Waste Management Licence

Number and Date of the Relevant Notice:	Activity Numbers (as listed in the NEMA EIA Activity Lis) :	Describe Each Listed Activity:
GN R718, 3 July 2009	Category A, Activity 3(1)	The storage, including the temporary storage, of general waste at a facility that has the capacity to store in excess of 100 m^3 of general waste at any one time, excluding the storage of waste in lagoons (general waste storage facility, salvage yard).
GN R718, 3 July 2009	Category A, Activity 3(2)	The storage, including the temporary storage, of hazardous waste at a facility that has the capacity to store in excess of 35 m^3 of hazardous waste at any one time, excluding the storage of hazardous waste in lagoons (hazardous waste storage facility).

Number and Date of the Relevant Notice:	Activity Numbers (as listed in the NEMA EIA Activity Lis) :	Describe Each Listed Activity:
GN R718, 3 July 2009	Category A, Activity 3(4)	The storage of waste tyres in a storage area exceeding 500 m^2 (waste tyre storage area).
GN R718, 3 July 2009	Category A, Activity 3(5)	The sorting, shredding, grinding or bailing of general waste at a facility that has the capacity to process in excess of one ton of general waste per day (salvage yard and recycling area).
GN R718, 3 July 2009	Category A, Activity 3(8)	The recovery of waste including the refining, utilisation, or co-processing of the waste at a facility that has the capacity to process in excess of three tons of general waste or less than 500 kg of hazardous waste per day, excluding recovery that takes place as an integral part of an internal manufacturing process within the same premises (oil traps at washbay).
GN R718, 3 July 2009	Category A, Activity 3(18)	The construction of facilities for activities listed in Category A.
GN R718, 3 July 2009	Category B, Activity 4(1)	The storage including the temporary storage of hazardous waste in lagoons (contaminated water and leachate pond, pollution control dams).
GN R718, 3 July 2009	Category B, Activity 4(6)	The treatment of hazardous waste in lagoons (oil traps at washbay).
GN R718, 3 July 2009	Category B, Activity 4(7)	Treatment of effluent, wastewater or sewage with an annual throughput capacity of 15 000 cubic metres or more (sewage treatment plant, plant filter plant, mine filter plant).
GN R718, 3 July 2009	Category B, Activity 4(10)	The disposal of general waste to land covering an area in excess of 200 m^2 (on-site general waste landfill).
GN R718, 3 July 2009	Category B, Activity 4(11)	The construction of facilities for activities listed in Category B.

3.4 National Water Act, 1998 (Act No. 36 of 1998)

In accordance with Section 21 and 40 of the NWA a water use licence application will be submitted to the DWA. Investigations have to be undertaken in order to determine what activities will take place, as well as the impacts thereof. It is likely that a licence will be required for the following uses:

- Section 21 (b) – Storage of water for both raw and potable water use;
- Section 21 (c) – Impeding or diverting the flow of water in a water course for crossing of streams via causeways as there is a stream crossing the mining area;
- Section 21 (f) – Discharging waste or water containing waste into a water resource through a pipe or canal for the disposal of sewage works effluent (if constructed);
- Section 21 (g) – Disposing waste or water containing waste in a manner which may detrimentally impact on a water resource for the pollution control dams, overburden dumps, coal stockpiles and discard dumps;
- Section 21 (i) – Altering the bed, banks, course or characteristics of a watercourse; and
- Section 21 (j) – Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity for the safety of the people for the dewatering of the mining pits to facilitate mining and to provide a safe mining environment.

3.4.1 Government Notice GN R. 704

Regulation 4 of this Government Notice states that no residue deposit, reservoir or dam may be located within the 1:100 year flood line, or less than a horizontal distance of 100 m from the nearest watercourse. Furthermore, person(s) may not dispose of any substance that may cause water pollution.

Regulation 5 states that no person(s) may use substances for the construction of a dam or impoundment if that substance will cause water pollution. Regulation 6 is concerned with the capacity requirements of clean and dirty water systems, while Regulation 7 details the requirements necessary for the protection of water resources.

Where any of the GN 704 Regulations are likely to be contravened, the user should apply for an exemption of Regulations 4 and 5 from the Minister.

3.5 Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)

Platreef must be in possession of an approved Mining Right for the mining of the PGMs on the respective farms, before mining operations may commence. In terms of the MPRDA various supporting documentation is required for the Project as part of the application for a Mining Right. In accordance with Section 23(5) of the MPRDA, the Mining Right will only come into effect on approval of the EMP.

The scoping report contemplated in Regulation 49 of the Regulations published in accordance with the MPRDA is founded on the principle of consultation with interested and affected parties, which consultation process and its result is an integral part of the fairness process. The decision to grant a mining right cannot be fair if the administrator did not have full regard to precisely what happened during the consultation process in order to determine whether the consultation was sufficient to render the grant of the application procedurally fair. Following the submission of the required Scoping Report, the EIA and EMP will be submitted to the DMR, for approval in terms of Section 39 of the MPRDA.

3.6 International Finance Corporation's Performance Standards and the Equator Principles

The International Finance Corporation (IFC) is a subsidiary of the World Bank and as a part of its Sustainability Framework, it has published a set of Performance Standards. Compliance with these Performance Standards is mandatory for any project proponent seeking project funding from the IFC. The Performance Standards were updated and revised with effect from January 2012.

The Equator Principles (EPs) are a credit risk management framework adopted by most large international funding institutions for determining, assessing and managing environmental and social risk in Project Finance transactions. Project Finance is often used to fund the development and construction of major infrastructure and industrial Projects such as the Project. Consistent with the current EP framework, the EP Association Steering Committee agreed that the revised IFC Performance Standards would also take effect for EP Association Members from 1 January 2012. EP Association Members have subsequently given support to EP III - the third and most robust version of the EP to date. The vote in favour of EP III means that from 4 June 2013 more deals will be assessed under a strengthened environmental and social risk management framework.

The EP III Principles are:

- Principle 1: Review and Categorisation;
- Principle 2: Environmental and Social Assessment;
- Principle 3: Applicable Environmental and Social Standards;
- Principle 4: Environmental and Social Management System and Equator Principles Action Plan;
- Principle 5: Stakeholder Engagement;
- Principle 6: Grievance Mechanism;
- Principle 7: Independent Review;
- Principle 8: Covenants;
- Principle 9: Independent Monitoring and Reporting; and
- Principle 10: Reporting and Transparency.

3.7 Additional Legislation

The ESIA study is not only subject to the terms and regulations of the MPRDA, NEMA, NEM:WA and the NWA, but must also comply with other applicable South African statutory requirements and guideline documents relevant to the Project. Table 3-3 includes a non-exhaustive list of legislation and guidelines that will be considered during the ESIA.

Table 3-3: Additional National Legislation, Associated Regulations and guidelines applicable to the Project area

Water
■ Water Services Act, 1997 (Act No. 108 of 1997) ■ DWAF: Best Practice Guideline G1: Storm Water Management ■ DWAF: Best Practice Guideline G2: Water and Salt Balances; August 2006 ■ DWAF: Best Practice Guideline A4: Pollution Control Dams (PCDs) ■ DWAF: Best Practice Guideline GH: Water Reuse and Reclamation, June 2006 ■ DWAF: Minimum Requirements Guideline for the Handling, Classification and Disposal of Hazardous Waste, 1998 ■ DWAF: Minimum Requirements Guideline for the Water Monitoring at Waste Management Facilities ■ SA Water Quality Guidelines – Aquatic Ecosystems, 1996 ■ SA Water Quality Guidelines – Domestic Water Use, 1996
Heritage Resources
■ National Heritage Resources Act, 1999 (Act No. 25 of 1999)
Fauna and Flora
■ National Environment Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) ■ National Forest Act, 1998 (Act No. 84 of 1998) ■ Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) ■ DWAF: Minimum Requirements Guideline for the Handling, Classification and Disposal of Hazardous Waste, 1998 ■ DWAF: Minimum Requirements Guideline for the Water Monitoring at Waste Management Facilities
Atmospheric Emissions
■ National Environmental Management: Air Quality Act, 2004 (Act No. 36 of 2004) including Government Notice 220 of 26 March 2010 ■ Department of Environmental Affairs and Tourism: Air Quality Guidelines; and ■ SANS 1929:2005 Edition 1.1 – Ambient Air Quality Limits for Common Pollutants
Hazardous Materials
■ Hazardous Substances Act, 1973 (Act No. 15 of 1973) ■ Occupational Health and Safety Act, 1993 (Act No. 85 of 1993)

■ Major Hazardous Installation Regulations (July 2001) ■ Regulations for Hazardous Chemical Substances (GN R. 1179 GG 16596 of 25 August 1995)
Noise
■ National Environmental Management: Air Quality Act, 2004 (Act No 39 of 2004) (NEM:AQA) ■ SANS 10103:2008 The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, and Annoyance and to Speech Communication
Roads and Rail
■ National Road Traffic Act,1996 (Act No 93 of 1996) ■ National Road Traffic Act Regulations, GN R. 225 of 2002 ■ SANS 10228 ■ SANS 10231 ■ SANS 10232-1 ■ SANS 10229:2005 ■ SANS10233
Development
■ Development Facilitation Act, 1995 (Act 67 of 1995) ■ Electricity Act, 1987 (Act 41 of 1987) ■ Electricity Regulations Act, 2006 (Act 4 of 2006) ■ National Building Regulations and Building Standards Act, 1977 (Act No. 103 of 1977)

4 PROJECT DESCRIPTION

4.1 Project Location

The Project area is located on the Northern Limb of the Bushveld Igneous Complex (BIC), approximately 280 km northeast of Johannesburg and 8 km northwest of the town of Mokopane (formerly known as Potgietersrus) in the Limpopo Province of South Africa (Plan 1 and Plan 2, Appendix A). The Project will be located on the farms Macalacaskop 243 KR and Turfspruit 241 KR with the construction of a TSF on the farm Rietfontein 2 KS (as the preferred location). The farms fall within the Mogalakwena Local Municipal boundaries in the Waterberg District Municipality of Limpopo Province. The Project is located approximately 5 km south of Anglo Platinum's Mogalakwena Platinum Mine.

The Project area is accessible all year-round by a two-lane tarred national highway, the N11. The N11 runs through three farms of the Project area. From the N11 the Project area can be accessed by all-weather gravel roads or by unpaved tracks.

4.1.1 Municipal Settings

The Project is located in the Waterberg District Municipality (WDM) and Mogalakwena Local Municipality (MLM). Local municipalities are further divided into wards which have democratically elected ward councillors who are responsible for representing the needs of the people in the specific ward. MLM is divided into 31 wards of which the directly affected villages fall within the wards 20 to 24, as shown in Table 4-1. The jurisdiction of the Mokopane Traditional Authority (TA) covers an area of 10 wards namely 12, 13 and wards 20 to 31. Table 4-1 outlines the directly affect communities, the relevant farms and ward numbers.

Table 4-1: Directly affected village and wards

Village	Farm Name and Number	Ward Numbers
Ga-Kgobudi	Turfspruit 241 KR	22
Madiba	Macalacaskop 243 KR	24
Tshamahansi	Turfspruit 241 KR and Rietfontein 2 KS	21 and 20
Ga-Magongoa	Turfspruit 241 KR and Rietfontein 2 KS	20
Masodi	Turfspruit 241 KR and Macalacaskop 243 KR	20, 22 and 23
Mzombane	Turfspruit 241 KR	20 and 21

4.1.2 Local Land Uses

According to the Mogalakwena Integrated Development Plan (IDP) (2011/2012) agriculture is important to rural villages within the municipal area. The Mogalakwena Local Economic Development (LED) Strategy (Urban-Econ, 2006) stated that agriculture should be prioritised as an important economic sector.

Many households within the Project area have agricultural plots on communal land. These fields are an average of 0.8 ha in size and consist primarily of maize farming. It is likely that these plots are utilised for subsistence purposes in order to subsidise the income of households residing there. In some cases it was reported that owners rent these plots out to farmers for a certain period. Some community residents also own cattle which are mostly for subsistence purposes with only a few farmers selling cattle commercially.

4.1.3 Land Tenure

MLM is 6 166 km^2 in size and consists of 38 proclaimed townships and 109 villages. Apart from Mokopane, the municipal area is mostly rural in nature consisting of agricultural land with a number of small settlements disbursed throughout the municipal area (Mogalakwena LED Strategy, 2006). With about three or four exceptions, all the townships (38) are located in Mokopane and the Mahwelereng area (north of Mokopane) (Mogalakwena IDP 2011/2012). The Platreef exploration area similarly falls within the Mokopane/Mahwelereng area.

The Mogalakwena Municipal area is crossed by the N1 and N11 national highways which spatially integrate the municipality with the rest of Limpopo Province as well as the economic hub of Gauteng and tourism attractions further north and in Mozambique and Zimbabwe.

The Mokopane/Mahwelereng area is noted as a provincial growth node which means it has been identified as an area for growth and services within the provincial context as well as at a district and local municipal level. Although Mokopane/Mahwelereng is identified as an Urban Zone (area where urban activities are undertaken) the IDP (2011/2012) notes that Mahwelereng exhibits some features of a peri-urban area such as subsistence farming. This is the case for the directly affected villages which are residential areas on the outskirts of Mokopane with some features of a peri-urban area.

4.2 Project Details

Platreef is currently investigating the construction and operation of an underground platinum mine and associated surface infrastructure on the farms Turfspruit 241 KR and Macalacaskop 243 KR, Rietfontein 2 KS and potentially Bultongfontein 239 KR.

4.2.1 Project Description

4.2.1.1 The Mineral to be Mined

Based on the Mining Work Programme Table 4-2* summarises the minerals to be mined.

Table 4-2: Particulars of the resource to be mined

Type of mineral	The target minerals are: PGM's Platinum (Pt), Palladium (Pd), Rhodium (Rh), Iridium (Ir), Ruthenium (Ru), and Osmium (Os). All Other Associated Metals and Minerals, including but not limited to: Gold (Au), Silver (Ag), Nickel (Ni), Copper (Cu), Cobalt (Co) and Chrome (Cr).

Locality (Direction and distance from nearest town)	The nearest town is Mokopane, located 8 km south of the Project Area in the Limpopo Province.
Extent of the area required for mining	Total area is 7 841.264 ha.
Extent of the area required for infrastructure, roads, servitudes etc.	Approximately 2 247 ha.
Depth of the mineral below surface	The reef outcrops and dips to a depth of approximately 1 100 m below surface.
Geological formation	The Project is located on the BIC. The BIC consists of a lower sequence of layered mafic and ultramafic rocks known as the Rustenburg Layer Suite (RLS) and an overlying unit of granites known as the Lebowa Granite Suite. These layered rocks occur in four areas known as the Western, Northern, Eastern, and Bethal limbs. The Project is located in the Northern Limb, on the reef known as the Platreef which has unique geological characteristics as defined in Section 4.3 below.

*Mineral Resources for the Project were classified under the 2010 CIM Definition Standards for Mineral Resources and Mineral Reserves. The mineral resource estimation was compiled by Dr Harry M. Parker, and Mr Timothy O. Kuhl.

Mineral Resources have been estimated on an externally undiluted basis and without consideration for mining recovery. Dilution and mining recoveries will vary with the geometry (dip, thickness) of the mineralisation and the eventual mining method used. These factors can only be estimated after life-of-mine plans are prepared. Typically dilution (low-grade or waste materials) ranges from 10% to 30%, and mining recoveries range from 70% to 100% using the mining methods considered for evaluation of reasonable prospects of economic extraction.

Mineral Resources, estimated assuming bulk-underground mining methods, are tabulated in Table 4-3. This table represents the Mineral Resource Base Case. The resource estimate was classified in the indicated and inferred resource categories.

Table 4-3: Mineral Resources estimation recorded in the Mine Works Programme

Platreef Mineral Resource Estimate February 2013: Flatreef Mineral Resource, assuming selective underground mining													
The base case at a 2.0 g/t 4PE cut-off is highlighted													
Class	**Cut-off Grade 4PE**	**Million**	**Grade**							**True Thickness**	**Contained Metal**		
	g/t	**tonnes**	**4PE g/t**	**Pt g/t**	**Pd g/t**	**Au g/t**	**Rh g/t**	**Ni %**	**Cu %**	**(m)**	**4PE Moz**	**Nickel Mlb**	**Copper Mlb**
Indicated	3	138	5	2.2	2.3	0.34	0.11	0.38	0.17	17.1	22	1 200	500

Platreef Mineral Resource Estimate February 2013: Flatreef Mineral Resource, assuming selective underground mining													
The base case at a 2.0 g/t 4PE cut-off is highlighted													
Class	**Cut-off Grade 4PE**	**Million**	**Grade**							**True Thickness**	**Contained Metal**		
	g/t	**tonnes**	**4PE g/t**	**Pt g/t**	**Pd g/t**	**Au g/t**	**Rh g/t**	**Ni %**	**Cu %**	**(m)**	**4PE Moz**	**Nickel Mlb**	**Copper Mlb**
Indicated	2	223	4.1	1.8	1.9	0.28	0.09	0.34	0.16	24.3	29.2	1 700	800
Indicated	1	482	2.5	1.1	1.2	0.19	0.06	0.27	0.15	29.1	39.4	2 900	1 600
Indicated	3	181	4.4	2	2	0.34	0.1	0.38	0.17	12.9	25.8	1 500	700
Indicated	2	410	3.3	1.5	1.5	0.26	0.08	0.32	0.18	18	44	2 900	1 600
Indicated	1	881	2.2	1	1	0.19	0.05	0.27	0.16	23.6	63.4	5 200	3 200

4.2.1.2 Mining Method

An underground mine will be employed making use of the sublevel blast hole stoping method. Primary access to the underground mine is planned to be via a 7.25 m diameter by 1 250 m deep production and service shaft (Shaft No. 1). Three additional ventilation shafts (Shaft No's 2, 3, and 4) will also be developed to a depth of approximately 900 m.

Access from the production shaft to the ore zones will be provided by the development of main access levels at depths of 650 m, 750 m, 900 m and 1 100 m below surface. Stope access will be provided by ramps and additional mining sublevels located near the individual ore zones.

The ore zones are divided into individual stopes. Access drifts are driven through the ore zone at the top and bottom of each stope from the mining sublevels. At the bottom of the stope, a number of drawpoints are mined and equipped to extract the ore. The ore is drilled and blasted from the access drifts and the ore is removed from the stope using a diesel-powered Load-Haul-Dumper (LHD) and dumped in an orepass located nearby. From here the ore is loaded from the orepasses onto trucks and hauled to ore bins located near the production shaft. The ore will then be fed from the ore bins to a crusher which will be located below the 1 100 m level. The crusher will discharge the ore into a fine ore bin. The ore will then be fed onto a conveyor system which will be located on the 1 200 level that will be transferring it to a skip loading station at the Shaft No 1.

After the mining of each stope is completed, it might be backfilled with cemented fill. Both paste fill and hydraulic fill options will be evaluated during future studies

4.2.1.3 Ore Receipt and Crushing

Primary crushing is done underground. Run of Mine (RoM) ore at a top size (F100) of 1 200 mm is fed to the jaw crusher, which gives a product (P80 (product, 80% passing)) of approximately 150 mm. For design purposes, this top size has been taken as 300 mm. Primary crushed materials are conveyed from underground to the surface concentrator. Tramp metal removal is effected using a tramp metal magnet and metal detector situated on the conveyor.

The crushed underground RoM is received at the secondary screen. The screen has a cut size / aperture of 40 mm, the oversize material proceeding to the secondary crusher feed bin and the under size material to the final crushed product screen via a transfer conveyor.

The secondary crusher feed bin has a live capacity of 250 t or approximately 30 minutes, the secondary cone crusher is choke fed via a vibrating feeder. The secondary crusher product (P100 of 79 mm) joins the primary screen under size material and is fed to the tertiary crusher product screen. This screen has a cut size / screen aperture of 12 mm, the under size reporting to the mill feed silo and the oversize to the tertiary short head cone crusher feed bin. The feed bin has a live capacity of 150 t or approximately 30 minutes. The tertiary crushers are fed via vibrating feeders, the crushed product joins the final crusher screen feed conveyor the P100 from the tertiary crusher is approximately 30 mm.

Although both secondary and tertiary screens are referred to as single deck, they are in fact double deck screens with the top deck providing a scalping and protection action thus assisting in reducing the screen area and also preventing choking and excessive wear on the cut size screen deck.

4.2.1.4 Milling

The milling circuit selected is two stages with a primary mill operating in open circuit feeding to a secondary mill operating in closed circuit. A mill feed silo with a live capacity of 12 000 t or 24 hours is fed via conveyor with final crushed product. The silo is equipment with three belt feeders which draw material from the silo onto the mill feed conveyor. The feed to the mill is controlled via these feeders, a weightometer situated on the mill feed conveyor measures the feed to the mill. Before entering the mill the material is sampled, the F80 (feed, 80% passing size) to the mill is 7.9 mm.

The primary mill is a 7.5 MW, 20 ft diameter, 35.5 ft Effective Grinding Length (EGL) ball mill. The mill is operated in open circuit. The mill grinds to a product size P80 of 500 µm. The mill discharges directly to the secondary mill sump. Mill design has been to utilise two mills of the same dimensions.

The secondary mill is a 7.5 MW, 20 ft diameter, 35.5 ft EGL ball mill. The mill is operated in closed circuit with a multi-cyclone nest; the circuit is designed for a re-circulating load of 250% and produces a P80 of 75 µm from the new feed size F80 of 500 µm. Water is added to the mill discharge sump to give a cyclone slurry feed density of approximately 51%. The overflow from the cyclones is at a density of 30% approximately and then gravitates directly to the flotation circuit conditioning tank.

The media used for the mill will be high chrome steel. Steel balls are added to the mill using a dedicated ball kibble, magnet and hoist arrangement. This will be a semi-automated operation and steel will be added as required. Spillage from the milling circuit will report to the mill discharge sump. Scats from the mill are discharged into a kibble for circuit removal.

4.2.1.5 Concentrator Plant

The plant will consist of a concentrator for all three production phases of 4 Million tonnes per annum (Mtpa), 8 Mtpa and 12 Mtpa during the LoM. The concentrator plant will consist of three stages of crushing, ball milling and classification.

4.2.1.6 Proposed Access Routes

The main access route to the Project site will be directly from the N11 national highway.

4.2.1.7 Expected Workforce

According to the Social and Labour Plan (SLP) for Platreef, the expected workforce for the mine when fully operational will be approximately 2 000 people (permanent and contractors).

During the construction phase the mine will employ 72 permanent people.

4.2.2 Project Motivation

The Project will contribute to the local economy through both direct and indirect employment opportunities and will result in a substantial injection of cash into the local economy of the Mogalakwena local municipal area. In addition, there will be an increase in opportunities for local suppliers of goods and services to the operation.

In general, the socio-economic conditions in the area will be uplifted through better infrastructure, LED Projects, Broad Based Black Economic Empowerment (B-BBEE) ownership and projects and other company Corporate Social Responsibility (CSR) initiatives such as Enterprise Development (ED).

4.2.2.1 Platinum

Apart for its use in jewellery, platinum has many applications as a catalyst, either in its pure form, or as an alloy with rhodium. This allows a large range of chemical reactions such as that of reforming petroleum, producing nitric acid, producing pharmaceutical products, and for removing hydrogen and chlorine (particularly in organic chemical synthesis). Platinum is also used in electronics; while its incorruptibility makes it ideal for crucibles (along with rhodium and iridium additions) and retorts used in handling high corrosive chemicals or where resistance to high temperatures is required. According to Johnson Matthey (2013) a decline in output from South Africa caused a deficit in the platinum market of 375 000 oz in 2012. Supplies of platinum fell by 13% to 5.64 million oz and its total demand in 2012 was down by 0.6% to 8.05 million oz. The recycling of platinum was marginally less than in 2011 at 2.03 million oz. Furthermore Johnson Matthey (2013) explains that primary supplies of platinum, at 5.64 million oz, were at a 12 year low, with platinum shipments by South African producers down by 16% to 4.10 million oz in 2012. Legal and illegal strikes, safety stoppages and the closure of some marginal mining operations caused the loss of at least 750 000 oz of production.

The Platinum 2013 Report (Johnson Matthey, 2013) reported that the gross demand for platinum in autocatalysts rose by 1.7% to 3.24 million oz. The European demand was recorded to be weak due to depressed light vehicle output and a lower market share for diesel vehicles; however, this was offset by higher demand in Asia and North America and increased demand for platinum autocatalysts for non-road diesel engines.

Furthermore the Platinum 2013 Report (Johnson Matthey, 2013) reported that the gross demand for platinum for jewellery manufacturing grew by 12% in 2012 to 2.78 million oz. This was helped by expansion of the retail jewellery distribution network in China. Manufacturers also took advantage of the relatively weak platinum price to increase stocks.

4.2.2.2 Palladium

Almost totally corrosion-free, palladium is used in alloy form with other precious metals in electronics (such as electrical contacts, particularly in telephone systems) and as resistance windings, especially where high precision is required. It is also used in electrothermal fuses, particularly in electric furnaces, as well as thermocouples and as a catalyst for the production of ethylene, vitamins A and E, brazing, welding (particularly jewellery), and other uses.

According to the Platinum 2013 Report (Johnson Matthey, 2013), the palladium market moved into a deficit of 1.07 million oz in 2012 following a surplus of 1.19 million oz in 2011. This was due to lower primary and secondary supplies, record demand for palladium autocatalysts and a large swing in investment demand from heavily negative in 2011 to strongly positive in 2012. However the gross demand for palladium in autocatalysts increased by 7.5% to a new high of 6.62 million oz. Demand strengthened for several reasons: recovering car output in Japan after the natural disasters of 2011; further growth in China; and a boom in new registrations in North America as consumer confidence and economic activity continued to improve.

The Platinum 2013 Report (Johnson Matthey, 2013) further reports that Industrial demand for palladium fell by 4% to 2.37 million oz in 2012. Demand for palladium in chip capacitors, its main electrical application, decreased due to thrifting and competition from base metal alternatives. Demand for palladium chemical process catalysts grew, however, particularly in Asia. There was a decrease of 12% to 445,000 oz in gross world demand for palladium in jewellery manufacturing (Johnson Matthey, 2013). Poor consumer demand for palladium jewellery in China resulted in fewer manufacturers and retailers producing it or carrying stock. In most other regions, palladium demand was steady and it was slightly higher in Europe, supported by its use in wedding rings for men.

4.2.2.3 Rhodium

With an extremely high resistance to corrosion, rhodium is used to plate steel and brass in order to prevent corrosion from seawater and other elements. Such coatings must be extremely thin and used only when the cost is justified. As an alloy with platinum (containing about 1% rhodium), it is used in thermocouples, electrical equipment and synthetic fibre production. It is used as a catalyst in producing nitric acid from ammonia, along with several other catalytic uses. Rhodium has a very high optical reflectivity, which is particularly useful since it is almost untarnishable.

According to the Platinum 2013 Report (Johnson Matthey, 2013) supply and demand for rhodium came close to balance in 2012 after the previous year's substantial surplus. This was the outcome of a reduction in mine supply, principally from South Africa, a smaller amount of rhodium reprocessed from end-of-life autocatalyst scrap and a strong increase in demand for rhodium for new autocatalyst manufacture and for physical investment.

4.2.2.4 Iridium

The high melting point, hardness and corrosion resistance of iridium and its alloys determine most of its applications. Iridium and especially iridium–platinum alloys or osmium–iridium alloys have a low wear. Corrosion and heat resistance makes iridium an important alloying agent.

According to the Platinum 2013 Report (Johnson Matthey, 2013) the Iridium demand fell by almost a half in 2012 because of lower purchasing from the electrical sector.

4.2.2.5 Ruthenium

Because of its ability to harden platinum and palladium, ruthenium is used in platinum and palladium alloys to make wear-resistant electrical contacts. In this application, only thin plated films are used to achieve the necessary wear-resistance. Because of its lower cost and similar properties compared to rhodium, the use as plating material for electric contacts is one of the major applications

According to the Platinum 2013 Report (Johnson Matthey, 2013), the demand for ruthenium fell by nearly a third in 2012 after two exceptionally strong prior years.

4.2.2.6 Osmium

Because of the volatility and extreme toxicity of its oxide, osmium is rarely used in its pure state, and is instead often alloyed with other metals. Those alloys are utilized in high-wear applications. Osmium alloys such as osmiridium are very hard and, along with other platinum group metals, are used in the tips of fountain pens, instrument pivots, and electrical contacts, as they can resist wear from frequent operation.

4.2.3 Infrastructure

The Project is a Greenfields Project and will, therefore, require many services, support facilities and infrastructure in order to operate. Most of the planned infrastructures require either an environmental authorisations in terms of NEMA or a WML in terms of NEM:WA. The major infrastructure requirements are discussed in the sections below and depicted in Plan 3 (Appendix A). A Geotechnical study has been conducted by SRK and the report included in Appendix B.

4.2.3.1 Bulk Water Supply

Platreef is a member of the Joint Water Forum (JWF); which forms part of Olifants River Water Resource Development Project (ORWRDP), and the Pruissen Water Forum. These forums have been established to facilitate and co-ordinate discussions with the various participants in the scheme within the Eastern and Northern Limbs of the Limpopo Province. Participants in the water scheme are required to indicate their water requirements from the scheme in order for total water requirements to be calculated relative to the capacity of the scheme. These requirements are translated into a non-binding Memorandum of Agreement and then a binding Off-take Agreement. The Project has indicated that their water requirement is approximately 16.2 Ml/d. Platreef is committed to working with the JWF to develop the ORWRDP as the primary source of bulk water to the service the needs of the Project.

4.2.3.2 Roads

The N11 national highway connects Mokopane with the South Africa-Botswana border. The Project site is accessed from the N11, a double-lane tarred national highway which is, at present, in good condition. The N11 runs directly through the Turfspruit and Macalacaskop farms. From the N11, intersections exist to the proposed mine and plant sites. These roads will be used as the main access road to the mine. It will be necessary to upgrade the existing dirt road and upgrade the existing track. The roads will not be utilised for the tramming of ore to the concentrator plants. This will be achieved by making use of conveyors.

4.2.3.3 Power Supply

Although capacity and infrastructure for power supply as it currently exists would not support mine development, the new 4.3 GW Medupi Power Station (once completed) will provide sufficient power to fulfil the required demand.

Platreef have entered into an agreement with Eskom, whereby the parastatal will supply 70 MVA of power by expanding the national grid that would bring an additional high voltage line near the Project area. Further agreements with Eskom were made to provide a temporary supply of a 5 MVA overhead power lines to support the power requirements during any future construction activities for the Project.

4.2.3.4 Tailing Storage Facility

Geo Tail was appointed by Platreef to carry out the necessary activities and tasks, in accordance with the specified requirements and scope of work, to present a scoping study for the new TSF required for the Platreef Project in Limpopo, South Africa.

The design objectives for the TSF are listed below:

- Create a safe and stable tailings storage facility and minimize risk to human lives, health and property;
- The design will be such that it will remain fit for the intended purpose and resist all external environmental influences that are reasonably likely to occur (sustainability);

- The design should conserve all resources as far as possible i.e. land area, water, airspace, topsoil, mineralization and energy;
- Comply with South African legal requirements and benchmarking against best practice international standards;
- Minimize environmental impacts, where potentially possible;
- Separation of clean and dirty water;
- Minimum storage of supernatant on the tailings storage facility;
- Cost effective construction, operation and closure; and
- The tailings storage facility will not be situated such that it sterilises any ore or be in conflict with any mining activity.

4.2.3.4.1 <u>Selection of Alternative Locations</u>

Four possible TSF sites were initially identified during the scoping phase. These possible sites, their locations and the status quo of each are:

- Site 1 (farm Turfspruit 241 KR): This site was eliminated after scoping due to its close proximity to sensitive environmental and social aspects;
- Site 2 (farm Rietfontein 2 KS): Preferred TSF site;
- Site 3 (farm Bultongfontein 239 KR): Alternative site and possible future expansion; and
- Site 4 (farm Rietfontein 240 KR): This site was eliminated after scoping because the geology and mineralisation of the site is not yet known by the mining right holder of the land. Placing a TSF here could therefore result in the sterilisation of resources.

4.2.3.5 Other Support Facilities Identified for the Project

Additional mine infrastructures that are anticipated to be constructed are the following:

- *Waste Management*: temporary handling and storage of general and hazardous waste, on-site change houses/ablution facilities with sewage treatment plant and a possible incinerator for treating sewage screenings;
- *Storage and Handling of General waste:* An onsite general waste landfill site is planned to be constructed;
- *Surface Water Management:* water supply dams, mine residue facility return water dams, pollution control dams and clean and dirty storm water controls, river crossings;
- *Storage and Handling of Hazardous Substances:* fuel, lubricants, various process input chemicals, ore and waste rock stockpiles/bunkers, gas, burning oils, and explosives;

- *Services*: overhead power lines, pipelines, conveyors, roads, telephone lines, communication and lighting masts;
- *Waste Rock Dump*: See Section 4.3.4.5 of this report;
- *Crusher Plant:* See Section 4.2.1.3 of this report;
- *Security, Access Control and Fencing;*
- *Lay Down and Storage Yard Areas;*
- *Compressor House;*
- *Stores, Lamp Rooms, Workshops and Wash Bays;*
- *Office and Control Rooms;*
- *Contractor Camps;*
- *Medical Station;*
- *Production Shafts system with men, material and ore handling systems (winders and headgear);*
- *Ventilation Shafts;*
- *4 Mtpa Concentrator Plant;*
- *Water Reservoir; and*
- *HV / MV and LV Substations.*

4.3 Waste Management

Golder Associates Africa (Pty) Ltd (GAA) has been appointed by Platreef to develop an Integrated Waste Management Plan (IWMP) and to undertake a Waste Management Licence Application process in terms of NEM:WA for the Project. All waste licence documents have been compiled and attached to Appendix C.

Waste management is one of the key features of a company’s environmental management system, whether the system is formalised or not. It is recognised that waste can be well managed in an environment where it is planned for, with clear objectives and targets set and implementation measures designed to achieve such objectives and targets. This planning requirement is now legislated and entrenched in NEM:WA, with the industry sector expected to prepare and implement Industry Waste Management Plans (IndWMPs).

The IWMP will be compiled so that it conforms to the requirements of the National Waste Management Strategy as was approved on 09 November 2011, the NEM:WA and its pending regulations and standards, and various other legislative requirements.

Platreef has not yet commenced mining and the Project provides an opportunity to set an ideal in respect of managing waste streams that it may be assumed will be generated. In setting an ideal IWMP, the following objectives need to be met:

- As a minimum, comply, but ideally exceed waste related legislative requirements; and
- Establish an overall IWMP towards waste management optimisation and continuous improvement.

An underpinning philosophy to the IWMP is the waste management hierarchy (Figure 4-1) to assess waste management options through which waste (which is normally regarded as fit for grave) could find application as a resource which implies that it moves back to the cradle part its life-cycle.

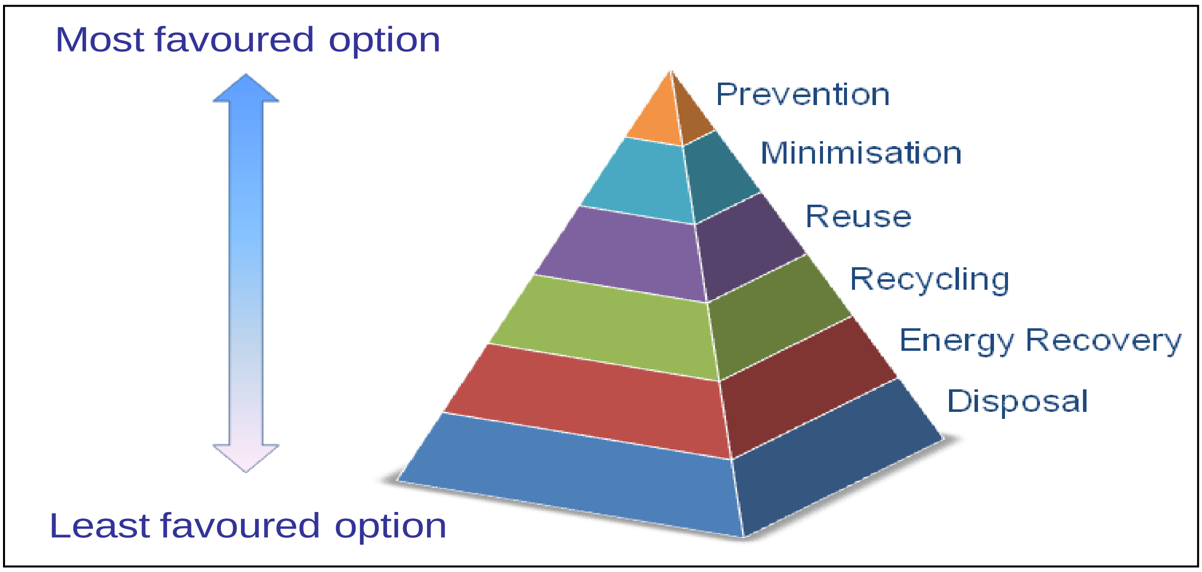

Figure 4-1: Waste management hierarchy

4.3.1 Elements of an IWMP

The IWMP will contain elements that relate to the control of generation, storage, collection, transfer and transport, processing and disposal of waste in a manner that is in accordance with legislative requirements and best principles of public health, economics, engineering, aesthetics, and environmental considerations.

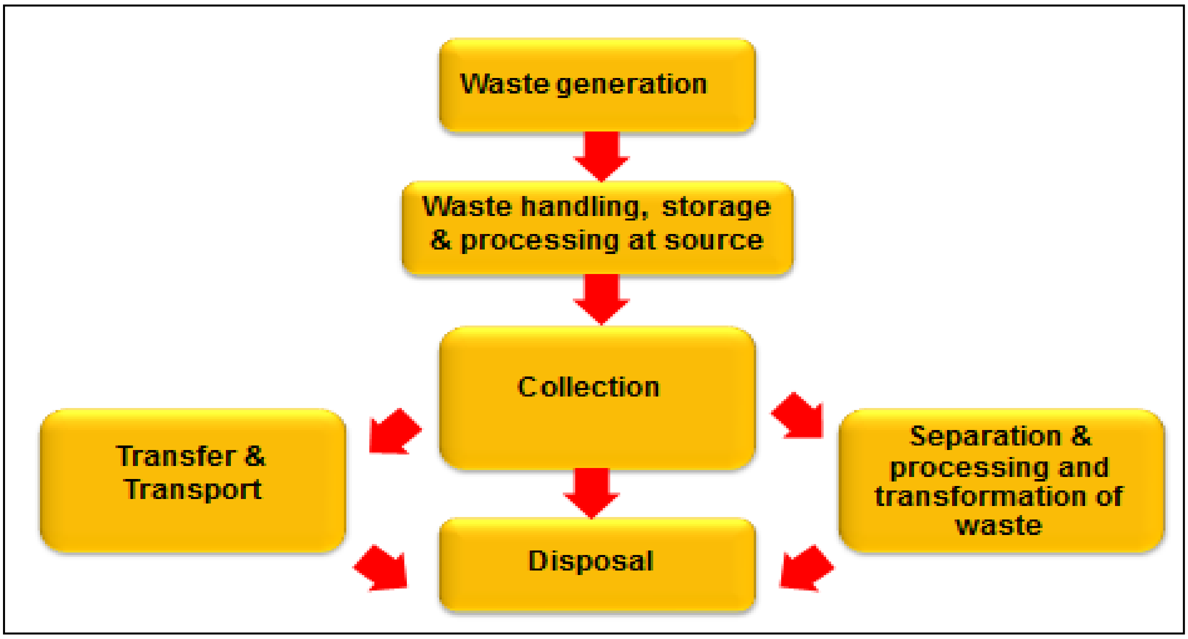

Figure 4-2: Elements of the IWMP

4.3.2 Sustainability of Operations

In order to ensure that proposed mining operation implements a sustainable waste management system, the following principles will need to be entrenched in the IWMP.

Providing for proper management through contractors

In order to ensure compliance to waste targets, legislative requirements, licence conditions, policies, procedures and standards, etc. Platreef will need to ensure that contractors adhere to such aspects. This can be achieved by including such aspects into contractor agreements/contracts, regular audits, implementing a penalty system for non-compliance, etc.

Ensuring dependable waste management outlets (either on site or off site)

Platreef will need to ensure that waste is safely disposed of at proper facilities. This can be achieved by means of performing the following:

- Provision of suitable, adequate on-site waste receptacles (to prevent letter and to enable separation at source);
- Provision of efficient collection, transfer and transport of waste (logistics optimisation, adequate waste equipment and resources, etc.);
- For off-site disposal facilities, contracts / agreements will need to be established in order to ensure that waste can be safely and timeously disposed of off-site; and
- For on-site disposal facilities, ensuring that disposal sites are constructed and operated in accordance with designs and operating plans approved by the relevant Authority.

Performing duty of care

NEMA (as amended) places a duty of care on any person who causes significant pollution or degradation of the environment, requiring him to institute measures to prevent pollution from occurring, or to minimise and rectify the pollution or degradation where it cannot reasonably be avoided. The NEM:WA echoes the duty of care provision by obliging holders of waste to take reasonable measures to implement the waste hierarchy whilst protecting the environment and public health.

Duty of care requirements will need to be entrenched in the IWMP. Examples of how this will be done include:

- Selecting strategies in line with the waste management hierarchy;

  It is important to note that Section 17 of the NEM:WA stipulates that "any person who undertakes an activity involving the reduction, re-use, recycling or recovery of waste must, before undertaking that activity, ensure that the reduction, re-use, recycling or recovery of the waste

  (a) uses less natural resources than disposal of such waste; and

  (b) to the extent that it is possible, is less harmful to the environment than the disposal of such waste".

- In the implementation strategy, include performing environmental and human health risks assessments prior to implementing downstream applications of waste (e.g. downstream use of sewage sludge in agricultural applications);
- Implementing groundwater, surface water, air quality, etc. monitoring programmes to detect potential environmental pollution;
- Allocating waste functions to appropriately skilled and trained employees; and
- Implementing a waste awareness campaign.

Adhering to cradle to grave principle

The cradle to grave principle (stipulated in NEMA) means that responsibility for the environmental and health consequences of a product, process or service, starts with the extraction or processing of the raw materials and extends through manufacturing and use to include ultimate disposal of products or waste. Consequently, a person retains responsibility for their waste even if it is transferred to another person for disposal or treatment off site.

Platreef will need to ensure that safe disposal certificates are obtained from waste service providers that have removed waste for recycling / treatment / disposal at an off-site facility. In addition, facilities to be used for recycling / treatment / disposal should be audited prior to establishing waste contracts / agreements. Auditing criteria should include the following:

- Compliance with legislative requirements (ensuring that the relevant permits/licences/authorisations/registration are in place for the facility to receive the waste); and

- Remaining airspace (ensuring that the facility has adequate airspace to accept wastes generated at the mine).

4.3.3 Waste Inventory

Since the Project has not yet commenced, the following inventory was assumed based on experience, calculations done according to figures received for similar mining operations in South Africa, and estimated numbers for workers on the mine.

The projected waste inventory is included in Table 4-4 with each source, classification, estimated quantities and potential management solutions. The following assumptions either apply individually or jointly to the waste inventory:

- For identification of potential waste streams that could be generated at Platreef, other similar sized platinum mines were used for comparative purposes;
- Production rate of 4 Mtpa (specifically as it relates to volume of tailings);
- Employment figures for Platreef up to 3 010 people pre-production and peak population in operation phase is 918 persons (used for determining generation rates for domestic waste); [1]
- The bulk shaft and construction phase is 6 years and life of mine is 30 years;
- Restaurant / canteen facilities will be provided on site;
- There will be a medical station in the plant area; and
- No provision has been made for waste generated from accommodation facilities, albeit that construction camps to a certain extent will contribute to the domestic waste stream during the establishment phases of the mine. In the context of the 30 year life of the site, the design and footprint of domestic waste disposal facility will not be significantly affected by such an activity.

Table 4-4: Waste inventory for the Project

Waste Type	Source	Classification	Estimated Quantity	Waste Management Facility/Solution
Mineral Waste				
Tailings	Concentrator process	Hazardous (mineral waste)	3.81 million tpa (dry) operational phase	On-site tailings storage facility (TSF)

[1] Golder was provided workforce figures by DRA with a peak of 3010 in the construction phase and a peak of 918 in the operational phase. The other numbers quoted pre-date the revision provided by DRA. A number of iterations have been undertaken over the years, and the expected labour force of 2000 at full production comes from the latest and current studies on which the current labour figures and Mining Right Application are based.

Waste Type	Source	Classification	Estimated Quantity	Waste Management Facility/Solution
Sludge	Mine filter plant (water treatment plant),	Hazardous until classification testing has been done according to SANS 10234.	$300m^3$/month (combined)	On-site TSF
	Plant filter plant			
Silt	Maintenance of: Plant pollution control dam (PCD)	Assume hazardous (mineral waste)	$1200m^3$/year	On-site TSF
	Mine PCD	Assume hazardous waste, subject to classification according to SANS 10234.	$1200m^3$/year	On-site landfill or licenced hazardous disposal facility, depending on classification
	Waste PCD		$1200m^3$/year	
Waste rock	Shaft excavations/mine development	Could vary from general to hazardous, but in terms of the required design standards it could be reasonably accepted that non-hazardous designs supported by Source Pathway Receptor Modelling would suffice for authorisation applications	1780 000 tons total from bulk mine shaft sinking. 360 000 tpa from Year 1 onwards	Re-use options will be explored in part, and unusable portions to be disposed on on-site waste rock dump
Non-Mineral: Industrial Waste				
Electronic waste	Offices and workshops	Hazardous	31 tpa operation phase	Recycling On-site/off-site H:H disposal
Scrap metal/steel (ferrous and non-ferrous)	Equipment and vehicle maintenance workshops	Ranging from general to hazardous	2 600 tpa all phases	Recycling
Used oil and grease	Equipment and vehicle maintenance workshops	Hazardous	22 tpa all phases	Recycling and take-back agreement Off-site H:H disposal
Used paint	Stores	Hazardous	40 m^3/a all phases	Reduction Donate to community

Waste Type	Source	Classification	Estimated Quantity	Waste Management Facility/Solution
				Take-back agreement
Used Batteries (Lead acid from mining vehicles and small NiCd from headlamps)	Workshops and designated bins mine wide	Hazardous	2.3 tpa all phases	Take back agreement Recycling On-site/off-site H:H disposal
Packaging	Stores: New equipment & consumables brought on site	General	17 000 tpa all phases	Recycling
Rubber (Tyres and conveyor belts)	Vehicle and Equipment maintenance area	General	51 tpa all phases	Recycling On-site re-use applications
Non-Mineral: Domestic Waste				
Domestic waste	Mine wide bins and storage facilities	General	1 240 tpa all phases	Separation (for recycling) On-site/off-site landfill
Office waste	Offices in shaft and concentrator areas	General	1.04 tpa operational phase	Recycling and take-back agreement
Wood and garden waste	transport and storage crates in stores	General	Approx. 1 300 tpa all phases	Recycling Donate to community Composting
Non-Mineral: Hazardous Waste				
Domestic wastewater	Sewage treatment plant	Bio-hazardous – until classification testing has been done according to SANS 10234	164 ML/a at peak construction phase population to 50 ML/a in operation	On-site sewage treatment plant (STP), with potential re-use of sewage effluent
Sewage residue (sludge and screenings)	Sewage treatment plant	Bio-hazardous– until classification testing has been done according to SANS 10234	21 tpa at peak construction phase population to 6.3 tpa in operation	Composting/ Off-site disposal facility
Explosive contaminated waste, and	Blasting areas in the shaft	Hazardous	17 tpa from construction phase	Take back agreement

Waste Type	Source	Classification	Estimated Quantity	Waste Management Facility/Solution
explosives packaging				
Explosive bags	Concentrator stores	Hazardous	4.7 tpa operational phase	Take back agreement
Dry reagent Bags from flotation unit	Concentrator stores	Hazardous	21 tpa operational phase	Take-back agreement/re-use
Lab waste	Laboratory	Hazardous	73 tpa all phases	On-site/off-site H:H disposal
Hydrocarbon contaminated soil	Mine wide, mostly at workshops	Hazardous	20 tpa all phases	Spillage prevention plan Bioremediation, Off-site H:H disposal
Crushed fluorescent tubes (traces of Hg)	Mine wide lighting, stored at designated hazardous storage area at shaft	Hazardous	1.1 tpa all phases	Avoidance/ reduction Recycling On-site/off-site H:H disposal
Oil contaminated PPE/Rags	Mine wide	Hazardous	33 tpa all phases	Off-site H:H disposal or Off-site Incineration
General medical waste (including sanitary waste)	Medical centre in the shaft area	Hazardous	8.7 tpa all phases	Destruction On-site/off-site H:H disposal

4.3.3.1 Waste Management Information System

It is recommended that Platreef implement a Waste Management Information System (WMIS). It could take the form of a standardised spread sheet, which is protected from tampering and managed under a specific department, or in the form of a software package that can be installed on a Platreef mine wide network accessible to all the relevant waste management staff for the frequent and accurate recording and tracking of all waste generated, stored, transported and disposed.

By tracking all waste, Platreef will be able to monitor performance in relation to targets as well as trends in waste management in order to prevent non-compliances or any illegal activities on and off-site. Having accurate waste data will empower Platreef management in terms of waste and will assist in auditing, evaluations and updating of plans and targets.

As a waste generator, Platreef will need to register on the South African Waste Information System (SAWIS) and submit waste data at intervals as required by the SAWIS. The waste data recording system should be aligned with the reporting requirements of the SAWIS.

The Platreef WMIS should include most if not all of the following reporting sections:

- Type, classification and composition of waste;
- Source and frequency of waste generation;
- Storage conditions;
- Transport used;
- Re-use or Recycling opportunities taken;
- Measurement of performance against targets for recycling etc.;
- Track costs of disposal vs. income from recycling;
- Disposal options used and waste destination;
- Uploading of safe disposal certificates; and
- Automated reports depicting the data and some interpretations thereof.

4.3.4 Waste Facilities

Waste related facilities that will be constructed as part of the Project is discussed in the sections below.

4.3.4.1 Integrated Waste Management Area

Waste trucks will enter the site from the mining areas at designated access controlled entrances and proceed to the general or hazardous storage facility depending on the type of waste transported. Recyclable and/or hazardous waste will be offloaded and stored in the appropriate storage area and the remaining waste will be transported to the landfill.

An access road to the integrated waste management area will be located at the north eastern corner of the site. Access to the site would be controlled through a security gate and guard house. An area has been allocated for a weighbridge and weighbridge control room. The access will be controlled 24 hours 7 days a week.

An internal asphalt surfaced road would allow access to the facilities. The width of the road will be 7.4 m and will have side drains to drain contaminated water to the contaminated water pond.

The entire waste site will be fenced with a concrete palisade fence of 2.4 m high in addition to fencing described for individual facilities within the integrated waste management area.

The sections below briefly describe the various waste facilities that will be included in the integrated waste management area.

4.3.4.1.1 <u>General Landfill</u>

A general landfill site will be constructed which will receive general waste only from the mining area. General waste is a generic term for waste that, because of its composition and characteristics, does not pose a significant threat to public health or the environment if properly managed. The landfill site is therefore classified as General. Hazardous waste will be stored in a separate area until it is regularly removed by an approved contractor to an off-site licenced hazardous waste disposal site.

The landfill size depends on the amount of waste it receives over its lifetime. The size of the waste stream and the consequent size of the operation ultimately determine the size classification.

Three deposition rates were considered in terms of waste streams over the lifetime of the mine and are as follows:

- Bulk Shaft rate of deposition (3 years) = 672 tpa / 1.84 tpd
- Construction rate of deposition (3 years) = 1 530 tpa / 4.19 tpd
- Operation Phase rate of deposition (30 years) = 708 tpa / 1.94 tpd

From the daily waste deposition rate (tonnes per day), as per the above rates the landfill size classification is **Communal (C)** as per the guidelines set out in the *Minimum Requirements*.

The density of the general waste is conservatively assumed to be 450 kg/m^3 as normal compaction would take place on the landfill. From the rate of deposition over the lifespan of the landfill a total of 33 412 tonnes or 74 248 m^3 of waste will be landfilled.

The overall size of the landfill (from the outside of the 1.5 m high surrounding berms) will be 120 m by 170 m and will be split up into two cells. The landfill cells will be excavated to a depth of 3 m below natural ground level and the maximum height of landfill will be 5 m above natural ground level. The slope of the waste body will be 1:4 and the minimum cover ratio is to be 1:5.

Leachate collector drains will be placed above the barrier system in a herringbone configuration to collect leachate and concentrate the flow to a protected sump from which the leachate will be transferred to a leachate holding pond. Leachate will be monitored from the manholes provided in the pipeline connecting the leachate sumps to the leachate pond.

Sub-soil drains will be placed below the barrier system also in a herringbone configuration to collect sub-surface water and will collect flow to a central manhole which will be able to drain to a position where sub-surface (clean) water can daylight into the environment. The sub-soil drains can also be used as a secondary monitoring point to determine if leachate is penetrating through the barrier system.

Landfill Barrier Requirement

According to the Standard for Disposal of Waste to Landfill 2012, general waste disposal is only allowed at a Class B landfill. The barrier for a Class B landfill will be as follow (from top to bottom).

- Woven Geotextile;
- 150 mm Stone Leachate Collection Layer;
- Liner Protection Geotextile;
- 2 mm Thick HDPE Geomembrane;

- Geosynthetic Clay Liner (GCL);
- Geotextile Drainage Layer; and
- 150 mm Base Preparation Layer.

The GCL will be used to replace an equivalent 600 mm Compacted Clay liner as allowed for by the Standard for Disposal of Waste to Landfill 2012. The GCL will have the same impermeable characteristics as the compacted clay liner.

Landfill operation

Both planned cells at the landfill site are to be constructed conjointly. The cells will have a depth of 3 m below ground level and will also be divided by a 3 m high berm in the centre of the cells. The first cell must be filled from the lowest point and waste deposited daily must be covered with a minimum of a 400 mm cover soil before compaction. Once the first cell is filled to natural ground level (3 m), the second cell can be developed in the same manner until the level is equal to the first. Thereafter the landfill can be filled upwards to a total high of 5m above ground level.

Access ramps will be constructed on two corners of the landfill site, allowing access to both cells and the minimum distance for waste disposal vehicles. Access ramps designs are based on the following;

- Maximum slope of 8 %;
- One ramp going up and one ramp for going down; and
- Minimum of 5 m ramp width.

Taking into consideration that the landfill will only be 5 m above natural ground level no vertical curve or safety berms will be required.

4.3.4.1.2 Leachate and Contaminated Water Pond

A leachate pond and contaminated water pond will be constructed which will receive leachate emanating from the landfill and contaminated water from all the waste facilities within the integrated waste management area (including the roads), respectively. Both ponds will have a composite liner system as follows:

- 1.5 mm Thick HDPE Geomembrane;
- Cuspated Drainage Layer;
- 2.0 mm Thick HDPE Geomembrane; and
- 200 mm Thick Compacted Clay Liner.

The leachate pond has been designed to take a volume of approximately 2 300 m^3 water. The pond will be excavated to a depth of 3 m below ground level and side slopes will be 1:2.5. A silt trap will be installed to a slope of 1:4 at one side. From the pond leachate can be pumped and sprayed over the waste body if required.

The contamination water pond has been sized to take a volume of approximately 21 000 m³. A silt trap will be constructed at the inlet of the pond and will contain one third of the water volume. The pond will be excavated to a depth of 3 m below ground level and side slopes will be 1:2.5. The silt trap would have a slope of 1:4 at one side.

4.3.4.1.3 Composting Plant

A composting plant will be constructed as part of the waste area. The composting facility size was determined based on total combined volume of 4 736 m³ per year for organic waste, sewage sludge, wood, garden waste, and wood and paper packaging. Some fraction of organic waste, wood, garden waste and packaging will be recycled and some landfilled so that selection of material utilized in composting will take place.

The composting facility will be a 150 mm thick reinforced concrete slab 120 m long and 30 m wide (3 600 m²). The concrete slab will be divided into 5 sections to accommodate different composting activities. The concrete slab will have a fall of 1:60 and runoff in the wet season will be captured in surrounding surface drains feeding into a sump located at the lowest point of the area.

Composting plant operation

Key operational features which must be managed to minimize composting cycle time include the following:

- System to maintain moisture above 50%;
- Temperature, which will not be an issue in South African climatic conditions;
- High C:N is apparent and addition of urea may be advisable;
- Particle size 3 mm to 5 cm to be aided by use of a shredder;
- Wood chip content will be determined but if high, alternate recycling of some wood to be considered;
- Turning of the windrow manages oxygen levels and pH; and
- Drainage and runoff collection.

4.3.4.1.4 General Waste Storage Area

The general waste storage area will provide the following elements:

- Recyclable skips and cages for recyclable accumulation by type;
- Area for separate disposal of packaging waste for subsequent separation to recyclable, composting and general landfill portions;
- Area for processing of wood and garden waste for use in composting via a shredder or for direct recycling where appropriate and, for disposal of residual to landfill; and
- Area for receiving the fraction of domestic waste (rubbish) not source separated as recyclables, for processing of organics for use in composting, for direct recycling of

further recyclables from the mixed waste where appropriate and, for disposal of residual to landfill.

The general waste storage facility will be 25 m long by 20 m wide to accommodate the elements as described above for a period of one week. The facility will have a liner protected reinforced concrete slab and the facility will be halfway covered with a 25 m by 10 m rain roof.

Surface water from the facility will be collected in concrete lined v-drains and will flow to the contaminated water pond.

4.3.4.1.5 Hazardous Waste Storage Area

The hazardous waste facility will be a standalone facility with separate security and entrance control. Appropriate demarcation and signage will be provided to indicate responsible person details and provide hazard warnings.

The facility will contain the following elements:

- Laboratory waste (stored in a secured bin);
- Medical waste (stored in barrels or purpose-made bins on pallets);
- WEEE (stored in bulk bags);
- Oily rags (stored in barrels on pallets); and
- Used oil (stored in a skid tank inside a bunded area).

The hazardous waste storage facility will be 20 m long by 15 m wide to accommodate the elements as described above for a minimum period of one week. The facility will have a liner protected reinforced concrete slab and the facility will be covered entirely with a rain roof 3 m high.

Surface water from the facility will be collected in concrete lined v-drains and will flow to the contaminated water pond.

4.3.4.1.6 Salvage Yard

A salvage yard will be constructed. The salvage yard will be 100 m by 100 m (1 hectare) to contain 12 months of scrap metal storage. The facility will have a 150 mm reinforced concrete slab fenced off with a controlled access point. Surface water will drain to the lowest point into a sump.

4.3.4.1.7 Tyre Storage Area

Tyres and conveyor belting will be stored in a separate facility with the required stacking and spacing arrangements to comply with legislation, particularly with respect to firebreaks. Fire fighting equipment will be required to be located in close proximity to the facility:

- 136 m long by 72 m wide facility;
- 12 stacks for tyres (5 m wide clearance between stacks);

- 3 stacks for conveyor belts (5 m wide clearance between stacks);
- Ground surface is cleared, levelled and compacted;
- Runoff will be diverted from upslope by a 1 m high diversion berm;
- A collector drain will be constructed on the boundaries to catch the run-off from the site. This should discharge through a silt trap to the contaminated water system;
- Appropriate demarcation and signage will be provided to indicate responsible person details and fire prohibition;
- The site will be fenced with two gates for access;
- The facility will have an 8 m firebreak around the facility perimeter and a centrally positioned fire hydrant; and
- Tyres to be neatly stacked, not exceeding 3 m height, 10 m width and row length to not exceed 20 m.

4.3.4.2 Vehicle Maintenance Workshop

An area has been allocated for a vehicle maintenance workshop. The workshop will typically include:

- Oil storage room;
- General storage room;
- Covered parking for plant and inspection pit;
- Re-fuel area with diesel tank;
- Wash bay; and
- Oil separator.

The vehicle maintenance workshop for the plant will be designed in accordance with SANS: 10400 (The National Building Regulations). The building's facades will consist of face brickwork to a minimum height of 2.5 m with grass green H14 IBR sheeting for side and roof cladding. All roofs will be designed from structural steelwork.

The oil water interceptor design to remove residual oil for collected surface water ahead of containment will be based on estimated maximum oil content and peak, average and minimum flow rates, which will be determined from review of the hydrologic studies and plant layout.

4.3.4.3 Water Treatment

Water treatment requirements at Platreef consist of the following:

- Treatment of process water from Return Water Dams to augment internal recycled process water;
- Treatment of mine water in a mine water filtration plant for re-use in the mine;

- Treatment of raw water from Flag Boshielo Dam for potable use at the mine, including supply of water to the ice plant; and
- Treatment of sewage at the mine.

4.3.4.3.1 Process Water Treatment Plant

Water used for the mine's processing requirements, Concentrator Plant and transport of tailings to the TSF is sourced from the internal recycle and treatment (filtration) of process water via the Process Water Treatment Plant (PWTP). Process water is augmented with water from Flag Boshielo Dam via the Raw Water Dam, to replace water lost from the system due to evaporation, etc.

As the water quality from the dam is variable and may contain silt, algae and other physical impurities depending on the season, a flocculation and sedimentation process will precede further filtration of the water. During periods with good quality water supplied from the dam, the clarification process can be bypassed to save on operating costs.

4.3.4.3.2 Mine Water Filter Plant (MWFP)

Water used for the mine's processing requirements is sourced from the internal recycle and treatment (filtration) of process water via the Mine Service Water Dam and Filtration Plant. Filtered water is augmented with water from Flag Boshielo Dam via the Raw Water Dam, to replace water lost from the system due to evaporation, etc.

As the water quality from the dam is variable and may contain silt, algae and other physical impurities depending on the season, a flocculation and sedimentation process will precede further filtration of the water. During periods with good quality water supplied from the dam, the clarification process can be bypassed to save on operating costs.

4.3.4.3.3 Sewage Treatment Plant

The sewage treatment requirements on site will vary during the initial construction phase and the operational phase. The construction activities will allow for ablutions only, with no showers, but operational personnel facilities will include showers. Once the mine is fully operational the onsite staff compliment will be 918 people and ablutions will cater for showers and toilets, as well as grey water from the kitchens and a canteen.

A Sewage Treatment Plant (STP) that will provide treatment of sewage for the 918 onsite personnel will be required for the full production phase. The STP will provide treatment for a typical sewage quality as may be expected from similar operations. It is recommended to construct the final STP early on in 2016 and to treat the sewage generated during construction and production phases at the plant. During the early construction activities in 2014-2016, sewage can be collected in a conservancy tank and removed from site by Contractor. Chemical toilets or a package STP can also be hired which may be removed after the third year.

The process flow diagram for the STP is shown in Figure 4-3. Sewage from the underground mine workings will be trucked and offloaded at the STP. A suitable offloading ramp and access to the incoming sewer line is required. A wash water supply (final effluent) will be provided to wash out the containers or truck after offloading.

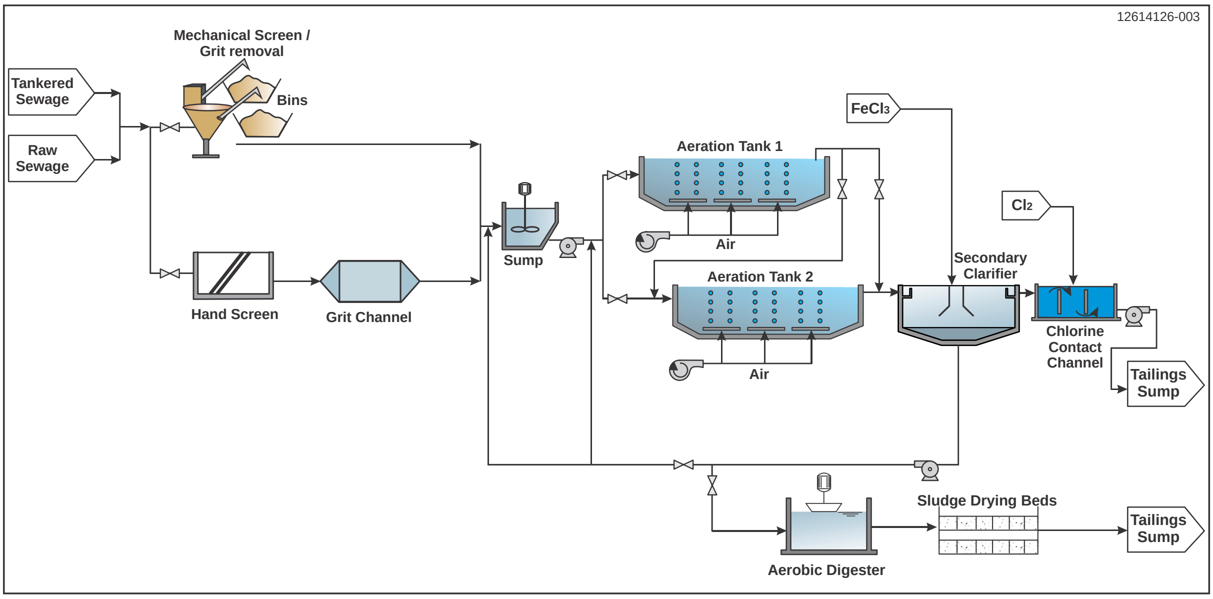

Figure 4-3: STP process flow diagram

The STP will generate three waste streams which will include:

- Treated effluent (treated to local environmental discharge standards) discharged to the process water circuit via the TSF;
- Grit and screenings (this will require disposal to a dedicated landfill site on site, or removed by Contractor to a municipal landfill site); and
- Sludge (this will require further disposal in accordance with the national guidelines on utilisation and disposal of wastewater sludge) will be disposed to the mine Composting Area for utilization as a nutrient.

4.3.4.4 Water Storage Facilities

Facilities under this heading are listed below:

1) Contaminated Water Collection:
    a) Mine Pollution Control Dam; and
    b) Plant Pollution Control dam.
2) Supply water storage facilities:
    c) Raw Water Dam; and
    d) Mine Service Water Dam.

The final design of these facilities will be based on the site wide mine water balance model and the available topographical information. The following design assumptions will apply to these facilities the purposes of the conceptual design, underpinning the EIA:

- All water storage and conveyance facilities require the outcome of the detailed and agreed mine wide site water balance for sizing of compartments, spillways, drains and other hydraulic structures. Currently, sizing of the above dams a) to c) are based on runoff calculations determined from a delineation of catchments and simulation of precipitation and catchment response, using the PC SWMM ® software package. Sizes will be confirmed by the mine water balance;
- Spillways were sized on the hypothesis that the relevant facility will be full during the occurrence of the 1:50 year return interval, and that no storage / attenuation takes place. Hence the broad crested weir equation was used, passing the 1:50 year recurrence interval peak flow. The raw water dam spillway was nominally sized at 5 m wide as the pumping into and out of the dam renders it a well-controlled environment, whilst there is also no catchment reporting to the raw dam except its own surface;
- Spillways will be 35 MPa reinforced concrete (both internal and external) with wood float finishing except where liners are affixed to the concrete, where a steel float finish and 20 mm bullnose edging will be called for. External spillways will have toe protection to prevent scour and undercutting of dam foundations. Scour protection will be in the form of grouted stone pitching. All exposed concrete corners will receive a 20 mm chamfer;
- For the PCDs, sediment traps were provided, due to the transport of fine material over the catchments. The sediment traps were provisionally sized to be 30% of the total volume of the dam. SEDCAD® can be used to more accurately size these sediment traps. However, the cost-benefit of conducting lifetime sizing of sediment traps using extensive lab testing of possible sediment transport materials, and finite element simulation of sediment bed development, is limited due to the transient and inherent variability of inputs to such models e.g. operational conditions, climatic scenarios, site conditions in terms of transported materials, mine site development, etc. Optimisation of sediment trap maintenance cycles can best be determined during operations;
- New waste management legislation was promulgated in August 2013, including the “National Norms and Standards for Disposal of Waste to Landfill” under section 7(1)(c) of NEM:WA. However, there is no clear definition as to the barrier requirements for contaminated water lagoons. Moreover, there is no information available as to the expected water qualities to be contained in the pollution control dams. Therefore, use was made of the former regulations (referred to as the “DWAF Minimum Requirements”), assuming a classification of H:H (hazardous waste) for the polluted water. Hence a triple liner system was proposed for the lining of the PCD. This has a significant capital cost implication, which can be mitigated if additional information becomes available to justify a lesser liner. The Raw Water Dam will receive a single 2 mm HDPE liner with a geotextile cushion layer, as the water is deemed to be raw water quality conforming to discharge quality. The Mine Service

Water Dam water quality is unknown at this stage and it is assumed that this dam will require at least a leak detection system i.e. a double liner system;

- All dams are compacted (modified proctor) earth embankment dams with inner and outer slopes of 1V:2.5H. Perimeter walls of the PCD's are 5 m wide at the crest, with inner walls having 3 m crest widths. The PCD's are able to receive runoff from upstream catchments by virtue of being slightly in cut on the upstream side, whilst the Raw Water Dam is in fill all around its toeline in order to divert runoff away. However, the Raw Water Dam is also partially in cut in its basin;
- All dams are provided with a herringbone layout subsoil drainage system. Main spines consist of slotted HDPE pipes of 160 mm diameter, encased in 19 mm stone and an external wrapping of the stone with a geotextile filter to be specified. Feeder pipes are of similar design but are of 110mm diameter. Spacing of the pipes has been assumed to be 10 m to 15 m. This cannot be confirmed until a seasonal ground water movement model is available. Formulations such as the Hooghoudt Formula and others which utilise the Darcy Equation can be used to fix pipe spacing analytically, with the groundwater knowledge as input. Subsoil drainage will report to daylight in a reinforced concrete headwall which will be designed for ease of sampling for water monitoring, or to a manhole if topography so dictates. In the latter case a dewatering pump will be required in the manhole;
- All dams will be fitted with 16 mm knotted polypropylene safety ropes to allow exit in case of accidental entry to the dam. Four safety buoys will be placed around each dam. Appropriate safety signage and fencing will also be provided as specified on the drawings;
- External cladding of the dams will consist of topsoil and hydroseeding;
- Inter-liner leak detection systems, where installed, will feed to a central leak detection sump, which is a recessed sump in the floor of the pond, filled with 13 mm stone. Leakage reports to the voids between the stone. A pipe which serves as a sleeve is recessed into the slope and extends into the sump. A submersible borehole pump resides in the bottom of the sleeve and is controlled by electronic level control. Leakage water collected is pumped back into the PCD. For a triple liner system, a primary and secondary leak system is provided i.e. two sumps; however, only one pump is required;
- Sediment traps are concrete lined to allow motorized mechanical equipment to enter the dam and excavate accumulated sediment. Ideally sediment traps must be serviced in the dry season, when precipitation is low and the compartment can be evacuated of water by mobile pumps;
- All liner systems will be anchored on the dam crests in a trapezoidal shaped anchor trench. The trench section is 750 mm square, with sloped sidewalls for construction purposes;

- Liners shall be fixed to the concrete with a stainless steel baton (angle-iron) bolted to the concrete with expansion bolts at 150 mm centres, and 5 mm neoprene rubber or similar gaskets to protect liners from steel and concrete; and
- All dams were modelled using AutoDesk® Civil 3D and based on survey information received from the Client dated 25 September 2013.

4.3.4.4.1 Mine Pollution Control Dam and Plant Pollution Control Dam

The following liner system is assumed for the PCD's (read from top to bottom of the liner system):

- 2 mm HDPE geomembrane – white to prevent excessive thermal deformation;
- 750 micron HDPE cuspated drain, basin primary leak detection layer;
- 1.5 mm HDPE geomembrane;
- 750 micron HDPE cuspated drain, secondary leakage detection layer;
- 1.5 mm HDPE geomembrane;
- 3 600 g/m² GCL;
- 250 g/m² non-woven needle punched geotextile; and
- Prepared soil layer to liner installer's specification.

Wind uplift forces are a significant consideration in the installation of liners and the operation of lined facilities. For this reason ballast must be provided to counter wind uplift forces. Geotextile sandbags filled with selected sand mixed with 4% cement by weight and placed on the liner floor in a chequerboard arrangement at 4 m centres will be used for this purpose. To prevent liner damage, 250 g/m² non-woven needle punched geotextile will be placed under the bags after sweeping of the liner.

4.3.4.4.2 Raw Water Dam

The following specifications will be used for the design of the raw water dam that will be constructed:

- The dam size was specified to be 49 500 m³ – the modelled volume is 52 500 m³, and maximum wall height of 4.62 m;
- The dam will be of earthworks construction assuming 50% cut and 50% fill;
- The incoming stream shall be deemed non-hazardous raw water, and only a single 2 mm thick white HDPE liner will be provided to prevent seepage losses; and
- Anchor trenches will be provided and preliminarily sized at 750 mm x 750 mm.

4.3.4.5 Waste Rock Facilities

4.3.4.5.1 Waste Rock Berm

A Waste Rock Berm (WRB) will be constructed around the Project site and is intended to perform the following objectives:

- Create a safety boundary between the mining activities and the encroaching residential developments;
- Act as a noise screening berm between the mining activities and the encroaching residential developments; and
- Act as a visual buffer between mining activities and the encroaching residential developments.

The waste rock volume required to be contained by the berm is 2.7 million tons.

The berm will have the following characteristics:

- Top of the berm width of 5 m sloped inwards at 2%. A minimum top width of 5 m is required to construct a waste rock structure practically with standard machinery;
- Inner and outer side slopes of the berm will be 1V:2H; and
- The berm will have height above natural ground level of 6.75 m along the WRB centreline.

Preliminary geochemistry information available at the time of producing this document indicated the following:

- Acid Base Accounting (ABA) results of 68 waste rock samples provided an indication of the relative proportions of acid generating and acid neutralising components in the Hanging Wall and Footwall rock units. The paste pH for the waste rock samples was found to be alkaline (8.9 – 10.1) and indicates the short term pH for the waste rock stockpiles. The alkaline pH can be attributed to limited acid generating sulphide minerals and abundance of neutralisation minerals in the short term;
- An evaluation of the acid generation potential and neutralisation potential using the MEND (2009) criteria classified 16% of the waste rock as Potentially Acid Generating (PAG). This included one of five shaft area Footwall samples; two of nine samples from the T1 Hanging Wall; two of 17 T2 Hanging Wall samples; and six of 19 T2 Footwall samples. The remaining waste rock samples classified as Uncertain (10%) or Not Potentially Acid Generating (Non-PAG);
- Thus the bulk of the waste rock samples (74%) have no potential of generating Acid Rock Drainage (ARD). It should be noted that the ABA test indicates the potential for a system to generate acidity and does not take into account mineral reaction kinetics; and
- Laboratory kinetic tests (run over 20 week period) are currently underway for selected waste rock, ore and tailings materials and will provide and understanding of long term acidity and metal leaching risks and liabilities for the Project.

It has been assumed that the PAG and Non-PAG waste rock material cannot be separated at the source and therefore a blend of PAG and Non-PAG waste rock material will report to the WRB. However, it is assumed that the majority of the PAG waste rock material will be found surrounding the ore body. Therefore it is assumed that the majority of the waste rock material which will report to the berm is anticipated to be Non-PAG. Therefore no engineered liner system is proposed beneath the berm, however a well compacted base and footprint / bed preparation to decrease the permeability of the in-situ barrier system and a seepage collection system is proposed to collect and manage all seepage as dirty water.

The following seepage management system is proposed:

- 110mm perforated pipe to be placed 50 mm above excavation low point;
- 13mm washed stone to be imported as drainage material 300 mm deep; and
- A4 Bidim to be wrapped around 13 mm washed stone with minimum 500 mm overlap.

The seepage collection pipes will follow NGL (where possible) and report to the low point in the South Western corner of the WRB. It will then gravitate or be pumped from a sump to the dirty water PCD in the South Western corner of the berm.

In flat areas where the seepage collection pipelines cannot be gravitated to follow NGL, low point sumps and pumps will be established to convey the collected seepage to dirty water PCD in the South Western corner of the berm.

The berm will be constructed as follows:

- The mine will convey the waste rock material from the shafts to a centralised location;
- A contractor will load the waste rock material from the centralised location to the WRB utilising trucks for haulage;
- The contactor will be responsible for developing access ramps in order to construct the WRB; and
- The material will be end-tipped and compacted by dozer and roller in layers to the resident engineer’s specifications.

4.3.4.5.2 Waste Rock Dump

Waste Rock Dumps (WRDs) will be constructed and will contain the full anticipated waste rock volume (excluding the waste rock berm volume) for the 4 Mt per annum mining scenario.

The required waste rock volume is 7 million tons.

As mentioned previously, it has been assumed that the PAG and Non-PAG waste rock material cannot be separated at the source and therefore a blend of PAG and Non-PAG waste rock material will report to the WRDs. As per the newly promulgated Waste Regulations R634, R635, and R636 contained within the NEM:WA, a minimum of a Class C barrier protection layer has been assumed. This assumption will be required to be confirmed pending the results of the geochemical investigations (currently be conducted).

This minimum Class C barrier protection layer specifies the following:

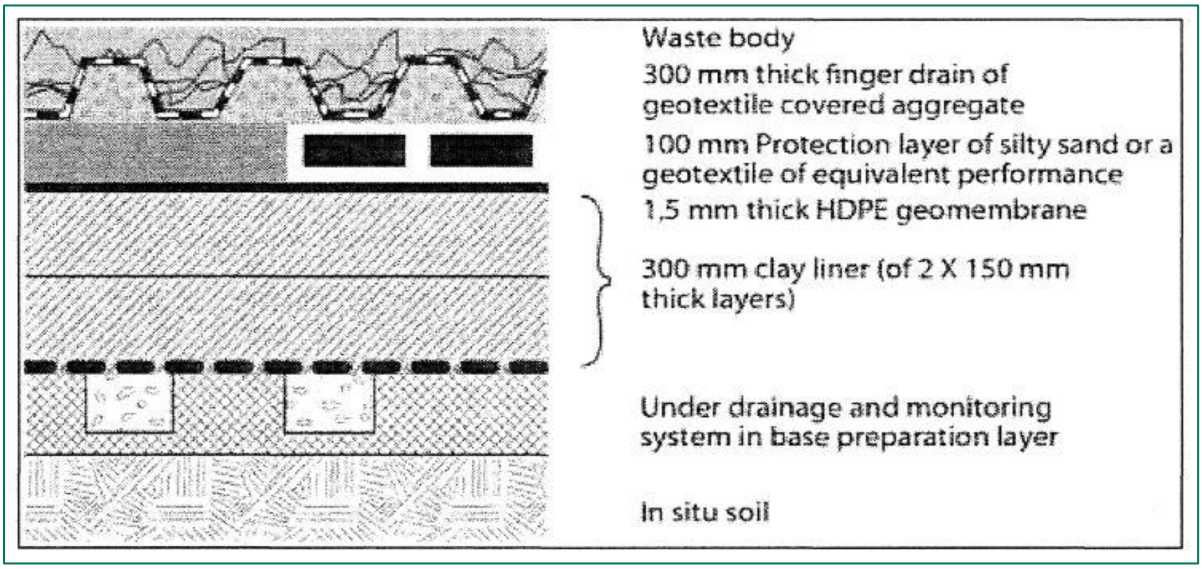

Figure 4-4: Class C barrier protection design (NEM:WA)

The following conceptual engineering design is proposed for the waste rock dump:

- 300 mm layer of topsoil to be stripped and stockpiled in designated areas;
- 1300 mm layer of silty sand (subsoils) to be excavated and stockpiled in designated areas;
- Excavate into soft ferricrete layer to allow bed of excavation to slope at 2% towards the south western corner of the facilities (following NGL); and
- Bed preparation compacted to 90% AASHTO density.

The following under drainage and monitoring system is proposed:

- Upstream (North West of the facilities) water quality monitoring borehole;
- Under drainage and monitoring system in base preparation layer consisting of 110 – 160 mm Φ HDPE perforated pipelines at 20 metre centre to centres in a (herringbone shape) within defined channels of 400 mm depth filled with 19mm washed stone;
- 160mm Φ HDPE solid pipeline towards a collection and monitoring manhole; and
- Pump with high/low level switch pumping the collected water back into the water system.

An alternative equivalent |(Class C) barrier protection design for the base and side slopes of the basin and starter walls of the waste rock dump is proposed as follows from bottom to top:

- Base preparation layer;

- Under drainage and monitoring system in base preparation layer consisting of 110 – 160 mm Φ HDPE perforated pipelines at 20 metre centre to centres within defined channels of 400 mm depth filled with 19 mm washed stone;
- Geosynthetic Clay Liner (GCL) 3 000 g/m^2;
- HDPE 1.5 mm single textured Geomembrane;
- Geotextile 210 g/m^2;
- 500 mm compacted sacrificial layer of competent material to protect the liner system;
- Leachate collection system of 110 – 160 mm Φ HDPE perforated pipelines at 20 metre centre to centres within defined channels (within the sacrificial layer) of 300 mm depth filled with 19 mm washed stone wrapped in a geotextile; and then the
- The waste rock material.

The following leachate collection and management system is proposed:

- Leachate collection system in compacted sacrificial layer consisting of 110 – 160 mm Φ HDPE perforated pipelines at 20 metre centre to centres in a (herringbone shape) within defined channels of 300 mm depth filled with 19 mm washed stone;
- 160 mm Φ HDPE solid pipeline (through liner system) towards a collection and monitoring manhole; and
- Pump with high/low level switch pumping the collected water back into the dirty water system.

The following geometric design for the starter walls of the waste rock dump is proposed:

- Top of WRDs starter walls width of 5 metres sloped inwards at 2%;
- Inner and outer side slopes of WRDs starter walls of 1V:2.5H; and
- Height above NGL of 2 m along the WRD centreline.

The following geometric design for the waste rock dump fill is proposed:

- 1 m freeboard below the top of the starter walls;
- Side slopes of WRDs fill material of 1V:1.5H (angle of repose); and
- Top of WRDs fill sloped parallel to NGL at 2% towards the South Western corner of the facility.

The waste rock dump will be constructed as follows:

- A contractor will be responsible for the construction of the base cells including:
  - Mass excavation and stockpiling;
  - Under drainage and monitoring systems;
  - Starter walls construction;
  - Liner installation and commissioning; and

- Developing access ramps into/out of the WRDs during the construction of the starter walls.

- The mine will convey the waste rock material from the shafts to a centralised location; and
- The mine will control and utilise a conveyor system to deposit the waste rock material into the waste rock facilities.

It is assumed that the WRDs will be permanent facilities. However, an option is available to reclaim the waste rock material for mine backfilling and/or crush it locally and to be used as aggregate for commercial use, e.g. road construction.

4.4 Project Activities

The proposed mining activities during the construction, operational and decommissioning phases are indicated in Table 4-5.

Table 4-5: Project activities occurring at the various phases of the life of the mine

Activity No.	Activity:	Timeframe:
Construction Phase		
1	Site Clearing: Removal of topsoil and vegetation	April 2014 – Jan 2018
2	Construction of surface infrastructure e.g. access roads, pipes, storm water diversion berms, change houses, admin blocks, waste storage area etc.	April 2014 – Jan 2018
3	Transportation of materials & workers on site	April 2014 – Jan 2018
4	Temporary storage of hazardous chemicals and fuels.	April 2014 – Jan 2018
Operational Phase		
6	Removal PGM's (underground mining process).	Life of the mine (approximately 30 years with the potential to extent this period)
7	Operation of surface infrastructure such as the operation of the mining shafts, pipes, the TSF and processing plant (includes water use and storage on site, including pollution control dams.	Life of the mine (approximately 30 years with the potential to extent this period)
8	Transportation of mineral off-site using conveyor.	Life of the mine (approximately 30 years with the potential to extent this period)
9	Storage, handling and treatment of hazardous products (fuel, explosives, and oil) and waste activities (waste, sewage, discards, PCD).	Life of the mine (approximately 30 years with the potential to extent this period)
Decommissioning phase		
10	Demolition & removal of all infrastructures (incl. transportation off site).	After the life of mine
11	Rehabilitation (spreading of soil, re-vegetation & profiling/contouring) (includes sealing of adit and	After the life of mine

Activity No.	Activity:	Timeframe:
	ventilation shaft entrances).	
12	Storage, handling and treatment of hazardous products (fuel, explosives, oil) and waste activities (waste and sewage).	After the life of mine
Post-closure Phase		
13	Post-closure monitoring and rehabilitation	After the life of mine

5 ALTERNATIVES CONSIDERED

5.1 Mining Method

The nature of the mineral reserve determines the preferred mining method and the location of the feasible reserve to be mined determines the location of the mining operation. These two factors limit the mining alternatives that are available. Due to the depth below surface the open pit mining method will not be feasible for the extraction of the mineral ore. The only possible alternative available for mining methods will be the no mining option.

5.2 Land-Use Alternatives

When considering the allocation of land for development and in deciding applications for planning permission affecting agricultural land, the agricultural implications must be considered together with the environmental, cultural and socio-economic aspects. In particular, prime quality land should normally be protected against permanent development or irreversible damage.

Consideration of land use alternatives is one of the cornerstones of community planning. Land use decisions must be evaluated in terms of sustainability, broadly defined as balancing environmental, economic and social equity concerns. The primary land use categories that encompass basic functions are residential, commercial, industrial, recreational, institutional, and agricultural uses. Land use is determined by a number of factors. These include climate, resources, population growth, economic activity and topography. When considering a new development for an area, it is required that other land use alternatives are considered to ensure that the development is justified and viable. Within the Project area, present land use includes subsistence crop production and subsistence animal farming. The agricultural potential is high on the deep soil due to the combination of average to medium regional rainfall and deep soil present. Alternative land use of the area that could also be viable is low cost housing.

The land may also be used for additional agricultural purposes such as grazing. Alternatively the land may be returned to its natural status which may hold possible eco-tourism benefits; however, due to the adjacent land predominantly being used for agricultural purposes, eco-tourism in the area is an unlikely option.

5.3 Infrastructure Alternatives

The specialist studies that were conducted will help to determine the preferred location of infrastructure and will be concluded in this report.

5.3.1 Water Supply

Furthermore, an investigation into alternative source for bulk water supply to the Phase 2B scheme proposed by the JWF has been undertaken. The alternate bulk water supply sources identified for the Project are:

- The existing Flag Boshielo Dam;

- The existing Rooiwal Waste Water Treatment Works; and
- The existing Seekoeigat Waste Water Treatment Works.

Further investigations are also underway with the municipalities to determine the actual quantity of water available and a more detailed investigation into these sources of water will be conducted.

5.3.2 Concentrator Plant

Two possible locations for the concentrator plant were investigated. These locations are situated east and west of the N11 road. The site to the east is situated within a floodline and, therefore, not a feasible option. The preferred location of the concentrator plant is, thus, on the west side of the N11, within the proposed operational area where the proposed production and ventilation shafts will be located. This location also makes it possible to group all infrastructure in one operational area for easier management.

5.3.3 Alternative TSF Sites

During the ESIA investigations the sites on the farms Rietfontein 2 KS and Bultongfontein 239 KR were selected as the preferred locations for the TSF. Through the various specialist studies conducted over the proposed area, TSF site 2, on the farm Rietfontein 2 KS, was chosen to be the preferred location. Section 7 describes the concise environmental conditions for the study area and motivates for the TSF site selection.

The pipelines, associated with the TSF, which will transport the tailings from the concentrator plant to the TSF and return water again from the TSF to the operational area, were aligned to ensure minimum impact on the environment yet making it practical to construct and easy to maintain during operation.

5.3.4 Alternative Plant Area

An alternative plant area has been investigated on the farm of Macalacaskop 243 KR (see Plan 3, Appendix A).

5.3.5 Alternatives to Waste Management

5.3.5.1 Alternative Waste Management Strategies

An alternative waste strategies study was undertaken to list and evaluate all possible waste management solutions for each listed waste stream that is expected at the proposed mine, as shown in the waste inventory in Section 4.3.3.

The waste management hierarchy was applied in developing waste management solutions for each waste stream expected at Platreef mine. The various options considered per waste stream are indicated in the following table together with their relative advantages, disadvantages and the selected option for application at the mine (Table 5-1).

Table 5-1: Alternative waste management strategies considered

Waste stream	Alternative strategies considered	Advantages	Disadvantages	Selected go-forward option(s)	Key determining factor in decision
Waste rock	Re-use as building material (such as berm around the site) and road construction	Reduces required size of rock heaps; provides alternative source of material Possible income, reduction of disposal costs	Requires testing to ensure it is safe for use, from an environmental and human health risk perspective Sustainable use of waste reduces the use of natural resources. However, rate of generation vs. rate of disposal required does not make this option sustainable in the long term, unless contractual agreements are entered into with multiple companies	✓	Re-use on-site is relatively easy to implement. This will provide material for, e.g. berm construction
	Backfilling	Reduces required size of surface rock heaps; large volumes can be used in backfilling to promote stability in the mined out underground areas Sustainable return of waste to its origin	Costly option and requires adjustment of mining method Reactive rock may result in risk of formation of acid mine drainage		Not financially feasible at this stage
	Disposal on rock heaps	Other options cannot handle total volume of waste rock that will be generated Well-known proven solution	Final disposal is always least desirable. Could potentially create dust issues, and possible leachate formation which could impact on water resources Large surface disposal facility will be subject to public scrutiny	✓	The remainder of waste rock (not used for berm construction) will be disposed on an on-site waste rock dump, provided that impacts related potential Acid Mine Drainage (AMD) and instability are prevented or mitigated
Tailings	Re-use as building aggregate in cement	Reduces required size of TSF; alternative source of material Possible form of income	Tailings are too fine for easy implementation as cement Public misperceptions may exist regarding safe use / applications of tailings Sustainable use of waste reduces the use of natural resources. However, rate of generation vs. rate of disposal required does not make this option sustainable in the long term, unless contractual agreements are entered into with multiple companies		Tailing are too fine to make re-use feasible
	Co-utilisation with waste rock for backfilling to the mine	Reduces required size of TSF Promote stability in the mined out underground areas	High operational costs may require special cementation to prevent ground becoming unstable Classification is required to determine chemical reactivity. Potential leaching to underground water sources and hence impacts on water users		Not financially feasible at this this stage
	Disposal on the TSF	Other options cannot handle total volume of tailings that will be generated Well-known proven solution Relatively easy to implement	Final disposal is least desirable High capital cost Large footprint required, potential leaching to underground water sources Large surface disposal facility will be subject to public scrutiny Requires remediation	✓	Tailings will be disposed to a licenced Tailings Storage Facility (TSF), while backfilling is being further investigated.
Process wastewater	Direct re-use, e.g. for dust suppression	Requires no treatment and thus easiest and cheapest option Can be achieved with minimal worker exposure to the water	Limited volumes may be available and clean enough for direct re-use	✓	Suggested for implementation as far as possible
	Recycling treated or semi-treated water	Reduces load on freshwater supplies	Must ensure water is treated satisfactorily for required application	✓	Water scarcity makes it necessary to recycle treated water Direct reuse is not always possible, which is where recycling and partial treatment of other wastewater should be used
	Recovering water from, e.g. stormwater runoff	Reduces load on freshwater supplies Reduces potential contaminated discharges to the	Water is relatively dirty and may require treatment A drainage system will likely be required	✓	This water must be collected in any event to prevent pollution to the environment Direct reuse is not always possible, which

Waste stream	Alternative strategies considered	Advantages	Disadvantages	Selected go-forward option(s)	Key determining factor in decision
		environment, provides additional source of water			is where recovery of other wastewater should be used
	Treatment	The effluent is of high quality can be reused in high quality applications and increases re-use possibilities	May be expensive, depending on level of treatment Requires high operator attention	✓	Direct reuse is not always possible, which is where recycling, recovery, and partial treatment of other wastewater should be used
	Water pinch analysis	Optimises water use on the plant, minimised freshwater use	Expensive initial cost Requires expert opinion and feasibility investigations		Water quality requirements not yet finalised
Domestic wastewater	Activated sludge process	Provides high degree of treatment Commonly used in most municipal treatment plants since it is the most advanced and reliable process	Expensive Sophisticated process requiring a high degree of operator control Produces large quantities of sludge		Expensive
	Extended aeration activated sludge process	This process is available as a modular plant and is thus easy to set up with a relatively small footprint It is a reliable solution in terms of effluent quality and is well-tried and tested More capable of handling fluctuating loads and concentrations than conventional activated sludge processes		✓	This process is adapted for smaller sewage volumes Modular plant (package units) and is thus easy to set up with a relatively small footprint
	Sequencing Batch Reactor (SBR) process	Smaller footprint and cheaper option	Requires an experienced engineering contractor Cannot easily be controlled, if at all, and is not as reliable as an active process		
	Waste stabilisation ponds	No power/oxygen required	Requires a significant land area (not available at this site)		
	Oxidation ditch	Requires less land than waste stabilisation ponds Easier to control than the activated sludge process	Requires more power than waste stabilisation ponds More suited to very small volumes of sewage in areas where below-quality discharges may be allowed		
	Reed beds or constructed wetlands		Requires a significant land area (which is not available at the mine site) Suited to very small volumes of sewage, and become less economically viable as the feed flow rate increases		
Domestic wastewater	Trickling filters	Relatively simple and uses a small land area	Requires significant pumping which adds to complexity and operating costs Has been used very often in the past and is thus well understood		Trickling filters are understood to be gradually being phased out nationally due to operational difficulties
Sewage sludge and screenings	Composting	Allows the sludge to be re-used through land application	Requires a composting facility	✓	A composting facility will be available, allows beneficial re-use as compost
	Disposal to sanitary landfill	May be cheaper, no other method of disposal for grit and screenings	Requires proper transportation and management due to hazardous nature	May be required for screenings and grit disposal	Only available solution for grit and screenings handling
Domestic waste	Source separation	Allows re-use, recycling, and composting to be possible	Slightly higher initial cost for bins	✓	Reduces the amount of potentially valuable materials that are contaminated by other materials and the amount of waste that is disposed of to landfill To be implemented using 2-bin or 5-bin system
	Re-use of uncontaminated cardboard	Cheap solution; easy to implement	Limited volumes of cardboard can be re-used, dependant on demand	✓	Remaining cardboard boxes not re-used can be sent for recycling
	Recycling non-organic waste	Reduces required general landfill size substantially Recyclable material has intrinsic value, which off-sets the cost of transport or disposal of other materials	Less easy to implement	✓	Availability of recycling contractors, financially feasible

Waste stream	Alternative strategies considered	Advantages	Disadvantages	Selected go-forward option(s)	Key determining factor in decision
Domestic waste	Composting of organic waste	Allows beneficial re-use of organic waste	Requires organic waste separation	✓	There is a composting facility; reduces waste volumes for disposal
	Disposal to general landfill	Easy to implement, required for un-recyclable waste and waste which cannot be composted	Leachate generation, could impact on groundwater and surface water resources	✓	Required
Wood and garden waste	Composting	Provides employment and compost for land conditioning and rehabilitation	Composting of wood requires chipping; requires composting facility	✓	A composting facility will be available; most beneficial to all parties
	Incineration (off-site energy recovery)	Could recover energy for other processes	Risk of air pollution High transport cost for off-site incineration		
	Fuel wood	Beneficial to communities, demand is high Low costs as it is assumed waste will be made available to local communities or labourers (minimal to no transport costs)	Risk of air pollution Low sustainability, as the material is lost and potential yields are low in comparison to inputs	✓	Only to be used for larger wood pieces if a wood chipper is unavailable
	Disposal to general landfill (on-site or off-site)	Can handle any type of wood or garden waste Minimal cost of transport to on-site facility; medium costs of transport to off-site facility	Material is lost and value cannot be recovered New legislation may prohibit this option Larger airspace required for landfill		New legislation may prohibit this option
Pallets	Take-back agreements with suppliers	Reduces waste to be managed by Platreef	Depends on supplier	✓	Easy to implement – managed by the suppliers
	Plastic pallets	Increased lifespan; usually recyclable	Only sustainable if it is recycled		
	Paperboard pallets	Lightweight, recyclable, no nails or splinters, not chemically treated	Lower durability; susceptible to water damage	✓	Easy to recycle, to be implemented where durability is not a concern
Pallets	Wood pallets	Cheaper; easier to repair and refurbish	May be chemical treated or fumigated; presence of nails	✓	Cheaper and more durable than paperboard; many downstream application opportunities available
	Community recycling Projects	Potential economic benefit to communities	Start-up funding required; feasibility depends on community	Feasibility to be analysed	Beneficial to community; improves mine-to-community relations
	Wood chips for composting	Beneficial reuse	Only possible where chemical treatment was not done on the wood; requires chipping	To be used failing take-back agreements	Requires nail removal and wood chipping, but allows beneficial reuse
	Energy recovery	Possible energy source for cement kilns	Dependant on demand		
	Disposal to general landfill	Can be implemented for any type of pallet	Bulky, thus limiting landfill airspace; loss of potential resource	Only for if chemical nature of the wood makes other options unfeasible	
Explosives and explosives packaging	Minimisation (careful planning of volume of supply, take-back agreements)	May result in no generation of waste at all		✓	Reduces waste generation; take-back agreements with blasting service provider may removal all possible explosive waste
	On-site detonation	Does not require services of a hazardous waste service provider	Requires detonation yard; safety must be adhered to	✓	On-site detonation of the packaging is possible and if done correctly will lead to the destruction of all explosive contamination
	Disposal to H:H landfill off-site	Does not require construction of detonation yard	Requires transport by registered provider; expensive	✓	Only required if on-site detonation is not implemented
Used oil and grease	Take-back agreements with suppliers	Liability removed from Platreef, promotes re-use or recycling opportunities Platreef could explore possible remuneration for used oil.	Potential for build-up/ accumulation should contractor not remove waste in time	✓	High sustainability, promotes recycling entrenched in contract
	Energy recovery (Pyrolysis or gasification, on-site or off-	Could supplement energy requirements for the mine or other fuel stocks for power stations or cement kilns.	High cost if Platreef wants to recover energy on-site, high transport cost if it is sent for off-site use.		

Waste stream	Alternative strategies considered	Advantages	Disadvantages	Selected go-forward option(s)	Key determining factor in decision
	site)	Potential to extend benefit to communities in future	Significant air quality risks and possible water contamination should an on-site facility be established.		
	Recycling (sell to recycling company)	Goes back into the value chain. Platreef could gain financially from recycling. Potential to extend benefit to communities in future. Limited environmental risk, should the waste be appropriately stored and handled during collection and transport.	Potential for build-up/ accumulation should contractor not remove waste in time	✓	Sustainable, economically feasible, best option for used oils / grease which cannot be managed with take-back agreements
	Treatment (treatment into a fuel oil, assumedly off-site)	Low cost, as this is done by a contractor Possible fuel creation. Potential to extend benefit to communities in future	Potential for build-up/accumulation should contractor not remove waste in time		
	Disposal to H:H landfill	Low public sensitivity as waste is removed from possible receptors	Low sustainability, as the oil and grease is lost as a resource, and diminishes landfill airspace. Potential to contaminate groundwater resources	✓	Take-back agreements or recycling may not be possible with some oils, which will require disposal
Oil contaminated rags and PPE	Minimisation	Reduced waste stream requiring disposal		✓	Minimisation through training and awareness of workers who typically generate hydrocarbon contaminated rags
	Incineration off-site	Destroys all toxins; reduces waste volume requiring disposal	Possible air pollution risks	✓	Reduces waste volume and toxicity
	Disposal to H:H landfill	Common proven solution	Potential to contaminate groundwater resources Diminishes landfill airspace	✓	May be more financially viable, following feasibility study
Hydrocarbon contaminated soil	Bio-remediation	Produces soils fit for re-use	May require permitting to re-use soil; less easy to implement	✓	Provides downstream application opportunities. Can be done on-site on a small scale or off-site in combination with other industries that produce similar waste. This may offer economies of scale and reduced liabilities if another company is paid to carry out the bioremediation.
Hydrocarbon contaminated soil	Incineration and thermal desorption	Reduces toxicity of waste	Requires additional fuel to allow it to burn; will likely still need to be disposed to hazardous landfill		
	Disposal to off-site hazardous landfill	Easy to implement	Least desirable solution since it makes no use of resource value Expensive transport and disposal costs	✓	Failing remediation, disposal can be used. Volumes may be large and thus make this expensive
Used paint and tins	Donation to communities / small businesses	Minimises wastage of usable paint		✓	Increases positive relations with community; beneficial use of leftover paint
	Used tins sent to manufacturers for refurbishment	Reduces waste volumes for disposal; beneficial re-use	Requires feasibility study to find willing manufacturers	✓	Beneficial re-use of tins
	Solvent recovery plant	Produces solvent which can be used instead of kerosene or white spirit	May be expensive	Feasibility required	Produces useful product
	Disposal to hazardous landfill	Easy to implement	Least desirable solution; makes no use of resource value	✓	To be done if solvent recovery plant is unfeasible and / or no manufacturers want to accept used tins
Used vehicle batteries	Take-back agreement	Reduces waste volumes for disposal; beneficial re-use possibilities		✓	Easy to implement; beneficial use of resource value; may result in rebate for future batteries
	Selling of battery parts to recycling company	Beneficial re-use possibilities	Less desirable than take-back agreements since it is more costly	✓	Necessary where take-back agreements cannot be done.
	Disposal to H:H landfill	Easy to implement	Makes no use of resource value	✓	Necessary where parts cannot be

Waste stream	Alternative strategies considered	Advantages	Disadvantages	Selected go-forward option(s)	Key determining factor in decision
					recycled
Lithium ion batteries	Recycling	Re-use of lithium in the batteries	Not financially feasible		
	Recycling / disposal by e-waste companies	Re-use of battery parts		✓	Most advantageous option, pending on availability of recycling companies in the area
	Disposal to hazardous landfill	Required if recycling is not possible	Makes no use of resource value	✓	If the batteries are not recycled, they must be disposed to landfill.
Fluorescent tubes	Selling to recycling companies	Beneficial use of resource value	Currently only a small number of facilities in South Africa are able to recycle fluorescent tubes or	✓	This option should be pursued as far as possible, for beneficial use of waste tubes
	Treatment and disposal	Required for waste fluorescent as last resort	Makes no use of resource value	✓	Final resort, required for final disposal
Waste electronics and electrical equipment	Re-use / refurbishment	Refurbishment remains cheaper than buying new. Old e-waste donated for refurbishment should not incur prices Potential community benefits	Refurbished electronics may not meet performance requirements, reliability may be inconsistent	✓	Although refurbished electronics have less functionality than new, they can be used by schools, etc.
	Selling to recycling company	Profitable if recyclers collect and pay	Finding a recycler and transporting it there	✓	Expensive component materials can be recovered and recycled perpetually
	On-site H:H disposal facility	Waste is safely disposed of.	High costs associated with H:H facility construction. Hazardous waste detrimental to the environment, though correctly lined H:H facility should mitigate impact. New regulations may prohibit disposal		New regulations may prohibit disposal
	Off-site H:H disposal facility	Ease of implementation	High transport costs New regulations may prohibit disposal		New regulations may prohibit disposal
Waste tyres	Re-treading	Tyres can be re-treaded multiple times, assuming it is done correctly. This reduces the demand for the production of new tyres.	Platreef requires the services of a removals company and a contract with a re-treading company. They will only re-tread tyres which have structural integrity	✓	Removes waste from site; provides beneficial re-use of tyres
	Re-use applications on-site	Cheap and easy to implement; reduces volume required for disposal Fair benefit in that larger volumes could be employed for general use for off-site engineering	Does not make optimal use of resource value Size of certain tyres may imply transport logistical challenges	✓	Off-site options to address and resolve continuous waste tyre arisings is fair due to the possibility of exploring new off-site application markets
	Shredding and granulation (required for recycling purposes)	High benefit, due to reduced transport costs and potential for further recycling	Shredding machinery is relatively expensive Specialised machinery required as well as trained employees (unless mobile shredder option becomes available)	✓	Due to the high calorific value of waste tyres, the energy recovery option as a dominant downstream use provides fair weighting subject to the potential constraint of manageable but expensive air abatement equipment
	Steel recovery	Makes use of some of the value of the waste	Common method of recovery is tyre burning which causes air pollution		
	Incineration / pyrolysis (off-site)	Electricity generation	Potential high risk of air pollution, unless air mitigation is performed in accordance with regulatory requirements, as to be expected from off-site facilities focussing on using alternative energy resources Very high capital cost of plant		Due to complexity of the pyrolysis process, specifically with regards to optimising its operational efficiency, the manageability of this option is low
	On-site disposal	Removes tyre stockpiles which are health and fire hazards	Reduces landfill airspace - landfill disposal may be prohibited by new legislation		New legislation prohibits disposal of whole tyres to landfill
Conveyor belts	Re-use on-site or off-site	Cheap and easy to implement	Will not be able to handle all of the waste conveyor belts	✓	Avoids costs and liabilities
	Sell-off to recycling company – contractors using the rubber for other applications	Beneficial re-use of resource	Low profit margin; high travel costs	✓	Since incineration and disposal are highly undesirable, this option should be pursued as far as possible for all conveyor belt waste remaining after re-use
	Incineration and pyrolysis	Recovery of useful heat energy	Possible air pollution		

Waste stream	Alternative strategies considered	Advantages	Disadvantages	Selected go-forward option(s)	Key determining factor in decision
	On-site disposal	Ease of implementation	Reduces landfill airspace		
Cement bags	Sell-off to recycling company - Cement bags can be recycled into high quality cardboard	Beneficial use of bags	If transportation is over very long distance, may not be economically feasible	✓	
	Composting	Cement bags with small volumes of cement are compostable, but they do not add value or nutrients to the compost material	Does not add resource value to compost	✓	Cement kiln on-site thus minimal cement bag waste will be generated, small volumes can be disposed of in composter or landfill
	Energy recovery by combustion	Can become part of take-back agreement; highly combustible	Small benefit from resource value; possible air pollution	✓	Cement bags are highly combustible and can be co-combusted in cement kilns. Could be incorporated into take-back agreements with suppliers
	Disposal to on-site general landfill	Ease of implementation	Makes no use of resource value	✓	Since the bags are made of paper and cement is inert, the entire packaging body can be disposed without treatment to general landfill.
Refrigerants	Take-back agreements	Cheap, easy to implement		✓	Easy to implement; beneficial use of valuable resource
	Recovery and recycling	Legislation in South Africa according to SANS 10147 prohibits the venting of refrigerants into the atmosphere. It requires the refrigeration and air conditioning industry to recover and recycle refrigerant.	Requires special services to recover and store refrigerant under pressure in gas cylinders before removal	✓	Required by law. Only to be implemented if take-back agreements cannot be made
	Disposal		No venting to atmosphere is allowed; expensive		

5.3.5.2 Alternative General Landfill Sites

5.3.5.2.1 On-site Landfill

The option to build an on-site landfill is subject to feasibility and trade-off study as this option will require significant capital expenditure for the establishment and licensing of the site. It is assumed to have a higher start-up cost but lower operating cost than the option of transporting waste to other off-site waste disposal facilities. It has been noted that the other mines in the area have established their own on-site landfills, indicating that it has been the most feasible option in other local cases:

A cost estimate for an on-site landfill would include:

- Licensing cost - currently being undertaken by GAA;
- Cost of constructing a facility – relative to the size of the waste stream expected. Costing for a total 36 year lifespan landfill has been estimated as roughly R 48.5 million. This cost will be expressed in phased development of a landfill which is roughly estimated at R 8.13 million for the Bulk Shaft construction phase and R 6.73 million for each 5 year period of mine wide operation subsequently;
- Machinery for transport, placement and compaction (trucks/tractors and a bulldozer); and
- Labour or contractors.

If Platreef decides to construct a landfill, it has the option to build a landfill with sufficient capacity for the full life of mine, or to build landfill cells in a phased approach, creating capacity for 5 years at a time, with the option to close or extend the landfill after each period. This would assist Platreef to spread the capital expenditure and the risks associated with the mining industry. It is suggested that the cells are developed as part of the long-term landfill footprint.

Due to the short timeframe until shaft sinking commences and the licensing required with full scale facilities it is suggested that Platreef initially provides a single cell landfill not exceeding 50 m^2 (and total capacity of only about 50 tons at 3 m height) which will have the objective of remaining below the licensing threshold and providing airspace until licensing is resolved. In effect, the temporary cell will act as not much more than one month's storage from which trucks will be filled for transport to temporarily arranged landfill off site.

Alternative locations for the on-site landfill

The below-listed options were selected as possible sites for the on-site general waste landfill to be located (see Plan 3, Appendix A).

Option 1: On-site SW corner

This location has been designated as a general waste area, and provides a total space of 14.25 ha. The design recommendation for this site is a 15 m total height, 12 m of which is above ground. The air space requirement for the full life-span of the mine requires a waste cell footprint of 100 m × 100 m which, with added space for infrastructure, results in an estimated space requirement of 1.75 ha. There is hence more than sufficient space at the location to accommodate the general waste landfill.

Option 2: On-site SE corner

Although there is sufficient space in this area for a landfill site, this area is close to the entrance to the site and visible from the N11, the main highway passing the site. This means that this landfill, which will be higher than the berm surrounding the site, will be quite conspicuous and its use may be highly constrained. Furthermore, this site is separated from the planned waste management area. A large sub-station planned for the location raises safety concerns.

This waste facility will be 15 m high. If it is to be flattened due to visibility, the available area will become constrained. As with the other facilities, this landfill will be lined, with limited cover material stockpile, developed in phases, and will include leachate collection and treatment. Utilities and facilities such as administration, power and water will have to be provided for separately at a high cost.

Option 3: On-site NW corner

This area has been designated as a Plant Construction Laydown area. This means that the use of this area will be highly constrained during the shaft sinking and mine construction phases. The 1:100 floodline also impinges nearby this area, although the site berm does not cross the flood line. Since the facility is designed in cells, i.e., as a small waste facility which will be expanded, the landfill can co-exist with the Plant Construction area usage and the available area is sufficient for the facility.

As with the previous landfill, this will be a lined facility with limited cover material stockpile, developed in phases, and including leachate collection and treatment. Stand-alone utilities and facilities such as administration, power and water will have to be provided for separately at a high cost since this facility area is too distant to share such utilities with the main site, particularly with the other elements of an integrated waste management area

Option 4: Off-site South of SW end

This location is just outside the General Waste area and also just outside the current site contained by a berm. To implement this option, the land lease will need to be extended as well as the berm to surround this area.

This landfill can be designed with different heights depending on the size of the area of land leased, but the design recommendation is 15 m total height, 12 m of which is above ground. Air space requirement is similar to Option A, with a waste cell footprint of 100 m × 100 m only, and a total footprint of 1.75 ha when infrastructure is included. Again, this landfill will be lined with limited cover material stockpile, developed in phases, with leachate collection and treatment. Utilities and facilities will be shared with the rest of the mine and integrated waste management site.

An added advantage of this option is that leachate can be managed easily within an integrated waste management area, and this site will be part of that area, albeit expanded beyond the current mine site. There are serious concerns regarding unofficial settlements already encroaching on the site and the difficulties in expanding the land lease may be insurmountable.

Option 5: Off-site West of site entrance

This area is situated just outside the Mine Main Gate and will not be protected by the site berm. This site could be under control of the municipality. As with Option 1 and Option 4, this landfill site will be 15 m high, 12 m of which will be above ground, and it will have a footprint of 100 m × 100 m and take up a total area of 1.75 ha.

It will be a lined landfill with limited cover material stockpile, developed in phases, with leachate collection and treatment. Separate utilities such as administration buildings and water supply will be required for this site. Closure and rehabilitation of an off-site facility is an added cost that may also result in legal issues and costs. An off-site landfill is subject to incursion from waste pirates, which poses serious health and safety issues but also potential liability issues to the mine. Incursion of residences in the proximity of an off-site landfill will be difficult to prevent and is considered to add further potential liability.

5.3.5.2.2 Mogalakwena Municipal Landfill

The most obvious off-site disposal option is the Mogalakwena Municipal Landfill situated on the South-Eastern border of the town of Mokopane, as it is the nearest public sector landfill. This site was licenced in 1994, according to the licence conditions the site may accept all general waste types but no hazardous wastes such as:

- Any medical and pharmaceutical waste;
- Acids and alkalis;
- Asbestos;
- Any petroleum products; and
- Chrome, Copper, Nickel, Lead, Arsenic and various other heavy metals and chemical bonds.

According to liaison with a local municipal official, the site life will only be for two or three more years until capacity has been reached. At that stage the municipality will either have to extend the site and apply for a new licence, or find alternative landfills for the disposal of their waste, these alternative landfills are listed below.

This option poses a risk to the Project, as there is no guarantee that the Mogalakwena municipal landfill will be able to accept waste from Platreef for the duration of the Project. If Platreef decides to use this as the primary disposal option, Platreef should ensure there is a guaranteed secondary option to fall back on in the event that the Mokopane landfill is no longer able to receive waste from Platreef.

5.3.5.2.3 Platreef Owned Cell at the Mogalakwena Landfill

It has been proposed that Platreef could sponsor the establishment of a new cell at the existing Mogalakwena landfill that would be dedicated for the disposal of waste from the Project. Much like constructing an on-site landfill, this option will require a new licence application and incur similar start-up costs for the construction. The potential benefits include:

- Loss of operational and long-term liability;
- No requirement for operational staff and equipment; and
- A relatively close disposal option, that provides design disposal capacity for the life of the mine.

The risks and draw-backs associated with this option include:

- Platreef would likely need to prepare a total cell capacity for 30 years usage bringing more cost up front than would be required for on-site landfill;
- The operator (municipality or private) could dispose of waste other than that planned for from the Project, namely municipal waste from the surrounding settlements, thus filling the cell before the expected date;
- The operator may not adhere to licence conditions and thus disqualify the use of the landfill;
- Increased transport cost due to greater distance (relative to on-site); and
- Site establishment, licensing and operating costs will be the same as for an on-site landfill, but transport costs will be higher.

As for an on-site landfill, Platreef could opt to construct an off-site Platreef owned landfill in a phased approach, with cells having a life span of 5 years at a time. This would help to spread the cost and risks over an extended period. This strategy would have to be discussed with the relevant municipal officials and legal agreements would have to be signed to ensure security of access to Platreef. In this case, significant additional costs for site selection including EIA would be incurred.

5.3.5.2.4 Alternatively Privately Owned Landfill

There is a privately owned landfill belonging to nearby platinum mine, Anglo American Mogalakwena Mine (AAMM), roughly 3 km away. AAMM had a previous landfill which has reached capacity and the new landfill to be commissioned in 2014 will have space for general waste, bioremediation of hydrocarbon contaminated soil and temporary storage of hazardous wastes before it is removed to Holfontein by a waste contractor.

As an alternative, Platreef could establish a mutually beneficial relationship with AAMM for the management of certain waste types; namely domestic waste for landfill and hydrocarbon contaminated soil for inclusion in their bioremediation process.

It is expected that AAMM will charge Platreef premium prices for the use of its waste management facilities, as it may not have catered for the extra waste stream in its original planning. This option may also be reliant on the relations between Anglo-American and Platreef.

5.3.5.2.5 Alternative Municipal Landfills

In the event that other nearby off-site disposal options are not available, i.e. Mogalakwena landfill is over capacity and AAMM declines to offer disposal services, Platreef may need to seek off-site disposal further away. There are a number of alternative municipal landfills in the area which may serve as alternative disposal options in the event of unfeasibility of an on-site landfill. These landfills include:

- Roedtan waste disposal site, 59.3 km from Platreef;
- Weltevreden landfill Polokwane, 79.7 km from Platreef; and
- Rebone waste disposal site, 91.3 km from Platreef.

5.3.5.3 Waste Rock Dump Site Selection

During the site identification process, the following five waste rock dump sites were identified within the study area (see Plan 3, Appendix A):

- Site 1 – North west of main shaft area and on Anglo Platinum property;
- Site 2 – South west of main shaft area, but inside Platreef prospecting rights;
- Site 3 – West of main shaft area and adjacent to a Tailings Storage Facility;
- Site 4 – Directly west of main shaft area (and pre-workshop location); and
- Site 5 – Located within the main shaft area.

The main site selection criteria were grouped in the following categories:

- Technical/engineering;
- Environmental;
- Social/public acceptance;
- Economical; and
- Legal/regulatory.

The procedure that was followed for the rating and ranking of alternative sites in terms of the main criteria included the following:

- Assigning a relative weight to the main categories of criteria;
- Identification of various sub-criteria under the main categories of criteria;
- Defining the sub-criteria; and
- Rating and ranking based on the sub-criteria.

5.4 No-Mining Option

The current land use is subsistence crop production and subsistence animal farming. The no-mining option will result in the continuation of such land use. Although economically viable, the continuation of agriculture may not provide the level of medium term economic growth to the area that mining would offer, such as increased employment of residents in the area, greater economic input into the area, allowing better development of the towns and surrounding areas, and greater socio-economic stability in the area. After mine closure and rehabilitation of mined areas, the land capability may return to a state which would allow the continuance of agricultural practices. It is important to remember that the Project will be an underground mine. For this reason, few of the current practices will be disturbed and may potentially continue as usual. The mine will also promote sustainable local economic development, to give communities the skills required to remain economically viable and successful after mine closure.

6 PUBLIC PARTICIPATION PROCESS

6.1 Introduction

The Public Participation Process (PPP) has been designed to provide I&APs with an opportunity to evaluate all aspects of the Project and to comply with all regulatory requirements. The aim is to promote collaboration between stakeholders representing all relevant interests and sectors of society, technical specialists and the various organs of state that work together to produce better decisions than if they had acted independently. This section provides an overview of the PPP and describes the engagement activities undertaken to date.

6.1.1 Objectives of the Public Participation Process

The PPP has been designed to achieve the following objectives:

- To ensure that I&APs are well informed about the Project;
- To provide I&APs sufficient opportunity to engage and provide input and suggestions on the Project;
- To verify that stakeholder comments have been accurately recorded;
- To draw on local knowledge in the process of identifying environmental and social impacts associated with the Project;
- To involve I&APs in identifying ways in which concerns can be addressed; and
- To comply with the legal requirements.

6.1.2 Phases of Public Participation

The PPP has been designed with four main phases of engagement, namely:

Application Phase

- Application for authorisations; and
- Notification of directly affected landowners.

Scoping Phase

- Further identification of stakeholders;
- Notification to the public of the environmental authorisation process;
- Distribution of a project Background Information Document (BID), placement of newspaper adverts and site notices; and
- Gathering issues of concern, suggestions and comments from I&APs.

Impact Assessment Phase (the Current Phase of this Report)

- Providing feedback regarding the specialist studies conducted;

- Providing I&APs with the opportunity to comment on findings of the specialist impact assessments and proposed mitigation measures; and
- Verification that comments raised by stakeholders have been accurately recorded.

Decision Making Phase

- With completion of the environmental authorisation process all registered IAPs will be notified of the decision made by the competent authorities and will be provided with details should they want to appeal the decision.

6.2 Public Participation Methodology

The section below sets out the various consultation activities undertaken as part of the environmental authorisation process.

6.2.1 Application Phase

6.2.1.1 EIA Application Form and Land Owner Notifications

Directly affected landowners were notified regarding the Project via registered mail on 14 December 2012 (See Appendix D). The following I&APs were notified of the Mining Right Application, the NEMA application, the WML Application and IWULA:

- Mokopane Traditional Council; and
- Limpopo Department of Rural Development and Land Reform.

6.3 Scoping Phase

6.3.1 Identification of Interested and Affected Parties

To ensure proper representation of stakeholders, the following identification methods were used to develop a stakeholder database:

- Using existing databases developed for the Platreef project;
- Conducting Windeed searches in and around the project site to verify landownership and obtain contact details;
- Responses received from the publication of newspaper advertisements and site notices;
- Responses received on the BID; and
- Networking and meetings with stakeholders to identify additional I&APs.

I&APs for the Project has been divided into three main groups, namely; authorities, landowners, and affected communities.

The authorities identified for the Project include:

- National DEA;
- Limpopo DMR;

- South African Heritage Resources Agency (SAHRA);
- Limpopo Regional Office of the DWA;
- Department of Agriculture, Forestry and Fisheries (DAFF);
- LDEDET;
- Limpopo Department of Rural Development and Land Reform;
- Limpopo Tourism and Parks Agency;
- Department of Public Works, Roads and Transport (DPWRT);
- Department of Health (DoH);
- Department of Labour (DoL);
- Department of Health and Social Development (DoHSD)
- MLM; and
- WDM.

Table 6-1 Landowners and properties

Farm	Portion	Registered Landowner
Macalacaskop 243 KR	0	Republic of South Africa, Department of Rural Development and Land Reform
Turfspruit 241 KR	0	Republic of South Africa, Department of Rural Development and Land Reform
Rietfontein 2 KS.	1	Republic of South Africa, Department of Rural Development and Land Reform

The abovementioned farms are owned by the Government of the Republic of South Africa and are held in trust by the Minister of Rural Development and Land Reform for the Mokopane community. Individuals and households in the area occupy and utilise the land on the basis of informal rights acquired under circumstances contemplated in the Interim Protection of Informal Land Rights Act, 1996 (IPILRA).

There are eight communities which are directly affected by the Project which include the following villages:

- Ga-Magongoa;
- Ga-Kgobudi;
- Madiba;
- Tshamahansi;
- Mzombane (also known as 7 Miles);
- Masodi;
- Sekgoboko; and
- Masehlaneng.

A stakeholder database has been compiled, please refer to Appendix D.

The regional and local settings of the project are depicted in Plan 1 and Plan 2 (Appendix A).

6.3.2 Public Participation Information Materials and Project Announcement

Announcement Letter (Appendix D) was distributed to the stakeholder database on 21 June 2013. The letter contained information about the Project, applicable legislation and decision-making authority, information on availability of the Scoping Report and details of the public meetings. A Registration and Comment Sheet was also provided for stakeholders to use for formal registration as I&APs or to submit comments.

Background Information Documents (Appendix D) were developed, hand delivered or emailed to the potentially affected and surrounding landowners and occupiers where possible. The BID was also emailed to the relevant competent and commenting Government authorities and environmental groups. It provided information about the Project and invited I&APs to partake in the PPP. A comment and registration form was attached to the BID which allowed I&APs an opportunity to raise their comments regarding the Project and also formally register for the environmental regulatory process.

Newspaper Advertisements I&APs were also notified about the Project through placement of newspaper advertisements. These were published in the Bosvelder, Noordelike Nuus (Afrikaans), Limpopo Mirror and Seipone (English, Tsonga and Sepedi) on 21 June 2013. The advert included a brief project description, information about the required legislation, the decision-making authority, details of the appointed independent environmental consultant, information about availability of the Scoping Report for public comment and details about the Public Meeting. An additional newspaper advertisement advertising the acceptance of the mining right application and associated Public Meeting was published (English) in the Daily Sun on the 7 August 2013 (Appendix D).

Site Notices were put up on 21 June 2013 and again on 25 June 2013 at conspicuous places to inform I&APs about the Project. See Plan 23 in Appendix A for a map indicating where the site notices were placed and Appendix D for a copy of the actual site notice. These notices contained information about the Project, the location thereof, legal process to be followed, the contact details of the Public Participation consultant and details regarding the Public Meeting.

Short Message Services (SMS) were sent out on 21 June 2013 and were used to notify people of the availability of the Scoping Documents as well as the public meeting to be held.

6.3.3 Meetings with Stakeholders

Public Meetings were held on 7 July 2013 at the site of the Project and in the community of Tshamahansi. An additional Public Meeting, which predominantly focussed on acceptance of the Mining Right Application, was held at the Mmadikana Sports Ground on the 11 August 2013.

A Key Stakeholder Meeting was held on 12 July 2013 in the town of Mokopane. The key stakeholders included:

- Civic organisations;
- Non-Government Organisations;
- Ward councillors;
- Local government;
- Provincial government;
- Traditional authorities; and
- Business forums.

Minutes of all the stakeholders meetings and the presentation which was made are included in Appendix D.

I&AP comments and views gathered from the engagements and from responses to the information materials comments are included in the Comment and Response Report CRR (Appendix D) and is included in the Final EIA/EMP Reports. Comments and concerns have been addressed in the EIA/EMP and responses are provided as part of the CRR.

6.3.4 Availability of the Draft and Final Scoping Reports

During the Scoping Phase various reports were available for public comment. These include the Scoping Report (for the MPRDA) and the Draft and Final Scoping Reports (for the NEMA and NEMWA). These are hereafter collectively referred to as Reports. The Draft Scoping Reports were made available for public comment from 21 June to 1 August 2013 and the Final Scoping Reports were made available from 23 August until 10 October 2013 at the following public places:

- Mokopane Public Library;
- Mahwelereng Public Library;
- Platreef community liaison offices;
- Eight directly affected villages headmen;
- Platreef community liaison offices;
- Digby Wells website www.digbywells.com; and
- I&APs were able to request a Compact Disc (CD) copy of the report.

6.4 Public Participation during the Impact Assessment Phase

The PPP for the Impact Assessment Phase utilised similar activities undertaken during the Scoping Phase, which are discussed in more detail in this section. These activities included:

- Making the Draft EIA/EMP Reports available for public comment;
- Development of engagement materials; and
- Meetings with stakeholders.

6.4.1 Availability of the Draft EIA Reports

The Draft EIA/EMP Reports were available for both NEMA, NEMWA and the MPRDA were made available at the following venues:

- Mokopane Public Library;
- Mahwelereng Public Library;
- Platreef community liaison offices;
- Eight directly affected village headmen were no liaison offices exist;
- The Mokopane Traditional Authority;
- The Platreef CSR office in Mokopane;
- Digby Wells website www.digbywells.com; and
- I&APs were able to request a CD copy of the report.

The Draft NEMA and NEM:WA EIA reports were available for public comment from 4 November until 14 December 2013 and the MPRDA report was available for comment between 4 November and 25 November 2013. I&APs were informed of the availability of the Reports by announcement letter, (Appendix D) email and adverts which were placed in the Bosvelder newspaper which appeared in English, Sepedi, Tsonga and Afrikaans on the 4 November 2013 (Appendix D). The comment period for the MPRDA report was later extended to 14 December 2013 on request from the Lawyers for Human Rights. I&APs were informed of this extension of the comment period by email and advertisements were placed in the Bosvelder and the Daily Sun (Limpopo), which appeared on 22 of November 2013 (Appendix D).

6.4.2 Engagement Materials

In addition to the EIA/EMP reports being made available, a non-technical summary of the Draft EIA/EMP Reports was compiled and translated into Tsonga, Sepedi and Afrikaans (Appendix D). The non-technical summary presented the EIA/ EMP reports as a summarised version and was written in easy to understand language.

6.4.3 Stakeholder Meetings

Traditional Authority, Key Stakeholder, Public and Focus Group Meetings were conducted during the Draft EIA/EMP comment period to present the Draft EIA/EMP Reports and to give I&APs the opportunity to make comments and verify that their comments had been captured and addressed during the Scoping Phase.

The Mokopane traditional authority meeting took place on 14 November 2013 at the Mokopane Traditional Authority Hall. A Key Stakeholder Meeting took place on the 15 November 2013 at the Oasis Lodge and both Public Meetings took place on the 17 November 2013 at the Mmadikana Sports Ground and at the community of Tshamahansi. A public meeting for the Mokopane town public was held at the Oasis Lodge on 20 November 2013.

An additional Focus Group Meeting and a Public Meeting were held on 28 November and 1 December 2013 respectively. These additional meetings took place because the Public Meeting held on 17 November 2013 at the Mmadikana Sports Ground was disrupted by the Economic Freedom Fighters (EFF) and Mr Aubrey Langa, so the meeting could not be conducted. However, attendance registers were kept and information material was distributed. The additional Public Meeting which was held on 1 December 2013 was completed successfully.

A meeting with the leadership of Tshamahansi also took place on 28 November 2013. This meeting was held at the request of the leadership as they required clarity on the future mining plans of Platreef.

All minutes, including the presentations made at the meetings, are included in Appendix D. Comments raised and responses provided at these meetings are included in the CRR. Posters translated into Sepedi, Tsonga and Afrikaans was also displayed at these meetings together with the distribution of poster booklets, also available in Sepedi and Tsonga (Appendix D). Translated non-technical summaries of the Draft EIA/EMP reports were also distributed at the meetings Appendix D.

6.5 Summary of PPP Activities and Consultations

Table 6-2 below presents a summary of the public participation activities and consultations which have been undertaken.

Table 6-2: Summary of the public participation and consultations

Activity	Detail	Reference
Application Form and Landowner Notification Phase		
Landowner Notification	Directly affected landowners were notified by registered mail of the Mining Right Application, NEMA, NEM:WA, and NWA licence applications on 14 December 2012	Appendix D1 Notification Letters
Scoping Phase		
Identification of stakeholders	Stakeholder database which includes authorities, landowners and affected communities.	Appendix D2 Stakeholder Database
Distribution of announcement letter and Background Information Document (BID)	Distributed to the stakeholder database on 21 June2013.	Appendix D3 Appendix D4 Announcement Letter Background Information Document
Sending of SMSs	SMSs sent to the stakeholder database to announce Scoping Report and Public Meeting 21 June 2013.	Appendix D2 Stakeholder Database
Placing of Adverts	Published in the Bosvelder, Noordelike, Nuus (Afrikaans) Limpopo Mirror, Seipone (English, Tsonga and	Appendix D5 Advertisement

Activity	Detail	Reference
	Sepedi) newspapers on 21 June 2013.	
Site Notices	Put up on 21 June 2013 and again 25 June 2013 at conspicuous places within the project area.	Appendix A Plan 23 and D6 Map of Site Notices
Announcement of Scoping Report	Announcement of the Draft Scoping Reports were made concurrently with the announcement of the project Reports were available at: ▪ Mokopane Public Library; ▪ Mahwelereng Public Library; ▪ Platreef community liaison offices; ▪ Eight directly affected villages headmen; ▪ Platreef community liaison offices; ▪ Digby Wells website www.digbywells.com; and ▪ I&APs were able to request a Compact Disc (CD) copy of the report. The Final Scoping Report was made available at the same venues from 23 August until 10 October 2013.	Appendix D3 Announcement Letter
Stakeholder Meetings	The following stakeholder meetings were held: ▪ Public Meetings were held at the site of the Project and in the community of Tshamahansi on 7 July 2013. ▪ An additional Public Meeting focussing on the acceptance of the Mining Right Application was held at the Mmadikana Sports Ground on 11 August 2013. ▪ A Key Stakeholder Meeting was held on 12 July 2013 in the town of Mokopane.	Appendix D7 Minutes, Attendance Registers and Presentation made at meetings
Comment and Response Report	Comments, concerns and suggestions received from stakeholders are captured in the Comment and Response Report. A summary of key comments are presented in Table 6-3 below.	Appendix D8 Comment and Response Report
Impact Assessment Phase		
Announcement of Draft EIA EMP	The Draft EIA/EMP Reports were made available at the following	Appendix D9 EIA/EMP Announcement Letter

Activity	Detail	Reference
	venues ▪ Mokopane Public Library; ▪ Mahwelereng Public Library; ▪ Platreef community liaison offices; ▪ Eight directly affected villages headmen were no liaison offices exist; ▪ The Mokopane Traditional Authority; ▪ The Platreef CSR office in Mokopane; ▪ Digby Wells website www.digbywells.com; and ▪ I&APs were able to request a CD copy of the report. Announcement of reports ▪ The draft NEMA, NEM:WA reports were available for comment from 4 November till the 14 December 2013 and the MPRDA report was made available for review from 4 November till the 25 November 2013. ▪ I&APs were informed of the availability of the reports by email and adverts placed in the Bosvelder newspaper which appeared in English, Sepedi, Tsonga and Afrikaans on the 4 November 2013. ▪ The review period for the MPRDA was later extended till the 14 December 2013 on request of the Lawyers for Human Rights. ▪ I&APs were informed of this extension of the review period by email and advertisements place in the Bosvelder and the Daily Sun (Limpopo) which appeared in these newspapers on 22 November 2013.	Appendix D10 Advertisements Appendix D11 Notification of Extension Advertisement
Non-Technical Summary	A non-technical summary of the Draft EIA/EMP Reports was compiled and translated into Tsonga, Sepedi and Afrikaans.	Appendix D12
Stakeholder Meetings	The following meetings took place to present the Draft EIA/EMP:	Appendix D13 Minutes, attendance registers

Activity	Detail	Reference
	▪ The Mokopane Traditional Authority meeting on 14 November 2013. ▪ A Key Stakeholders Meeting on 15 November 2013. ▪ Public meetings on 17 November both at the Mmadikana Sports Ground and at the community of Tshamahansi. ▪ A Public Meeting for the Mokopane Town public on 20 November 2013. ▪ An additional Focus Group Meeting on 28 November 2013. ▪ Meeting with leadership of Tshamahansi on 28 November 2013. ▪ An additional Public Meeting on 1 December 2013.	and presentation from meetings
Poster and Poster Booklets	▪ Posters were produced translated into Sepedi, Tsonga and Afrikaans displayed at meetings ▪ poster booklets, also available in Sepedi and Tsonga	Appendix D14 Posters and poster booklets
Comment and Response Report	Comments, concerns and suggestions received from stakeholders are captured in the Comment and Response Report.	Appendix D8 Comments and response report

6.6 Summary of Comments Raised during the Consultations

Comments provided by stakeholders throughout the authorisation process have been captured in the CRR and also includes responses provided (see Appendix D). A summary of the comments are included below in Table 6-3.

Table 6-3: Comments raised by I&APs

Category	Comments Raised
Economic Displacement	▪ Compensation for the fields which would be lost due to the project activities. ▪ Alternative land for farming activities.
Blasting	▪ Potential damage to houses and infrastructure.
Traffic	▪ Increase the amount of traffic due to mine activities. ▪ Safety of children.

Category	Comments Raised
	▪ Road safety and traffic control measures.
Infrastructure	▪ Uncertainty regarding the location of infrastructure.
Water	▪ Impact of the project on both ground and surface water. ▪ Drilling activates will impact on groundwater quality and availability.
Resettlement	▪ Uncertainty as to whether physical resettlement would form part of the project.
Land ownership	▪ Uncertainty regarding the ownership of the land government or community owned
Health	▪ Impacts of the mine on people's health e.g. dust.
Graves	▪ Uncertainty around grave relocation. ▪ Compensation for grave relocation.
Medical plants	▪ Loss of medicinal plants due to the location of surface infrastructure. ▪ Loss of access to medicinal plants due to fencing of the mining area.
Air Quality	▪ The increase in dust due to mining activities.
Noise pollution	▪ Impacts of the mine with regards to noise pollution created by traffic, machinery and blasting.
Employment	▪ Employment of unskilled labour. ▪ Employment of the disabled and woman. ▪ Employment of local people as a first priority. ▪ Employment by contractors.
Skills Training	▪ Requests for skills development and training for communities prior to mining commencement. ▪ Skills requirements for employment. ▪ Skills audit in communities.
Business opportunities	▪ The type and number of business opportunities which the mining operations will bring.
Benefits of the mine	▪ Enquiries as to how the mine will benefit people and communities.
Trust	▪ Mistrust in Platreef management. ▪ Mistrust in the consultants undertaking the MRA process. ▪ Mistrust in the community leadership by community members. ▪ Mistrust in Government. ▪ Mistrust in the B-BEE agreements and arrangements which will be entered into with Platreef. ▪ Unmet expectations.

Category	Comments Raised
Section 93 of the MPRDA	▪ Lifting of the Section 93 restrictions on Platreef.
Affected Villages	▪ Concern around not only eight directly affected villages are impacted by the project but all 17 villages of the Mokopane Traditional council
Division of communities	▪ Separate meetings were needed to be held with the Village of Tshamahansi.
Public Participation	▪ The availability of hand-outs at meetings. ▪ The use of SMS. ▪ The absence of Government representation at meetings. ▪ Absence of traditional leadership at meetings. ▪ Following protocol before public meetings. ▪ Additional meetings for stakeholders who live in town and on farms.
Information	▪ Availability of information such as the SLP.
Surface Lease Agreements	▪ Lack of agreements being in place. ▪ Nature of the Surface Lease agreements. ▪ Proof of surface lease agreements from Platreef. ▪ Who are the agreements being signed with.

6.7 Announce the Authorities Decision on Environmental Authorisation

Once an environmental authorisation decision about the Project has been taken, I&APs will be notified of the decision by means of either, email, fax or post. A newspaper advert will also be placed. The notifications will include the needed information about the authority's decision and the appeals procedure to be followed should any I&AP want to appeal.

7 THE RECEIVING ENVIRONMENT FOR THE PROJECT AREA

Specialist studies were conducted and impact assessment reports included in the Appendices. Independence declaration forms have also been filled out by each specialist and have been included in Appendix E.

7.1 Geology

During the Late Archaean to early Proterozoic eras, large volcano–sedimentary intracratonic basins, including the 2 985 to 2 780 Ma gold-rich Witwatersrand basin, developed on the stable Kaapvaal Craton. The Witwatersrand basin is unconformably overlain by the ca. 2 700 Ma Ventersdorp Supergroup; a sequence of rift-related lavas that were extruded in immediate post- Witwatersrand time. The Ventersdorp Supergroup is unconformably overlain by the Transvaal Supergroup; a 15 km-thick sedimentary sequence dated between 2 714 to 2 100 Ma that is dominated by dolomites within the lower stratigraphy, and shales and sandstones in the upper elevations (Bor-Ming *et al*, 1990; Eriksson *et al*, 2001).

The Project area is located on the Northern Limb of the BIC. The BIC intrudes the Transvaal Supergroup, forming a massive igneous province up to 7 km in thickness, extending over 60 000 km². The BIC is the world's largest layered intrusion and the world's largest source of platinum (Cawthorn, 1999). The BIC is divided into four exposed sections, known as the Eastern, Western, Northern, and Southern Limbs. A fifth section, the Bethal Limb, is located under younger sedimentary cover and does not crop out.

Typically the BIC consists of a mafic–ultramafic layered suite, a granite suite, and a package of predominantly felsic volcanic rocks. Emplacement of the complex appears to have been rapid, with both intrusive and extrusive rocks dated to about 2 057 Ma (Harmer, 2000 cited in Kinnaird *et al*., 2005). Plan 4 (Appendix A) is a representation of the geology for the Project area.

7.2 Topography and Visual Aspects

The Topography and Visual Impact Assessment specialist report is attached in Appendix F. The major findings are summarised below.

The study area falls within the Limpopo River Catchment Area. The perennial Mogalakwena River and flows along the western boundary of the study area. Floodplains occur along the Mogalakwena River on the south-western boundary of the study area. Several non-perennial streams flow in a westerly direction through the study area. The project area is situated in the Mogalakwena River valley. Mountainous areas run to the east and west of the project area, while the Project site itself. The Project area is relatively flat except for the mountainous area in the north-eastern corner and several isolated ridges. The land within the Project area is mainly used for agricultural activities and livestock.

7.2.1 Site Topography

The topographical model indicates that the elevation of the Project area increases from 1 030.5 metres above mean sea level (mamsl) in the Mogalakwena River floodplain in the south-western corner of the Project area to 1 759 mamsl on the ridges in the north-eastern corner of the Project area. Plan 2 (Appendix A) illustrates the topographical model and features of the Project area.

The majority of the Project area has gentle slopes of between 0° and 5°. Moderate slopes of between 6° and 15° occur in some areas. Isolated steeper slopes of between 16° and 21° occur along the banks of the Rooisloot and Klein-Sandsloot Rivers. The steepest slopes occur on the ridges and range between 22° and 69°. Plan 6 (Appendix A) illustrates the slope model of the Project area.

The slope aspect/direction of the Project area is generally in a south-westerly direction towards the Mogalakwena River. Slopes of various other directions occur in isolated areas along the river valleys/channels and on the ridges. Plan 7 (Appendix A) illustrates the aspect model of the Project area.

The relatively flat topography of the Project area will only provide minimal screening of the Project. The mountainous areas to the east and west of the project area will provide screening of the Project to those areas on the opposite sides of the mountains.

7.2.1.1 Alternative TSF (Site 3 Bultongfontein 239 KR) Site

A mountainous area runs along the eastern side of the alternative site. The topographical model indicates that the elevation of the alternative site ranges from 1 162.5 mamsl to 1,807 mamsl on the ridges in the eastern part of the alternative site (Plan 5, Appendix A).

The majority of the alternative site has gentle slopes of between 0° and 3°. Moderate slopes of between 4° and 8° occur in some areas. Isolated steeper slopes of between 9° and 16° occur along the ridges with the steepest slopes of between 17° and 48° (Plan 6, Appendix A). The slope aspect/direction of the alternative site is generally in either a north to north-westerly or a west to south-westerly direction (Plan 7, Appendix A).

7.2.2 Viewshed Analysis

Two viewshed models were completed for the Project. The first was a theoretical viewshed model, while the second is known as a mitigated viewshed model.

The theoretical viewshed model for the Project is illustrated in Plan 8 (Appendix A). This model depicts the area from which the Project will potentially be visible. The theoretical viewshed covers an area of approximately 663 km². The second viewshed model for the proposed Platreef Project illustrates the potential mitigation effect of vegetation screening (Plan 9, Appendix A). The mitigated viewshed model depicts the area from which the proposed Project would potentially be visible if the existing noise berm was used as a vegetation screen. This viewshed covers an area of approximately 631 km².

The receptors identified within the theoretical viewshed area include residents of the town of Mokopane as well the following villages as illustrated in Plan 8 (Appendix A):

- Ga-Kgobudi;
- Ga-Madiba;

- Ga-Magongoa;
- Ga-Mapela;
- Ga- Masenya;
- Ga- Molekana;
- Mahwelereng;
- Masodi;
- Moshate;
- Mzombane;
- Phola Park;
- Sekgakgapeng; and
- Tshamahansi.

The villages of Ga-Kgobudi, Ga-Madiba, Ga-Magongoa, Mzombane and Tshamahansi are closest to the proposed development and are therefore expected to experience the highest visual impact. The theoretical viewshed model indicates that the Project will potentially be visible from the N1 and N11 national routes and the R101 and R518 regional routes as well as other smaller roads within the project area. The southern part of the Witvinger Nature Reserve will potentially be visually affected by the Project.

The mitigated viewshed model indicates that the screening effect of the vegetated noise berm will result in the village of Ga-Masenya no longer being visually impacted on by the Project.

7.2.2.1 Alternative TSF (Site 3 Bultongfontein) Site

The relatively flat topography of the alternative site will only provide minimal screening of the proposed TSF. The mountainous area on the eastern side of the alternative site will provide screening of the proposed TSF to those areas on the opposite side of the mountain.

The vegetation on the alternative site consists mainly of natural bush and there is only a small area of agriculture near the village of Machikiri. The natural bush on the alternative site is slightly denser and taller than the vegetation of the Project area described above. The natural bush will provide moderate screening of the proposed TSF.

7.3 Climate and Meteorological Overview

The climate is semi-arid, with precipitation occurring as rain. Average annual rainfall is around 300 mm. Over 90% of the annual rainfall occurs between the months of October and March. The highest monthly averages typically occur in November and December, although

January also receives precipitation above average. In terms of Koeppen Climate Classification, the area belongs to BSh (Arid Climate, Steppe, hot).

Precipitation reduces erosion potential by increasing the moisture content of materials. This represents an effective mechanism for removal of atmospheric pollutants and is therefore considered during air pollution studies. Rain-days are defined as days experiencing 0.25 mm or more rainfall.

The significant variation in the windfield in the Waterberg area is indicative of strong underlying topographical influence on the prevailing meteorological conditions. The Waterberg mountain range exercises its influence on the local scale, with its peaks and valleys.

The predominant wind direction is from northeast, with the secondary component from the east northeast and east. Contributions from the NW and SE quadrant are observed. Calm conditions (wind speeds < 0.5 m/s) occurred for 4.2% of the time. Wind class frequency distribution per sector is given in Figure 7-4 and Figure 7-5.

The spatial variability in the wind fields for the Platreef modelled data is presented. The predominant wind direction is from the northeast, frequent winds mainly from the NW and SE quadrant (Table 7-1). Although wind speeds are generally moderate during this period (average 3.66 m/s), the predominant speeds ranged between 3.6 and 5.4 m/s and occurred 42% of the time. Wind speeds greater than 5.4 m/s (i.e. threshold friction velocity of 0.26 m/s) have the ability to generate fugitive dust from open areas and storage piles. Wind speeds greater than 5.4 m/s in the Platreef area account for 14.4% during the period.

Diurnal variability in the wind fields for the Platreef modelled data is presented in Figure 7-2. At night time, wind field conditions are from the northeast (25.4% of the time) with secondary contributions from east northeast and east. Wind speeds between 3.6-5.4 m/s and 5.4-8.8 m/s occurred 53% and 18% of the time. The morning time is dominated by wind fields from the northeast, north northeast and north with secondary components from the east and east southeast directions. Wind speeds between 3.6-5.4 m/s and 5.4-8.8 m/s occurred 37% and 18% of the time.

In the afternoon, the predominant wind was blowing from the northwest direction (17%), with 13% coming from the north northwest direction. Secondary components were observed from the south east sector. The evening wind field conditions were different from what was observed in the afternoon, with winds from the northeast (18%) and east northeast (16%). Wind speeds between 3.6-5.4 m/s and 5.4-8.8 m/s occurred 49% and 13% of the time.

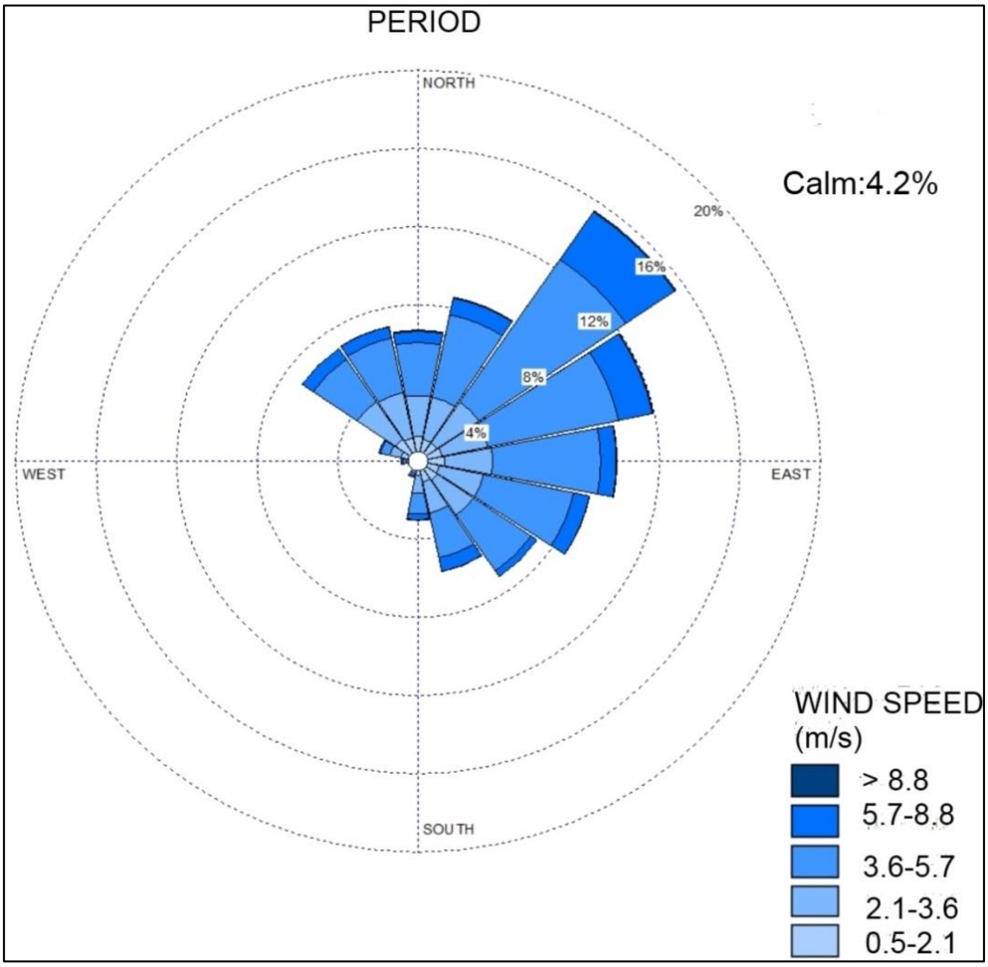

Figure 7-1: Surface wind rose modelled data (01 January 2009 – 31 December 2011)

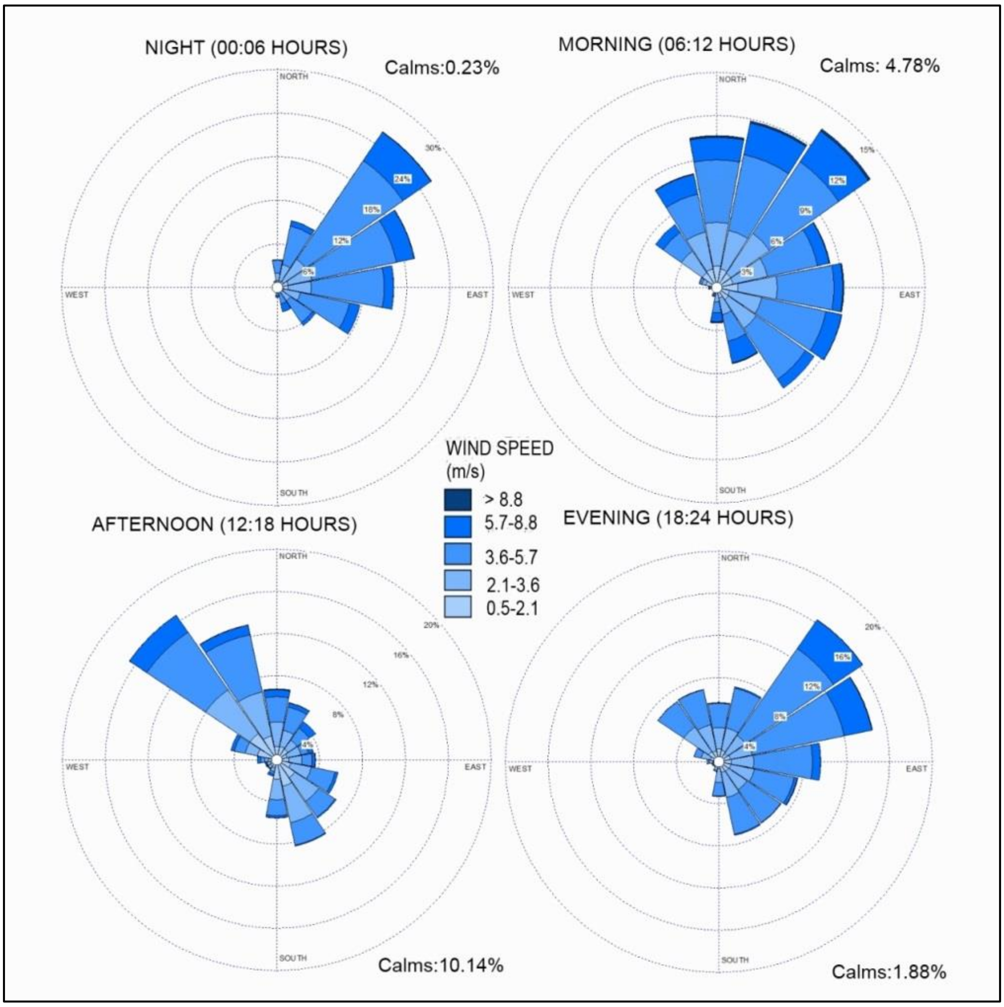

Figure 7-2: Diurnal variation of winds between Night time 00:00 – 06:00 (Top left), Morning 06:00 – 12:00 (top right), Afternoon 12:00 – 18:00 (Bottom left), Evening 18:00 – 24:00 (bottom right) and (modelled data 01 January 2009 – 31 December 2011)

The seasonal variability observed in the wind regime is represented by the plots in Figure 7-3. In spring the predominant wind speed comes from the NE with secondary components from the NNE and ENE. Less infrequent winds were observed from the N, NNW and NW. The predominant wind direction did not change significantly in summer. However, there were changes in the frequency of winds from the NE which was observed to have decrease and winds from ENE direction to have increased slightly.

In autumn, strong winds, in order of dominance were coming from the E, ENE, NE, and ESE with secondary components from the SE and NE. In winter the influence from the NE sector diminished with the wind from the E, ESE, SE and SSE dominating.

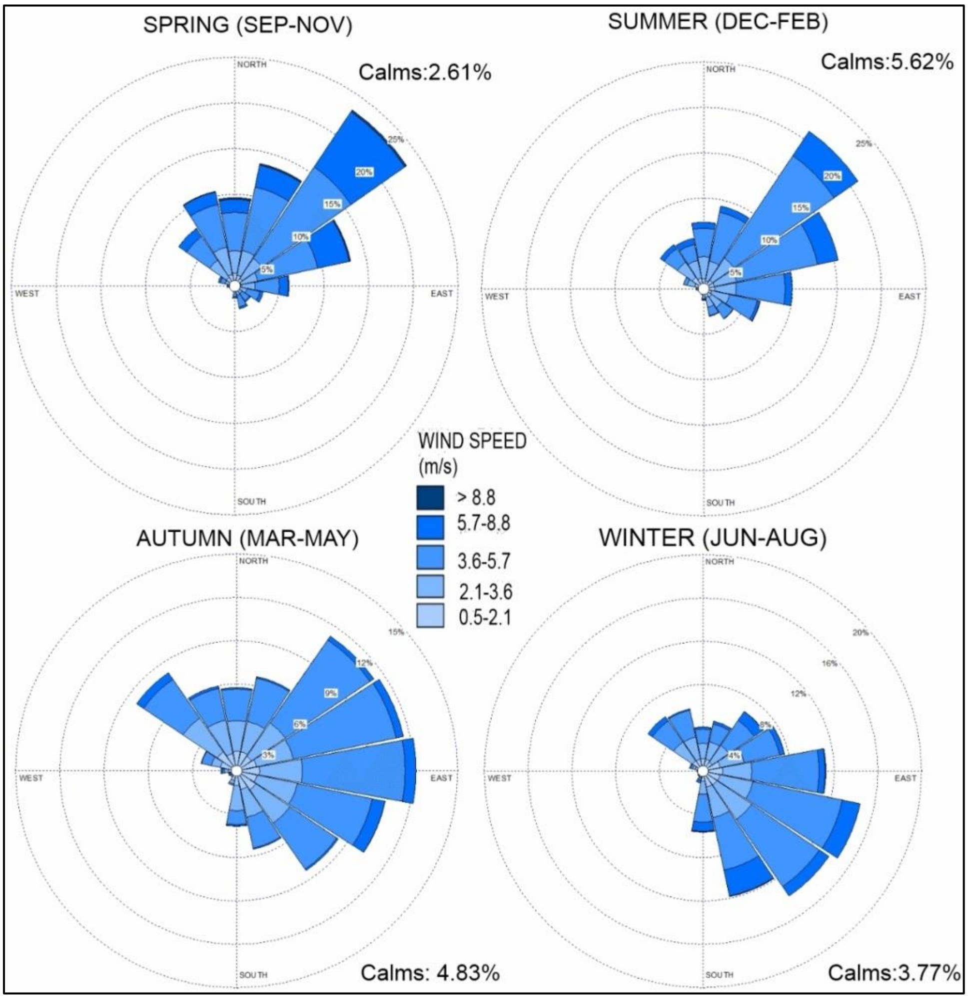

Figure 7-3: Seasonal variation of winds in spring season (September – November) (top left), summer season (December - February) (top right), autumn season (March – May) (bottom left) and winter season (June – August) (bottom right) (modelled data 01 January 2009 – 31 December 2011)

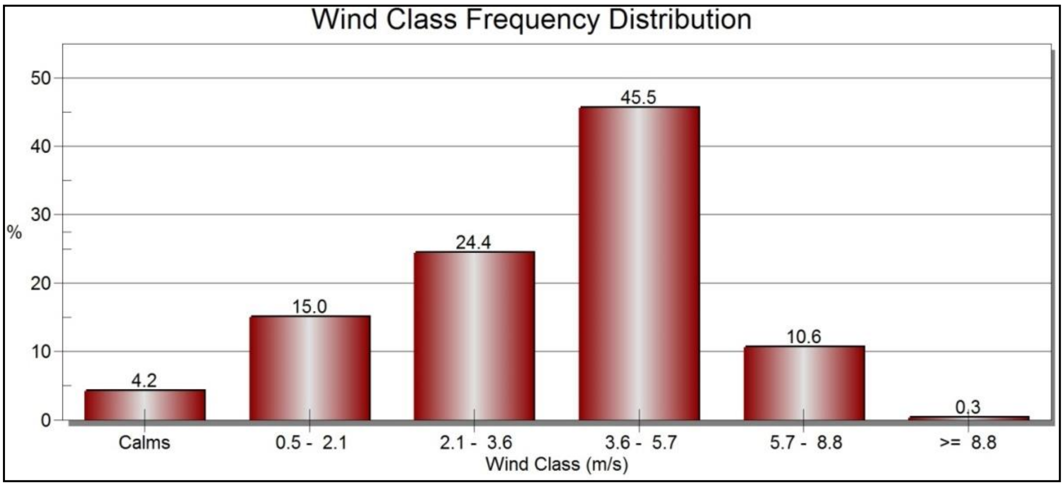

Figure 7-4: Wind Class Frequency Distribution for Platreef modelled data, 01 January 2009 – 31 December 2011

Table 7-1: Wind Class Frequency Distribution per Direction for Platreef modelled data, 01 January 2009 – 31 December 2011

	Directions (m/s)	Wind Classes (m/s)					
		0.5 - 2.1	2.1 - 3.6	3.6 - 5.4	5.4 - 8.8	>= 8.8	Total
1.00	N	1.26	2.09	2.58	0.70	0.05	6.69
2.00	NNE	1.16	2.18	3.99	1.18	0.05	8.56
3.00	NE	1.13	2.53	7.72	4.04	0.07	15.48
4.00	ENE	1.23	2.32	5.87	2.46	0.04	11.92
5.00	E	1.34	2.36	4.91	1.21	0.03	9.86
6.00	ESE	1.09	2.23	4.27	1.09	0.02	8.69
7.00	SE	1.17	2.16	3.25	0.56	0.00	7.14
8.00	SSE	1.09	1.62	2.19	0.86	0.02	5.77
9.00	S	0.72	0.92	0.99	0.38	0.03	3.03
10.00	SSW	0.37	0.26	0.14	0.10	0.00	0.86
11.00	SW	0.30	0.13	0.06	0.02	0.00	0.50
12.00	WSW	0.26	0.14	0.05	0.03	0.00	0.49
13.00	W	0.41	0.19	0.14	0.11	0.00	0.84
14.00	WNW	0.88	0.57	0.41	0.13	0.00	1.99
15.00	NW	1.37	2.30	2.46	0.83	0.00	6.96
16.00	NNW	1.23	2.36	2.69	0.72	0.02	7.02
	Sub-Total	14.99	24.36	41.72	14.40	0.32	95.80
	Calms						4.20
	Missing/Incomplete						0.00
	Total						100.00

South African Weather Service has an Automatic Weather Station (AWS) within the reasonable distance from the Platreef Project site (Station Code: 0633882 7 – Mokopane), approximately 14.5 km south southeast from the proposed plant area). The data collected at this station were not considered to be fully representative of conditions on site, particularly on Rietfontein 2 KS, so the use was made of modelled data and trends were observed analysing the three years available (2009-2011).

Three-year averaged maximum, average and minimum temperatures for the study area are given in Figure 7-6. Annual average temperatures for the Project area are given as 18.3°C. The average daily maximum temperatures range from 22.9°C in December to 8.1°C in July, with daily minima ranging from 21.5°C in December to 7.1°C in July. Annual average temperature for the study area is given as 16.8°C.

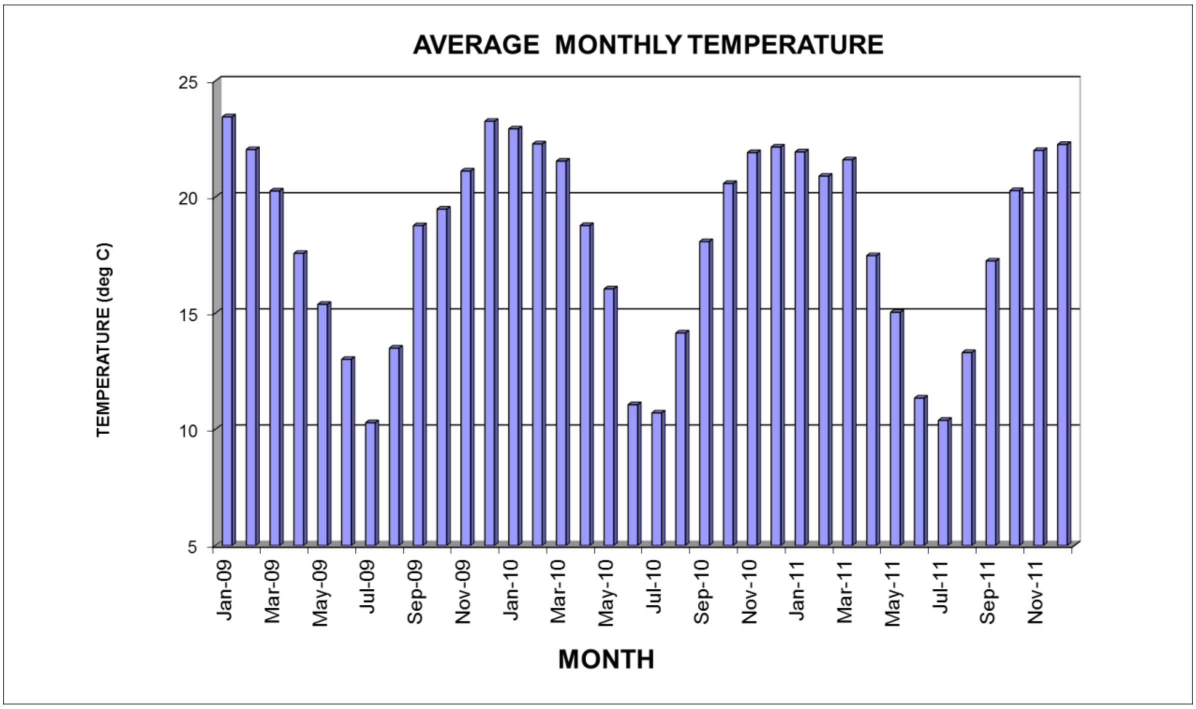

Figure 7-5: Average monthly temperature derived from the Platreef modelled data (2009-2011)

Table 7-2: Averaged monthly minimum, maximum and average temperature values derived from the Platreef modelled data (2009-2011)

Temperature (deg °C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Monthly Max.	23.5	22.3	21.6	18.8	16.0	13.0	10.7	14.1	18.8	20.6	22.0	23.3	18.7
Monthly Min.	21.9	20.9	20.3	17.5	15.0	11.1	10.3	13.3	17.2	19.5	21.1	22.2	17.5
Monthly Ave.	22.8	21.7	15.5	17.9	15.5	11.8	10.5	13.6	18.0	20.1	21.7	22.6	17.6

The data in Table 7-3 are representative of the relative humidity for the Platreef area. The annual maximum, minimum and average relative humidity is given as 66.9%, 61.1% and 63.9%, respectively. The daily maximum relative humidity remains above 60% for most of the year (with exception of November and December), and range from 78.5% in winter (July) to 55.8% in November. The daily minimum relative humidity on the other hand is less than 70% throughout the year, with the highest minimum (69.4%) occurring in June and the lowest (49.4%) occurring in November.

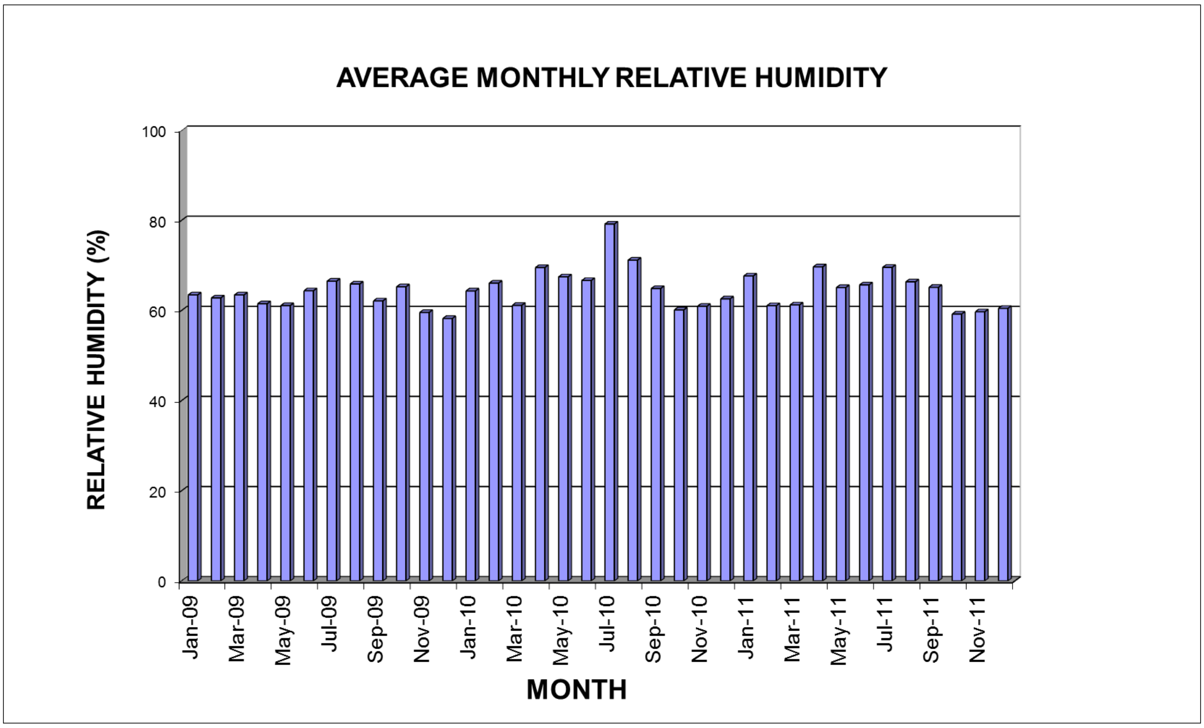

Figure 7-6: Average Monthly Relative Humidity derived from the Platreef modelled data (2009-2011)

Table 7-3: Average Monthly Relative Humidity derived from the Platreef modelled data (2009-2011)

Relative Humidity (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Monthly Max.	68	66	63	70	67	67	79	71	65	65	61	63	67
Monthly Min.	63	61	61	62	61	64	67	66	62	59	60	58	62
Monthly Ave.	65	63	65	67	65	66	72	68	64	62	60	60	65

As shown in Table 7-4, the three year annual maximum, minimum and average monthly precipitation rates for the Project area are 84 mm, 45 mm and 59 mm, respectively. The highest monthly maximum precipitation (304 mm) occurs for December. The rate decreases down to 8.1 mm in July. The monthly minimum precipitation ranges between 191.3 mm in January and 0 mm in July and August.

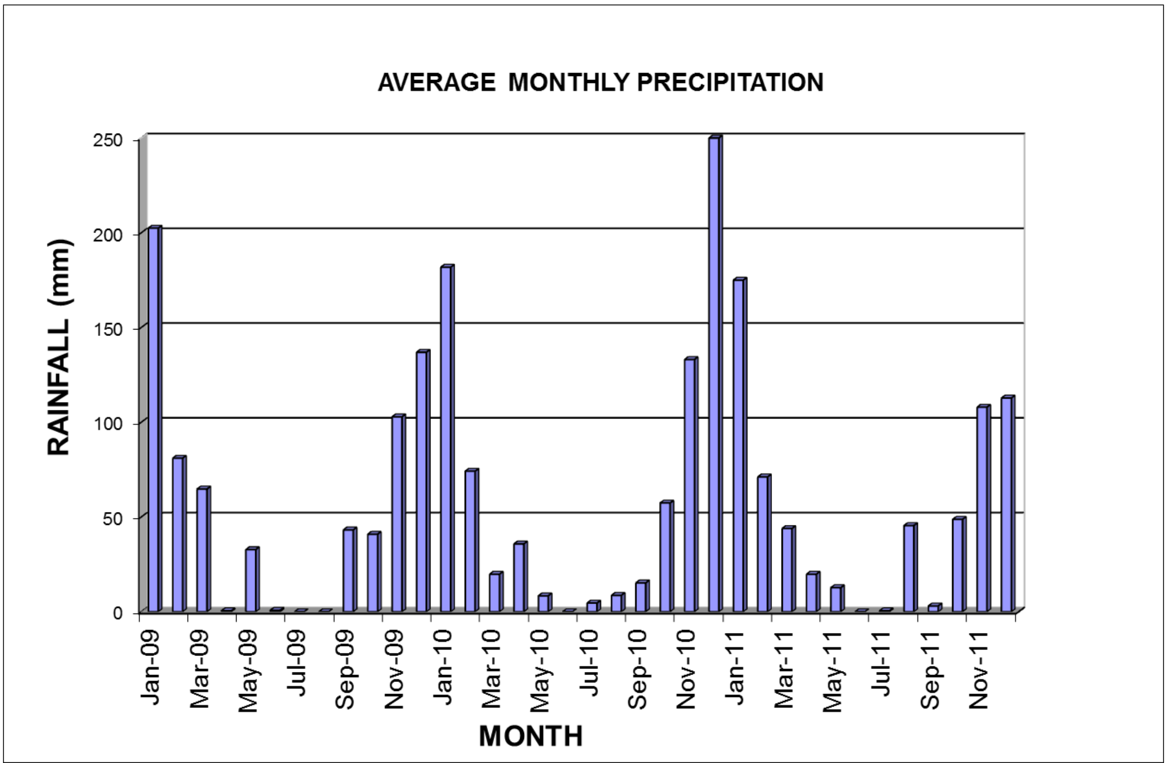

Figure 7-7: Average Monthly Precipitation derived from the Platreef modelled data (2009-2011)

Table 7-4: Average Monthly Precipitation derived from the Platreef modelled data (2009-2011)

Precipitatio n (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Monthly Max.	202	81	65	36	33	1	5	45	43	57	133	304	84
Monthly Min.	175	71	20	1	8	0	0	0	3	41	103	113	45
Monthly Ave.	186	75	18	19	18	0	2	18	20	49	115	185	59

As shown in Table 7-5, the annual maximum, minimum and average monthly evaporation rates for the Potgietersrus (Mokopane) area for the period 1957-1987 are 244 mm, 130 mm and 178 mm, respectively. The highest monthly maximum evaporation (322 mm) occurs for October. The rate decreases significantly down to 109 mm in June. The monthly minimum evaporation ranges between 180 mm in October and 68 mm in April.

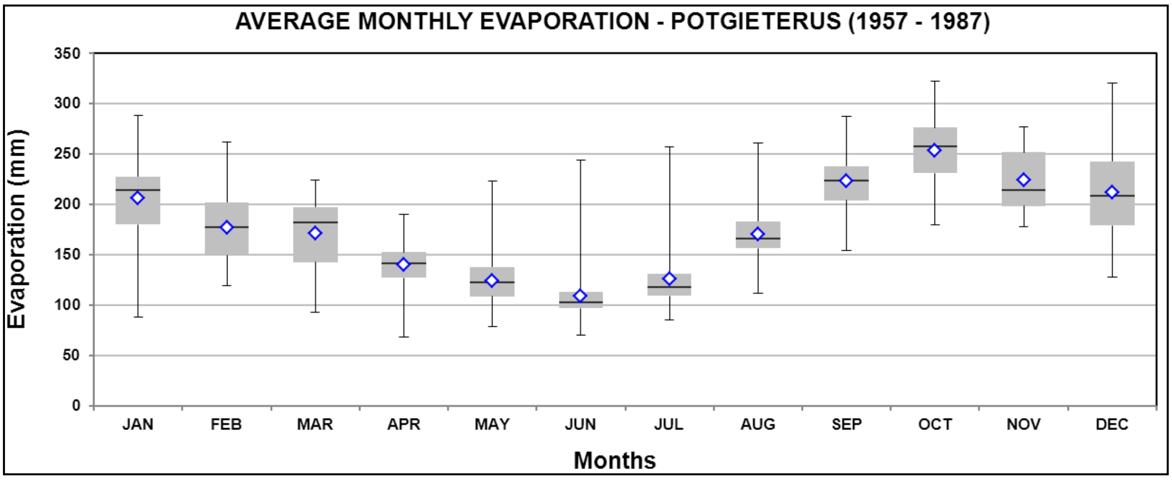

Figure 7-8: Average Monthly Evaporation for Potgietersrus S-Pan Evaporation Station (1957 – 1987) (Source: South African Weather Service)

Table 7-5: Maximum, minimum and average monthly evaporation rates for the Potgietersrus (Symon's Pan) S-Pan evaporation station for 1957-1987 period (South African Weather Service)

Evaporation (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Monthly Max.	289	262	224	190	223	244	257	261	288	322	277	320	289
Monthly Min.	88	120	93	68	79	70	85	111	155	180	178	128	88
Monthly Ave.	206	177	171	141	124	109	126	170	224	253	224	212	206

7.4 Flora and Fauna

A Flora and Fauna Impact Assessment were undertaken and the report has been attached to Appendix G.

The Project is situated within the Savanna biome, which is the largest biome in Southern Africa. It consists of a grassy ground layer and a woody plant upper layer. It is known as Shrubveld when the woody layer is close to the grass layer and as Bushveld in any intermediate phases. Factors that delimit this biome include sufficient rainfall, fires and grazing of animals (SANBI, 2011).

Field investigations were conducted by Digby Wells during the dry season (June 2011) and during the wet season (September 2011). A second dry season survey was commissioned during August 2013, during which specific infrastructure placements were investigated. The findings and recommendations of these investigations are detailed below.

7.4.1 Flora

The four vegetation types were found to occur within the Project area that can be seen in Plan 9 (Appendix A). This includes:

- Makhado Sweet Bushveld (Vulnerable) (Mucina & Rutherford, 2006);
- Mamabolo Mountain Bushveld (Least Threatened, because statutorily conserved in Witvinger Nature Reserve) (Mucina & Rutherford, 2006);
- Polokwane Plateau Bushveld (Least Threatened) (Mucina & Rutherford, 2006);
- Waterberg Mountain Bushveld (Least Threatened) (Mucina & Rutherford, 2006).

7.4.1.1 Vegetation Communities

During the field survey the vegetation was found to predominantly bushveld, however residential and farming regions allowed for secondary succession and the growth of pioneer species due to the disturbances exerted. A complete species list can be seen in the Flora and Fauna specialist report in Appendix G. One hundred and thirty five (135) species were identified throughout the Project area. Six vegetation communities (Plan 10, Appendix A) were identified including:

- Ridge Bushveld;
- Impacted Ridge Bushveld;
- Degraded Mixed Bushveld;
- Secondary Grassland and Agricultural fields;
- Wetland vegetation; and
- Residential areas.

A summary of the different vegetation communities and the area they cover is given in Table 7-6

Table 7-6: Broad communities identified in the study area

Plant Community	Area (ha)	Percentage of Total (%)
Community 1: Ridge Bushveld	795.4	7.44
Community 2: Impacted Ridge Bushveld	259.75	2.43
Community 3: Degraded Mixed Bushveld	2007.7	18.79
Community 4: Secondary Grassland and Agricultural fields	3516.3	32.91
Community 5: Wetland vegetation/Dam	338.5	3.17
Community 6: Residential areas.	3767.9	35.26

7.4.1.2 Ridge Bushveld

This vegetation type is defined as vegetation unique to the ecological system of a ridge and was found to be different in comparison to the environment that directly surrounds it. It consists of a grassy layer and a tree/shrub layer which is characteristic of the Bushveld. The grass layer includes species such as *Panicum natalense, Eragrostis rigidior, Brachiaria serrate* and *Schizachyrium sanguineum* along the channels within the ridge area. On the mid and higher slopes the grassy layer diminishes. The tree/shrub layer consists of *Acacia* *caffra, Combretum heroerense, Commiphora neglecta, Diospyrus villosa, Dombeya rotundifolia, Ficus sycamorus, Ficus glumosa* and *Cussonia paniculata*. A high level of indigenous well established bushveld species were abundant and prominent. This can also be due to the fact that these ridges form part of the Witvinger Nature Reserve ridge range.

7.4.1.3 Impacted Ridge Bushveld

The Impacted Ridge Bushveld vegetation community forms part of the ridges that are close to settlements. For this reason the ridges are constantly exposed to the cutting down of trees for firewood and the grazing of cattle. If compared to the Ridge Bushveld vegetation community, the impacts are apparent as the amount of indigenous trees is significantly reduced. The reason for this is that indigenous species such as *Dombeya rotundifolia* are targeted first for the purpose of firewood and species such as *Dichrostachys cinerea* remain. The grassy layer consisted of species such as *Themeda triandra, Hyparrhenia hirta, Aristida congesta, Eragrostis curvula, Eragrostis rigidior, Melinis repens* and *Sporobolus centrifugus.* The tree/shrub layer comprised of *Aloe cryptopoda, Grewia bicolor, Grewia flava, Ruellia cordata, Gymnosporia buxifolia, Kirkia wilmsii* and *Dichrostachys cinerea*.

7.4.1.4 Degraded Mixed Bushveld

This vegetation community was found in between the base of ridges and residential areas/settlements, which was interrupted in certain sections by agricultural/secondary grasslands. This was also significantly impacted by removal of vegetation for firewood, grazing and dumping of domestic waste. Mining activities for sand mining were also found within this community with informal gravel roads that are used for this purpose. The grassy layer was dominated by *Melinis repens, Eragrostis plana* and *Eragrostis rigidior*. The tree/shrub layer includes *Acacia karroo, Acacia garrarrdii, Ziziphus mucronata, Aloe greatheadii, Aloe marlothii, Euphorbia ingens* and *Dichrostachys cinerea*.

7.4.1.5 Secondary Grasslands/Agricultural Fields

Secondary grasslands and agricultural fields have been placed together, since the secondary grasslands persist where previous agricultural activities ceased. Where agricultural activities are still current, *Zea mays* (maize/mielies) is found. The secondary grasslands consist predominantly of secondary/pioneer grasses such as *Eragrostis curvula, Melinis repens, Urochloa panicoides, Cynodon dactylon, Hyparrhenia hirta, Aristida congesta, Pogonarthria squarrosa, Dactyloctenium aegyptium* and exotic species such as *Tagetes minuta, Senecio latifolius, Xanthium strumarium, Bidens pillosa, Solanum panduriform* and *Ricinus communis*. Secondary grassland and agricultural fields are also intermixed in-between each other, there is no distinct pattern as secondary growth is determined by activity or non-activity. Legally protected large Leadwood trees (*Combretum imberbe*) were found in large amounts in the secondary grassland vegetation type as remnant vegetation of the previous dominating bushveld of this region.

7.4.1.6 Wetland Vegetation

The wetland regions are indicated by wetland indicator and aquatic plant species. Wetland regions are usually seen as sensitive areas due to their unique ecological cycles and the species that are dependent on or inhabit them for both fauna and flora. Wetland vegetation species include *Ammania baccifera, Imperata cylindrica, Phragmites australis, Centella asiatica, Kyllinga erecta* and other Cyperaceae species.

7.4.1.7 Residential Areas

Although not identified as an official vegetation community, Residential areas form part of a large section of the Project area. Although developed, this area still has vegetation species within it and due to the large extent of the Residential area within the Project area; it is mentioned as a community. Species found within developed areas include *Mangifera indica, Carica papaya, Bouganvillea spinosa, Persea americana, Ceiba pentandra, Bauhinia variegate, Euphorbia milii, Senna pendula var. glabrata* and *Melia azedarach.*

A complete list of all plant species identified on site is found in the specialist report in Appendix G. Plan 10 (Appendix A) graphically represents the distribution of the different vegetation units identified on site. This map does not include data for Bultongfontein, as site access was restricted at the time the field surveys were conducted. A number of Species of Special Concern (SSC) were identified within the different vegetation habitats and these are described in of the Flora and Fauna impact assessment report in Appendix G.

7.4.1.8 Alien and Invasive Species

Alien invasion for the Project area was not regarded as severe and is not regarded as a major hindrance to biodiversity.

Alien species in South Africa are categorised according to the Conservation of Agriculture Resources Act, 1983 (Act No. 43 of 1983) (CARA) and the NEM:BA.

Declared alien and invasive species have been divided according to CARA into three categories:

- Category 1: Declared weeds that are prohibited on any land or water surface in South Africa. These species must be controlled, or eradicated where possible;
- Category 2: Declared invader species that are only allowed in demarcated areas under controlled conditions and prohibited within 30m of the 1:50 year flood line of any watercourse or wetland; and
- Category 3: Declared invader species that may remain, but must be prevented from spreading. No further planting of these species are allowed.

In addition, the NEM:BA Regulations (GN R. 506, GN R. 507, and GN R. 508 in Government Gazette 36683 of 17 July 2013) was issued on the 17th of July 2013. These regulations were used for categorising alien plant species found on site in this study. The NEM:BA categories for invasive species according to Section 21 are as follows:

- Category 1a: Species requiring compulsory control;

- Category 1b: Invasive species controlled by an invasive species management programme;
- Category 2: Invasive species controlled by area, and;
- Category 3: Invasive species controlled by activity.

Certain species have different alien invasive categories for different provinces in South Africa (see Alien Invasive Species list in the Flora and fauna impact assessment report in Appendix G).

7.4.2 Grazing Intensity/Land-use

The Project is broadly managed either privately and fenced or by the community and not fenced. The majority of the site is currently not fenced and communally utilised for grazing. Large agricultural fields also exist but are discussed separately. The communal grazing areas are severely overgrazed with the subsequent bush encroachment the result.

7.4.3 Fauna

Fauna expected to occur on site include assemblages within terrestrial and wetland ecosystems: mammals, birds, reptiles, amphibians and invertebrates. Each of these assemblages occurs within unique habitats; the ecological state of these habitats directly relates to the number of species found within them. The main habitats occurring in the Project area are bushveld plains and pans with little altitudinal variation.

7.4.3.1 Mammals

For a desktop review of mammals that could possibly occur within the Project area, South African National Biodiversity Institution's (SANBI) Biodiversity Information System (SIBIS) was used. The list shows all animal species that were previously recorded within the Limpopo Province and the Project area. The list also indicated the International Union for the Conservation of Nature (IUCN) status, as well as the NEM:BA status. By making a comparison between the previously recorded species list and the currently occurring species found during the field survey, the magnitude of impacts resulting in species reduction or loss can be estimated

The probability of occurrence was estimated based on habitat requirement and distribution. Protected species of Limpopo Province under Schedule 3 were also considered. Amongst these listed; the Leopard, Honey Badger, Hedgehog, Bat-eared fox and Civet were identified to have a high probability of occurrence within the Project area.

The Red Data species considered for this survey can be seen in the flora and fauna impact assessment report Appendix G). The probability of occurrence was estimated based on habitat requirement and distribution. Protected species of Limpopo Province under Schedule 3 were also considered. Amongst these listed; the Leopard, Honey Badger, Hedgehog, Bat-eared fox and Civet were identified to have a high probability of occurrence within the Project area.

7.4.3.2 Mammals Found During the Field Survey

Burrows and holes of small mammals, which can possibly belong to mice, rats and/or suricates, were found during the field survey. Sherman traps were set up to capture small mammals that are nocturnal. Species captured included the *Aethomys namaquensis*.

A full species list of mammals recorded can be seen in Table 7-7. Two of the species found are protected under Schedule 3 of the Limpopo Environmental Management Act. Both of these species were found to the north-east of the project area, which is a ridge range that forms part of the Witvinger Nature Reserve.

Table 7-7: Mammal species identified during the field survey

Family	Species Name	Common Name
Bovidae	*Sylvicapra grimmia*	Common duiker
Bovidae	*Pelea capreolus*	Grey rhebok*
Cercopithecidae	*Papio cynocephalus*	Chacma baboon
Hystricidae	*Hystrix africaeaustralis*	Porcupine
Leporidae	*Lepus saxatilis*	Scub hare
Muridae	*Aethomys namaquensis*	Namaqua rock mouse
Procaviidae	*Procavia capensis*	Rock dassie
Procaviidae	*Heterohyrax brucei*	Yellow-spot dassie*
Sciuridae	*Paraxerus cepapi*	Tree squirrel
Sciuridae	*Xerus inauris*	Ground squirrel
Viverridae	*Galerella sanguinea*	Slender mongoose

Note: * denotes species protected by the Limpopo Environmental Management Act (2003) Schedule 3*

7.4.3.3 Avifauna

Birds have been viewed as good ecological indicators, since their presence or absence tends to represent conditions pertaining to the proper functioning of an ecosystem. Bird communities and ecological condition are linked to land cover. As the land cover of an area changes, so do the types of birds in that area (The Bird Community Index, 2007). Land cover is directly linked to habitats within the Project area. The diversity of these habitats should give rise to many different species. According to the South African Bird Atlas Project (SABAP2), almost 300 species of birds have been identified in the area; the majority of these birds are comprised of bushveld species. All birds that could be present within QDS 2429AA and 2428BB are listed in the Flora and Fauna impact assessment report in Appendix G.

The Yellow-Billed Stork and African Spoonbill are protected by the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA). The AEWA covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle, including many species of divers, grebes, pelicans, cormorants, herons, storks, rails, ibises, spoonbills, flamingos, ducks, swans, geese, cranes, waders, gulls and terns. This conservation agreement includes issues such as species and habitat conservation, management of human activities, research and monitoring, education and information, and implementation.

Red Data bird species protected within the Limpopo Province was also considered during the field survey (see the flora and fauna impact assessment report (Appendix G). The possibility of occurrence was based on the distribution and habitat requirements of these Red Data species. The Yellow-billed Stork is also included in this list and has a Near Threatened status (Barnes, 2000). The probability of occurrence is high for aquatic birds, due to the fact that the wetland to the south-west of the site forms part of the Nylsvlei Ramsar system and fulfils the habitat requirements of these species.

7.4.3.3.1 Bird Species Found During the Field Survey

During the field survey 49 species were observed. The species identified were listed in the flora and fauna impact assessment report (Appendix G). This list cannot be considered as a complete list as many other birds can be present within any given season or day of the year. During the dry season survey, bird activity was greatly reduced.

7.4.3.4 Herpetofauna

No Red Data status reptiles were found during the field surveys. The probability of occurrence was determined based on the distribution and habitat requirements. The complete list of reptiles and amphibians expected to occur on site can be viewed in the Flora and Fauna impact assessment report in Appendix G.

7.4.4 Biodiversity Value Assessment

The biodiversity value or sensitivity assessment takes into account all of the plans, data tables and figures mentioned above (Threatened Ecosystems and NPAES), as well as the field data gathered during the site visits. Plan 11 (Appendix A) presents the outcomes of the biodiversity value assessment by incorporating all vegetation units, floral and faunal aspects in one map. A Very High Sensitivity was assigned to the Riparian Areas and Ridges owing to the ecosystem services provided by these as well as their irreplaceability as unique biodiversity features. The mixed bushveld vegetation within the Project area boundary was found to be in a good ecological condition and was mostly allocated a Moderately to High Sensitivity. The vegetation occurring on flat lower lying areas was severely overgrazed or cultivated and was in poor condition. These lower lying areas identified as Secondary Grassland and Agricultural fields and scored as Moderately Low sensitivity and contain the majority of the infrastructure planned

7.4.5 Species of Special Concern

7.4.5.1.1 Flora

No Red data species considered identified by the Pretoria Computerised Information System (PRECIS) data for the grid squares were identified during the field survey, however the Limpopo Environmental Management Act (Act 7, 2003) and the National Forests Act (Act 84,

1998) was also taken into consideration. Under the National Forest Act three protected species were found on site, including:

- *Combretum imberbe* (Leadwood);
- *Boscia albitrunca* (Shepherds tree); and
- *Sclerocarya birrea* (Marula).

The protected tree species *Combretum imberbe* was encountered on the lower lying flat areas within regular intervals as this tree species is not removed when agricultural fields are made.

7.4.5.1.2 <u>Plant Species with Ethnobotanical Uses</u>

Ethnobotany is a branch of botany that places focus on the use of plants for medicines and other practical purposes. The use of native plants for ethnobotanical uses can be detrimental to populations that are overexploited.

From the list of plant species identified (see flora and fauna impact assessment report in (Appendix G) during the field surveys there are 53 species that have cultural uses. Medicinal plants are important to many people and have been used traditionally for centuries to cure many ailments. Plants have also been used traditionally for other cultural uses, such as building material, and for spiritual uses such as charms.

7.4.6 Ecological Sensitivity Assessment

7.4.6.1 Protected Areas

7.4.6.1.1 <u>Witvinger National Reserve</u>

The Witvinger National Reserve has an IUCN status listed as Category IV Protected Area. This means that management of the area is performed to ensure the maintenance of habitats and meet the requirements of certain species. The Nature reserve supports high levels of biodiversity which is endemic to the area and therefore extremely important to conserve. Ridges link the Project area to this reserve.

7.4.6.1.2 <u>Nylsvlei Nature Reserve</u>

The wetland area on site is part of the Nylsvlei floodplain which is one of South Africa's least impacted floodplain systems. Part of the system is conserved and is recognised as a Provincial Reserve; the Nylsvlei Nature Reserve. The reserve has statutory protection and is also recognised as a Ramsar Site. Ramsar recognition indicates the wetland to be of international importance for waterfowl.

The wetland area forms the western boundary of the site. A steep ridge area lies on the other side of the wetland; another area of high sensitivity which falls in the Waterberg Wilderness Reserve.

7.4.6.1.3 <u>Waterberg Wilderness Reserve</u>

The private reserve has national conservation protection status as a result of it supporting high levels of biodiversity. It is not indicated on the map as it does not appear on the SANBI database. This reserve is important for populations of tree species such as Protea, Acacia, Combretum and Searsia that readily occur here. It also includes many protected mammal species such as Leopard (*Panthera pardus*), Serval (*Leptailurus serval*), African Wild Cat (*Felis silvestris*), Brown Hyaena (*Parahyaena brunnea*), Aardwolf (*Proteles cristatus*), Honey Badger (*Mellivora capensis*) and African Civet (*Civettictis civetta*)

7.4.6.2 Important Bird Areas

The Project area does not fall within any important bird areas as listed in the national or provincial biodiversity guidelines.

7.4.6.3 Nationally Threatened Ecosystems

The list of national Threatened Ecosystems has been gazetted (NEM:BA: National list of ecosystems that are threatened and in need of protection) and result in several implications in terms of development within these areas. This list was referenced in order to ascertain the level of ecosystem threat of the ecosystems present within the Project area.

The Project area does not fall within any demarcated National Threatened Ecosystems. The closest National Threatened Ecosystem is the Springbokvlakte thornveld which is located approximately 20 km north from the Project area.

7.4.6.4 National Protected Areas Expansion Strategy (NPAES)

The NPAES are areas designated for future incorporation into existing protected areas (both National and Informal protected areas). These areas are large, mostly intact areas required to meet biodiversity targets, and suitable for protection. They may not necessarily be proclaimed as protected areas in the future and are a broad scale planning tool allowing for better development and conservation planning. Plan 12 (Appendix A) indicates the proximity of the Project area to existing expansion focus areas specifically the Limpopo Central Bushveld.

7.4.7 Alternative TSF Sites

TSF site 2 (Rietfontein 2 KS) is predominantly in a moderate Biodiversity Value (BV) (and drainage lines) delineated area, the moderate BV area is described in the flora and fauna impact assessment report (Appendix G) as Degraded Mixed Bushveld vegetation type, this vegetation community was found in between the base of ridges and residential areas/settlements, which was interrupted in certain sections by agricultural/secondary grasslands. These plant communities were also significantly impacted by removal of vegetation for firewood, grazing and dumping of domestic waste. Mining activities for sand mining were also found within this community area with informal gravel roads that are used for this purpose. If the TSF does not encroach within the moderately-high to high BV areas of the Ridge bushveld boundaries as indicated, then TSF site 2 becomes the more attractive option, as it will then fall completely within degraded bushveld, with no protected species

TSF site 3 (Bultongfontein 239 KR) is located within a Moderately BV area or Degraded Mixed Bushveld vegetation type. The protected species encountered in this area, however, were predominantly *Combretum imberbe* (Leadwood), *Boscia albitrunca* (Sheperds tree) and *Sclerocarya birrea* (Marula) (protected tree species). This occurrence of the three tree species mentioned above brings the BV of this site up to High. This area is sensitive due to its semi- natural landscape (which is important for ecosystems functioning) and the fact that it contains protected plant species. The area is currently used for grazing by the local community, and was found to be overgrazed. Further studies shows that this site borders with the Witvinger Nature Reserve, thus posing a risk to the reserve if constructed.

7.5 Aquatic Ecology and Wetlands

An aquatic impact assessment report has been compiled for the Project area (see Appendix H).

A total of two types of systems were identified for the Project area, namely the Mogalakwena River floodplain and the Rooisloot, Ngwaditse and Dithokeng Rivers. The Rooisloot, Ngwaditse and Dithokeng rivers are ephemeral systems and were predominantly dry during the field survey periods. Water was noted in the lower reaches of the Rooisloot and Ngwaditse rivers and it was concluded that this is largely attributed to household effluent. No water was noted in the upper catchment areas of these systems, supporting this conclusion. As a result of this, an ecological state assessment of these systems could not be conducted.

In order to establish the ecological integrity of the associated aquatic ecosystems, several sites were selected on the Mogalakwena, Groot-Sandsloot, Ngwaditse, Dithokeng, Nyl, Rooisloot and Dorp rivers associated with the project area.

A total of seven sampling points were selected for the study. The Global Positioning System (GPS) co-ordinates for each of the sampled sites are given in Table 7-8. An illustration of the locations of the sampling sites in relation to the mine area is presented in Plan 13 (Appendix A).

Table 7-8: GPS co-ordinates and short descriptions of the various study sites

Site name	Coordinates	Description
PLA 1	23°59'35.92"S 28°57'34.24"E	The site is the intended downstream sampling point for the Groot-Sandsloot River. It was characterised by soft mud with steep eroded flood banks. The channel itself looked to have been recently mechanically dug.
PLA 2	24°3'44.22"S 28°58'48.49"E	This site is a flood plain of water trapped behind a sand berm. It appears to be fed by the drainage channels of the Dithokeng River located to the north east of the water body. Approximately 250 metres above the system sand mining is taking place.
PLA 3	24°6'25.21"S 29°1'40.67"E	This is the upstream site of the Rooisloot River, It had a moderately wide channel and 100m above the road crossing was large dam wall that had fallen into disrepair. The site

Site name	Coordinates	Description
		was dry during the site visit.
PLA 4	24°8'11.46"S 28°57'49.96"E	This was the mid-stream site for the Rooisloot River, it runs through a high density settlement. The stream was flowing and bedrock sand and gravel were present.
PLA 5	24°5'39.94"S 28°54'5.62"E	This was the downstream site of the Mogalakwena River. The site was characterised by alien riparian vegetation (Eucalyptus sp.). Dry grassy sandy channel.
PLA 6	24°10'21.01"S 28°59'11.67"E	The site was at the N11 road crossing of the Dorps River, The water was coloured white, large amounts of litter was scattered on the eroded banks.
PLA 7	24°16'32.56"S 28°58'31.55"E	The upstream site of the Mogalakwena River was dry with wide banks. A large amount of grasses had grown within the channel
PLA 8	23°59'40.34"S 28°59'25.88"E	This is the site of a dam built along a minor drainage channel at the time of survey it was dry but a single frog was found
PLA 9	24° 0'9.74"S 28°58'59.63"E	This site falls within the proposed TSF site. The river bed was dry although water still persisted in the dam below.
PLA 10	23°56'57.17"S 29° 0'23.97"E	The stream flow here originated from a seepage point at the base of the dam wall. Fish and invertebrates were found in the pools that formed at the head the stream.

7.5.1 Water Quality

Organisms which are present within freshwater ecosystems are directly affected by water quality. It is therefore essential to collate the water quality data in order to understand the responses of biota within the freshwater systems. The assessment of water quality of local river systems is based on selected *in situ* variables.

Table 7-9 presents the *in situ* variables measured within sampling points associated with the Project area during the 2013 low flow assessment.

The *in situ* water quality analysis for the low flow period indicated that the water quality at site PLA 1 was within acceptable pH and temperature range, however, conductivity was elevated and dissolved oxygen was below guideline levels. The high conductivity of the river is most likely associated with the pollution in the stream. The levels recorded are elevated and this could be negatively effecting the in stream biota. Table 7-9 presents the results for the low flow assessment.

Table 7-9: *In situ* water quality results for the Groot-Sandsloot, Nyl, Mogalakwena, Rooisloot and Dorps Rivers

Constituent	Range	PLA 1	PLA 2	PLA 3	PLA 4	PLA 5	PLA 6	PLA 7
pH	6.5 – 9	7.89	7.98	DRY	8.10	DRY	7.73	DRY
Temperature (°C)	5 – 30	17.8	18.7	DRY	18.5	DRY	20.8	DRY
Conductivity (µS/cm)	< 700	1255	1086	DRY	973	DRY	1256	DRY
DO (mg/l)	> 5	4.4	4.36	DRY	2.28	DRY	0.9	DRY

Constituent	Range	PLA 1	PLA 2	PLA 3	PLA 4	PLA 5	PLA 6	PLA 7
DO (% saturation)	80 - 120	46	42	DRY	22.71	DRY	7.8	DRY

The *in situ* water quality analysis for the low flow period indicated that the water quality at sites PLA1, PLA2, PLA4 and PLA6 was poor with conductivity and dissolved oxygen concentrations being out of the recommended DWAF (1996) guidelines values.

The elevated levels of conductivity may be attributed to the associated urban pressures these rivers find themselves under, namely the discharge of chemicals and untreated effluent would increase the levels of conductivity and could negatively affect aquatic biota.

The levels of dissolved oxygen were a concern as oxygen is the most important measure of water quality for aquatic biota (Mason, 1991). Levels below 5.0 mg/l (Kempster *et al*., 1980) were seen to negatively affect aquatic biota and the levels of oxygen at PLA1, PLA2, PLA4 and PLA6 may be negatively affecting the aquatic biota during the low flow period.

The *in situ* water quality associated with the Project area is considered to be in a poor and degraded state. Several signs of sewage effluent and urban runoff were present within the associated river systems as seen in the below figure. Results from the surface water analysis confirm the above statement and refer to eutrophic conditions and high concentrations of chloride and nutrients.

7.5.2 Habitat

The Index of Habitat Integrity (IHI) assesses the number and severity of anthropogenic impacts and the damage they potentially inflict on the habitat integrity of aquatic ecosystems. The results of the IHI of the Limpopo River are presented in Table 7-10.

Table 7-10: IHI results for the Groot-Sandsloot, Nyl, Mogalakwena, Rooisloot and Dorps River systems during the 2013 period.

Component	Score	Description
Instream IHI %	51.2	Largely modified
Instream Category	D	
Riparian IHI %	53.9	Largely modified
Riparian Category	D	

The current land-uses have impacted on the functioning of this system. Local agricultural practices, pertaining predominantly to livestock have impacted on the ability of this system to provide important services. Agricultural activities have altered the natural hydrology of the system. The decrease in surface roughness due to overgrazing has resulted in a potentially destructive hydrological regime for the system. In addition to this, livestock also impact directly on the quality of water as a result of nutrient input and trampling of the system. Owing to the fact that agricultural practices are on-going for the Project area, coupled by the absence of mitigation measures for the current land-uses, it is assumed that the ability of the units to provide important ecological services will continue to deteriorate. The severity of the current identified impacts was however determined to be minor at this stage.

7.5.3 Fish Assessment

The use of fish as a means to determine ecological disturbance has many advantages (Zhou *et al*., 2008). Fish are long living, respond to environmental modification, are continuously exposed to aquatic conditions, often migratory and fulfil higher niches in the aquatic food web. Therefore fish can effectively give an indication into the degree of modification of the aquatic environment. The River Health Programme (RHP) uses the Fish Response Assessment Index (FRAI). The FRAI is based upon the preferences of various fish species as well the frequencies of occurrence in which the species occur.

Electroshocking was carried out in rivers that contained water during the field study.

The expected species of the A61F and A61G quaternary catchments was adapted and is presented in the aquatics impact assessment report.

The FRAI assessment was adjusted to suit the site specific requirements with the Frequencies of Occurrence (FROC) of particular species adjusted from the expected species list (Kleynhans *et al*., 2007). The FRAI and FROC have been adjusted according to the following factors: sampling effort, habitat type, cover combination, stream lengths and altitude. Below in Table 7-11 are the results for the FRAI assessment.

Table 7-11: FRAI results for the 2013 survey

Component	Results
FRAI (%, adjusted)	47.74
EC: FRAI	D
Category	Largely modified

Based on the outcome of the fish assemblage assessment the fish community associated with the Project area can be considered to be largely modified. This largely modified state of the fish community is a result of poor water quality compounded with low water availability. Many species of the fish are believed to be present within the refuge areas in the local impoundments. Due to the reliance of local communities on the fish as a protein source it is important to maintain these aquatic systems.

Many of the absent fish species such as *Chiloglanis pretoriae* are sensitive to pollutants and modified flow regimes. The absence of these species confirms that the water quality as well as the instream habitat of the associated river systems is currently largely modified.

Oreochromis mossambicus was present during the field study. This organism is a Red Data species.

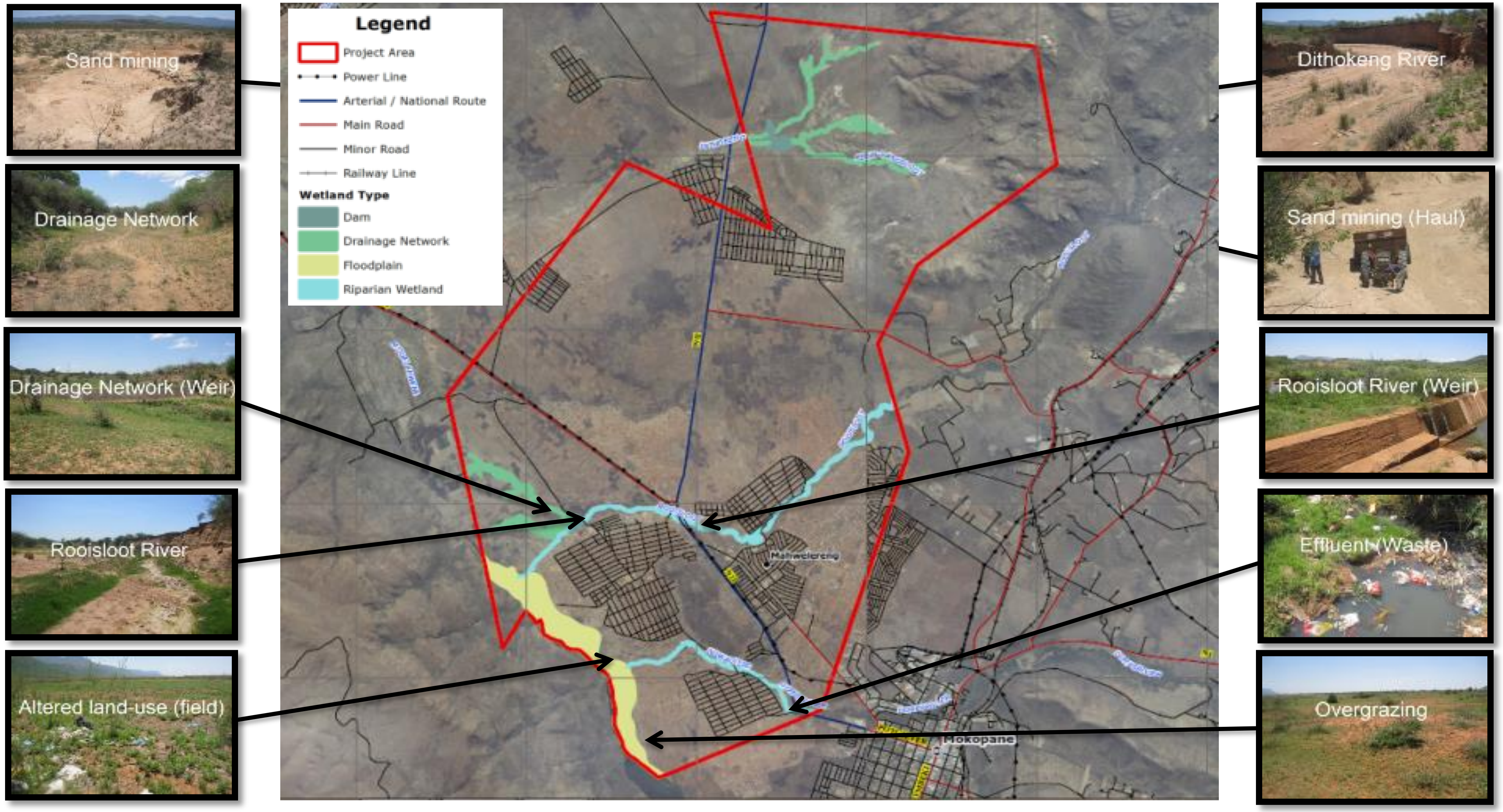

Figure 7-9: Identified impacts and the resulting affects to IHI for the Project area

7.5.4 Macroinvertebrate Assessment

As a result of aquatic macroinvertebrates integrating the effects of physical and chemical changes in the aquatic ecosystems, they are good, short-term indicators of ecological integrity. Integration of biological indicators (like aquatic invertebrates) with chemical and physical indicators will ultimately provide information on the ecological status of a river (RHP, 2001).

7.5.4.1 Habitat for Aquatic Macroinvertebrates

The reaches which were assessed consisted of a variety of biotopes with each of the systems comprising of different habitat structures. The dominant feature of the invertebrate habitat is the sandy-clay substrate which dominates the river systems under study. Generally, no stones in or out of current biotope were found to be available at any of the sites except for PLA 4 where bed rock and small stones were present. During both surveys aquatic and marginal vegetation was limited due to low flow volumes. Flow velocities during the surveys were also found to be low or not discernible. Four of the seven sites visited were found to have water in them the result of their habitat assessment is listed in Table 7-12.

Table 7-12: IHAS results for the Groot-Sandsloot, Nyl, Mogalakwena, Rooisloot and Dorps Rivers systems low flow 2013

IHAS Component	PLA 1	PLA 2	PLA 3	PLA 4	PLA 5	PLA 6	PLA 7
Flow speed (m/s)	1<	No discernible flow	DRY	1<	DRY	1<	DRY
Total score (%)	15	45	DRY	50	DRY	12	DRY
Suitability	Poor	Inadequate	DRY	Inadequate	DRY	Poor	DRY

The Invertebrate Habitat Assessment System (IHAS) results were found to be poor to inadequate for PLA 1, PLA 2, PLA 4 and PLA 6. This was largely due to sandy benthic conditions coupled with poor riparian vegetation. Flow rates were below 1 m/s at all sites containing water. PLA 2 is a standing water body with no flow. PLA 3, PLA 5 and PLA 7 were all dry sites and could therefore not be assessed. The poor habitat conditions would not be able to support a large degree of species diversity within the invertebrate taxa.

7.5.4.2 South African Scoring System (version 5)

The findings of the macroinvertebrate assessment for the system recorded taxa with sensitivity scores ranging from highly pollution tolerant to moderately pollution tolerant. A large variety of taxa with low tolerances to pollution were found in the study site associated with the Project area.

According to Kleynhans (2000) the associated sites consist of aquatic biota that is moderately sensitive and of a moderate ecological importance. During the current surveys (2013) no sensitive organisms were found. The absence of these sensitive taxa confirms the classification of Kleynhans (2000). The South African Scoring System (version 5) (SASS5) results for the low flow survey of the associated sites are given in Table 7-13.

Table 7-13: SASS 5 scores for the Groot-Sandsloot, Nyl, Mogalakwena, Rooisloot and Dorps rivers systems high flow 2013

Site	PLA 1	PLA 2	PLA 3	PLA 4	PLA 5	PLA 6	PLA 7
SASS Score	15	11	DRY	37	DRY	4	DRY
Taxa	5	5	DRY	7	DRY	3	DRY
ASPT	3	2.2	DRY	5.28	DRY	1.3	DRY
Category	E	E	DRY	E	DRY	E	DRY

The SASS5 scores for the low flow survey ranged from 4 at site PLA 6 to 37 at site PLA 4. The ASPT ranged from 1.3 at site PLA 6 to 5.28 at site PLA 4. The SASS5 scores were then placed into the biological bands based on Dallas (2007) (Table 7-14).

Table 7-14: Limpopo Plain biological banding (Dallas, 2007)

Class	SASS 5 Score	ASPT	Condition
A	>143	>5.8	Natural/unmodified
B	115 – 143	5.5 – 5.8	Minimally modified
C	94 – 115	5.1 – 5.5	Moderately modified
D	72 – 94	4.6 – 5.1	Largely modified
E	<72	<4.6	Seriously modified

According to Dallas (2007) the sites associated with the Project area are considered to be within the E category indicating that the macroinvertebrate community is present in a seriously modified state. The SASS5 interpretation guidelines are given in the table below (Table 7-15).

Table 7-15: The suggested SASS 5 and ASPT interpretations (Chutter, 1998)

SASS 5	ASPT	Suggested interpretation
>100	>6	Water quality natural, habitat diversity high
<100	>6	Water Quality natural, habitat diversity reduced
>100	<6	Borderline case between water quality natural and some deterioration in water quality
50 - 100	<6	Some deterioration in water quality
<50	Variable	Major deterioration in water quality

According to the SASS 5 interpretation guidelines there is a major deterioration in water quality at all of the sites investigated during the field study. The results of the *in situ* and FRAI corroborate this finding. Additionally, only pollution tolerant species were found to be present at the selected sites. The IHAS assessment revealed that the invertebrate habitat at the sites were inadequate to support a diverse community of invertebrate. Although the habitat was determined to be inadequate sensitive species should still be present. The complete absence of sensitive species is indicative of water quality impairment.

The seriously modified SASS 5 category confirms the observation of the negative effects and presence of sewage effluent and urban runoff.

7.5.4.3 Macroinvertebrate Response Assessment Index

In order to compressively understand the structure and status of the invertebrate population, the Macroinvertebrate Response Assessment Index (MIRAI) was implemented. The results of the MIRAI are given in Table 7-16. The MIRAI was implemented based on the collective score of the sites associated with the Project area and is considered as per the reach of the river assessed.

Table 7-16: MIRAI results for the 2013 survey

Component	Results
MIRAI (%)	19.7067
EC: MIRAI	E/F
Category	Seriously modified

The results of the MIRAI indicate that the invertebrate community that is currently present is in a seriously modified state. The invertebrate communities present at all the sites of the current study are indicative of modified water quality. This is confirmed by the absence of pollution sensitive species from the selected sites.

The majority of the sample sites are located within non-perennial river systems and therefore, confidence in the invertebrate assessment is low. Based on the results of the SASS 5 and MIRAI, the invertebrate communities present at the sites are in a seriously modified state. Based on the findings of the *in situ* water quality analysis, as well as previous baseline information, eutrophication and the concentration of salts, as a result of evaporation and sewage effluent, have negatively influenced the water quality of the associated river systems resulting in a seriously modified state of invertebrates.

7.5.5 Integrated Ecological State

The ecological class of the study components are presented in Table 7-17.

Table 7-17: The ecological classification of study components and the resulting Eco-status for the low flow 2013 survey

River	Groot-Sandsloot	Dithokeng	Rooisloot		Mogalakwena	Dorps	Nyl
Component	**PLA 1**	**PLA 1**	**PLA 3**	**PLA 4**	**PLA 5**	**PLA 6**	**PLA 7**
Water quality (*in situ*)	D	D	DRY	D	DRY	D	DRY

<table>
<tr><th>River</th><th>Groot-Sandsloot</th><th>Dithokeng</th><th colspan="2">Rooisloot</th><th>Mogalakwena</th><th>Dorps</th><th>Nyl</th></tr>
<tr><th>Component</th><th>PLA 1</th><th>PLA 1</th><th>PLA 3</th><th>PLA 4</th><th>PLA 5</th><th>PLA 6</th><th>PLA 7</th></tr>
<tr><td>Habitat</td><td colspan="7">D</td></tr>
<tr><td>Fish</td><td colspan="7">D</td></tr>
<tr><td>Invertebrates</td><td>E</td><td>E</td><td>DRY</td><td>E</td><td>DRY</td><td>E</td><td>DRY</td></tr>
<tr><td>Ecostatus</td><td>E</td><td>E</td><td>DRY</td><td>E</td><td>DRY</td><td>E</td><td>DRY</td></tr>
<tr><td>Ecostatus (River reach)</td><td colspan="4">E</td><td colspan="3">E</td></tr>
</table>

Although the RHP does not take the water and habitat quality into consideration when determining the eco-status of a system, it is noted for the purposes of transparency that the sites associated with the Project had impaired water quality and modified habitat states. The final eco-status for the associated sites was determined to be a Category E meaning the conditions at the biological communities present at the sites are in a seriously modified state.

The reason for the seriously modified biological community is a result of impaired water quality. Water quality modification is occurring in the form of treated and untreated sewage effluent resulting in eutrophication at sites as well as the influx of urban runoff. These factors are compounded by low rainfall and high evaporation leading to water that has a high level of dissolved salts with a low concentration of dissolved oxygen.

When the current study is compared to the ecological and management categories for the quaternary catchments set out in Kleynhans (2000), the following findings can be noted: The PESC of river reaches included in this study is not largely natural (Class B), but the current PESC is a Class E. The ecological importance and sensitivity as described in Kleynhans (2000) was moderate; the current study sampled aquatic species which were of importance (*Oreochromis mossambicus*) and therefore, the ecological importance is seen as high.

7.6 Wetlands

A wetlands assessment report has been compiled and included in Appendix I of this report.

7.6.1 General Description of the Wetland Systems

7.6.1.1 The Floodplains

The floodplain surface usually slopes away from the channel margins as a result of preferential sediment deposition along the channel edges and areas closest to the channel which can then result in the formation of backwater swamps at the edges of the floodplain margins (DWAF, 2007). According to Kotze *et al*. (2007) floodplains usually receive most of their water during high flow events when waters overtop the stream banks. According to McCartney (2000) flood attenuation is likely to be high early in the season until the floodplain soils are saturated and the oxbows and other depressions are filled. Additionally, the flood attenuation capacity is drastically reduced in the late season. It is unlikely that floodplains contribute significantly to stream flow regulation (Kotze *et al*., 2007). The contribution of water from floodplains to stream flow and groundwater recharge is limited as a result of the clayey floodplain soils which retain water (Kotze *et al*., 2007).

7.6.2 Channelled Valley Bottom Systems

According to Kotze *et al*. (2007), channelled valley bottom systems are characterised by less active deposition of sediment and an absence of oxbows and other floodplain features such as levees and meander scrolls. These wetland types tend to be narrower and have somewhat steeper gradients and the contribution from lateral groundwater input relative to the main stream channel is generally greater. The primary cause of this channelling is the result of erosion (Kotze *et al*., 2007).

7.6.3 General Functional Description of the Wetland Systems

7.6.3.1 The Floodplain

According to Kotze *et al*. (2007) floodplains are considered to be important for flood attenuation because of the nature of the vegetation and the topographic setting that they occupy. The velocity of flow decreases laterally as the flood overtops the river banks, thus allowing for the deposition of particles within the floodplain landscape (Kotze *et al*, (2007). According to Hemond and Benoit (1998) phosphorous and other toxicants bound to trapped sediment are likely to be retained on the floodplains and this is a vital mechanism through which wetlands trap phosphates. According to Kotze *et al*. (2007) nitrogen removal via denitrification is likely but also limited due to the short flooding periods. Additionally, due to the dilution effects, the concentration of nutrients in flood waters entering the floodplain is often low (Kotze *et al*., 2007).

7.6.3.2 Channelled Valley Bottom Systems

A key benefit of the valley bottom wetlands with channels associated with both farms is the enhancement to the quality of water. According to Kotze at al. (2007) these wetlands contribute less towards flood attenuation and sediment trapping, but would supply these benefits to a certain extent. These wetlands would thus provide a service through limited flood attenuation by the spreading out and the slowing down of floodwater in the wetland, thereby reducing the severity of floods downstream and by trapping and the retention in the wetland itself of sediment carried by runoff waters. Additionally, these wetlands would offer some nitrate and phosphate removal potential, particularly from the water being delivered from the adjacent hillslopes (The Federal Interagency Stream Restoration Working Group, 1998).

7.6.4 Floodplain Functional Description

The general features of the wetland units were assessed in terms of functioning and the overall importance of the hydro-geomorphic units were then determined at a landscape level. The level of functioning supplied by the Mogalakwena River floodplain for various ecological services for the Project area is presented in Table 7-18. The result from the "WET-EcoServices" tool for the respective wetland unit is presented below in Table 7-18. Figure 7-10 presents the percentage of the five ecological services classes for the respective wetland systems assessed.

Table 7-18: A listing and scoring of ecological services offered by the Mogalakwena River floodplain identified for the study area

Ecological Services	Floodplain
Flood attenuation	2.3
Streamflow regulation	2.8
Sediment trapping	2.3
Phospahte trapping	2.7
Nitrate removal	2.7
Toxicant removal	2.9
Erosion control	2.3
Carbon storage	2.3
Maintenance of biodiversity	3.8
Water supply for human use	3.5
Natural resources	4.0
Cultivated foods	3.6
Cultural significance	2.5
Tourism and recreation	3.4
Education and research	2.5

The layout of the radial plot for the floodplain system indicates the importance and dependence by the local communities on the system for varying resources. In addition to this, the system also has the ability to enhance water quality. This is important to note when considering the local land-uses and surrounding activities impacting on the water quality of the system.

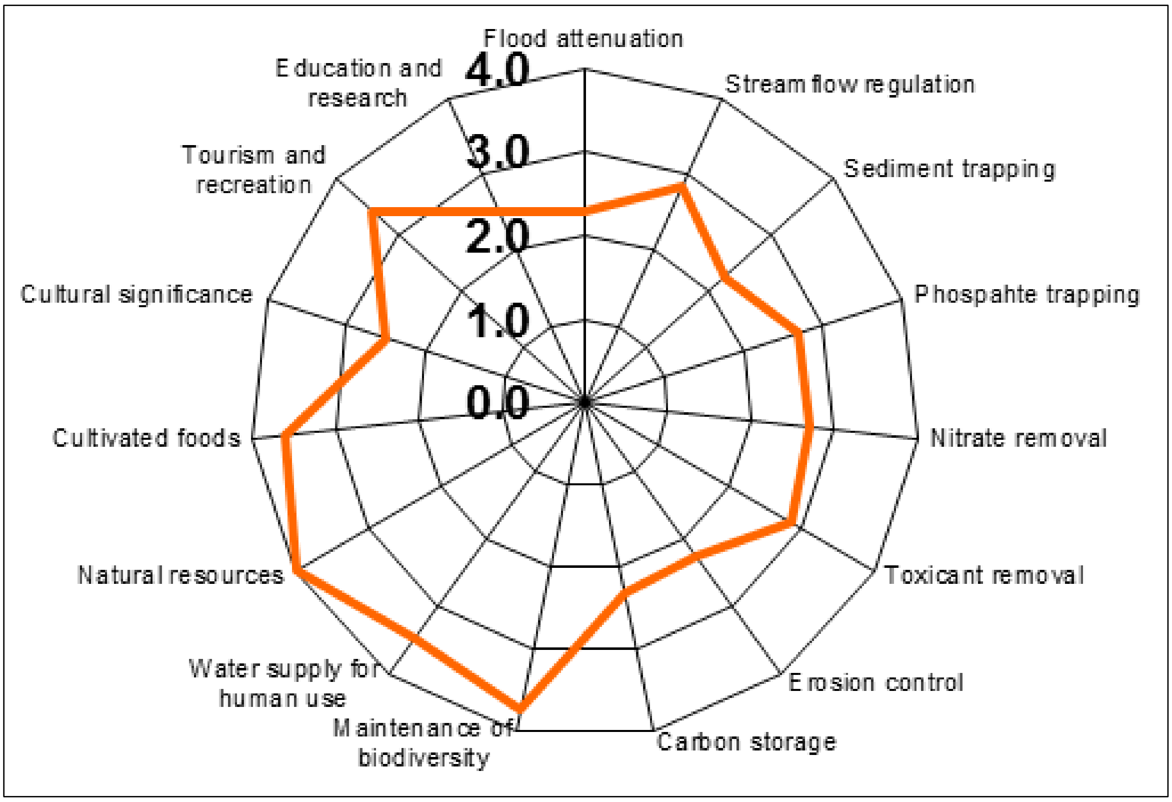

Figure 7-10: Radial plots of functions performed by the floodplain system

Table 7-19: A list of the percentage of each importance class for the provided services

Ecological Services	Floodplain
Low	0%
Moderately low	0%
Intermediate	27%
Moderately high	46%
High	27%

No ecological services considered to be of low or moderately low importance were identified for the system (Table 7-19). The majority of the ecological services (46%) provided by the Mogalakwena River floodplain was determined to be of moderately high importance. These services may be attributed to the enhancement of water quality with the removal of phosphates as well as by removing nitrates and toxicants. Owing to the dependence of the local communities on the system, it is likely that there is an important cultural relationship with the community and the system. The floodplain is adjacent to the Waterberg Wilderness Reserve which indicates the importance of this system to provide both tourism and recreational activities such as fishing and birding. In addition to the above mentioned services, there is an important opportunity to conduct further research into the system, especially considering the ecological significance of the Nylsvlei Ramsar site in the upper catchment areas and the relationship between the two systems.

The dependence of the local communities on the system is indicated by the high importance of selected services. These services pertain largely to water supply and food resources. The water of the floodplain is used for drinking, cooking, cleaning and watering of plantations. In addition to this, the system is also fished by locals for food. An additional service identified to be of a high importance and not directly beneficial to the local communities is the maintenance of biodiversity. This is further supported with the location of the Waterberg Wilderness Reserve on the periphery of the system.

The current land-uses have impacted on the functioning of this system. Local agricultural practices, pertaining predominantly to livestock, have impacted on the ability of this system to provide important services. Agricultural activities have altered the natural hydrology of the system. The decrease in surface roughness due to overgrazing has resulted in a potentially destructive hydrological regime for the system. In addition to this, livestock also impact directly on the quality of water as a result of nutrient input and trampling of the system. Owing to the fact that agricultural practices are on-going for the Project area, coupled by the absence of mitigatory measures for the current land-uses, it is assumed that the ability of the units to provide important ecological services will continue to deteriorate. The severity of the current identified impacts was, however, determined to be minor at this stage.

7.7 Air Quality

Baseline monitoring and assessment of atmospheric pollutants was appraised using data from the South African Air Quality Information System (SAAQIS) database. The Air Quality Monitoring Station in Mokopane is one of the three air quality monitoring stations commissioned for the Waterberg-Bojanala Priority Area (WBPA) in 2012. The other two stations are in Lephalale and Thabazimbi. The National Priority Area covers the Bojanala District in the North West Province and the Waterberg District in the Limpopo Province. The database contains measurement for known priority pollutants, recording data based on the recommended averaging period. Archived measurements for the past five months are discussed below to emphasize the background conditions.

An air quality assessment report has been compiled and included in Appendix J.

7.7.1 Measured Concentrations

7.7.1.1 PM_{10} Concentration

In literature, particulate matter (specifically $PM_{2.5}$ and PM_{10}) represents danger to the receiving population as it can penetrate into indoor environment increasing the exposure period to such pollutants. The PMs have the ability to penetrate the trachea-bronchial and alveolar regions of the human respiratory system leading to respiratory diseases. If the PM contains heavy metals, the risk to human is exacerbated based on the exposure period, age and wellbeing of the individual.

Average daily PM_{10} concentrations recorded at the Mokopane Ambient Air Quality Station are presented in Figure 7-11. The average measured background PM_{10} concentration for the last five months is generally within the current National Ambient Air Quality Standards

(NAAQS) for PM_{10} of 120 µg/m³. The limit was exceeded once in December as seen in the figure below. If the future NAAQS ambient standard of 75 µg/m³ is considered (which will come into effect on the 1st of January 2015), there are several days exceeding the limit value. However, the World Health Organisation (WHO) Guideline of 50 µg/m³ is actually exceeded on a number of occasions (red dotted line - Figure 7-11).

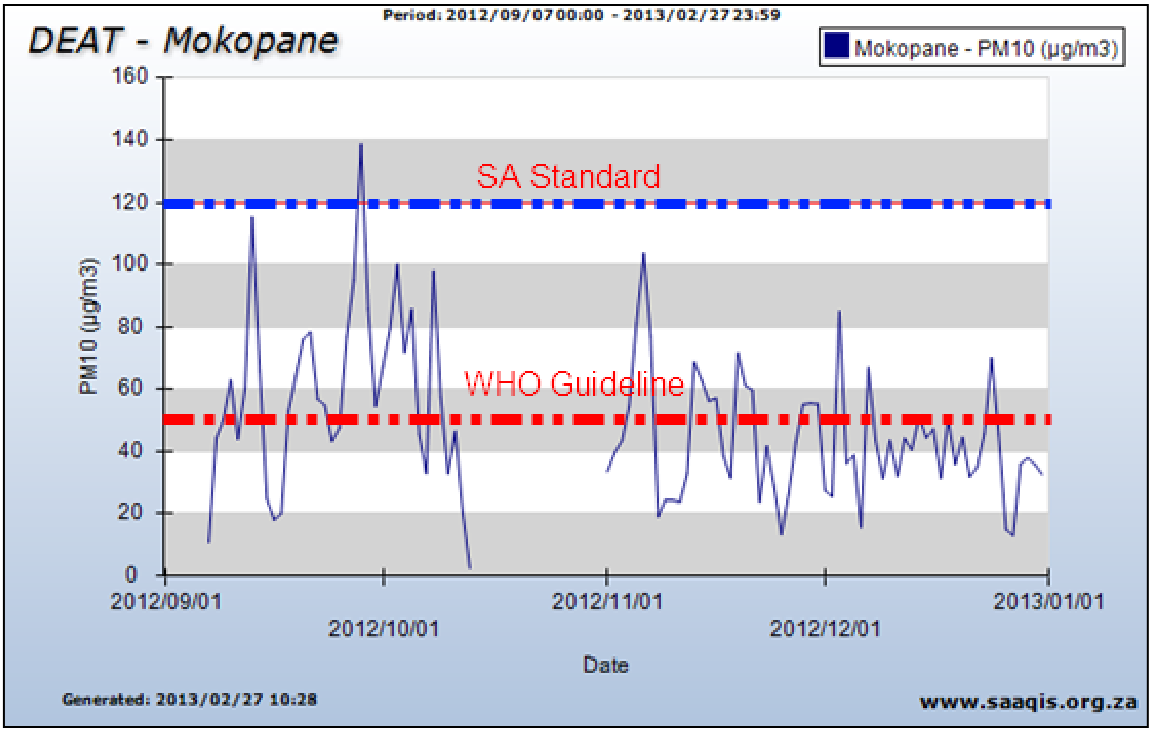

Figure 7-11: PM10 concentrations from the WBPA air quality monitoring station in Mokopane

Measurements conducted in 2003/2004 by WSP Walmsley confirm historical levels of ambient particulate matter in the Project area. The $PM_{2.5}$ and PM_{10} levels were measured using Single Striker Filter Units (SSFU) installed at Mahwelereng to continuously monitor ambient concentrations of pollutants. Figure 7-12 shows the PM_{10} concentrations from April 2003 to April 2004 with five of the twelve months of sampling exceeding the South African Standard of 120 µg/m³. If reference is made to the IFC (WHO Guideline), only one of the twelve months of sampling was within compliance (March 2004).

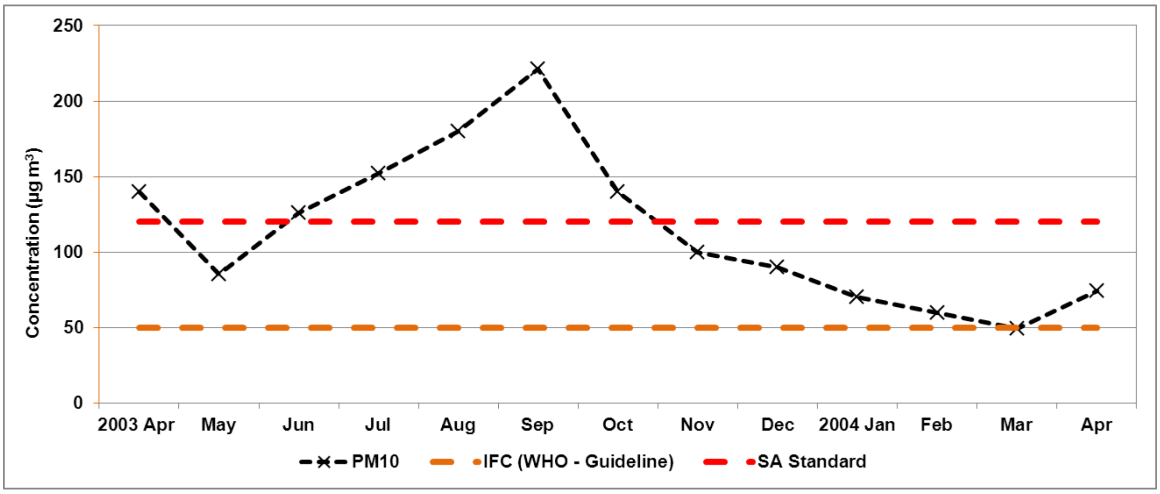

Figure 7-12: PM_{10} concentration measured in the Project Area (April 2003 - April 2004)

7.7.1.2 $PM_{2.5}$ Concentrations

The NAAQS for particulate matter with aerodynamic diameter less than 2.5 microns ($PM_{2.5}$) was promulgated on 29 June 2012 by the Minister of Water and Environmental Affairs. Ever since, ambient $PM_{2.5}$ standard of 65 µg/m³ is in force until 31 December 2015, and a new standard of 40 µg/m³ would take effect from 1 January 2016.

The $PM_{2.5}$ concentration observed over the five months period is observed to be well below the IFC (WHO Guideline) value of 25 µg/m^3 and the NAAQS of 65 µg/m^3 (which takes immediate effect from the date of promulgation) as shown Figure 7-13.

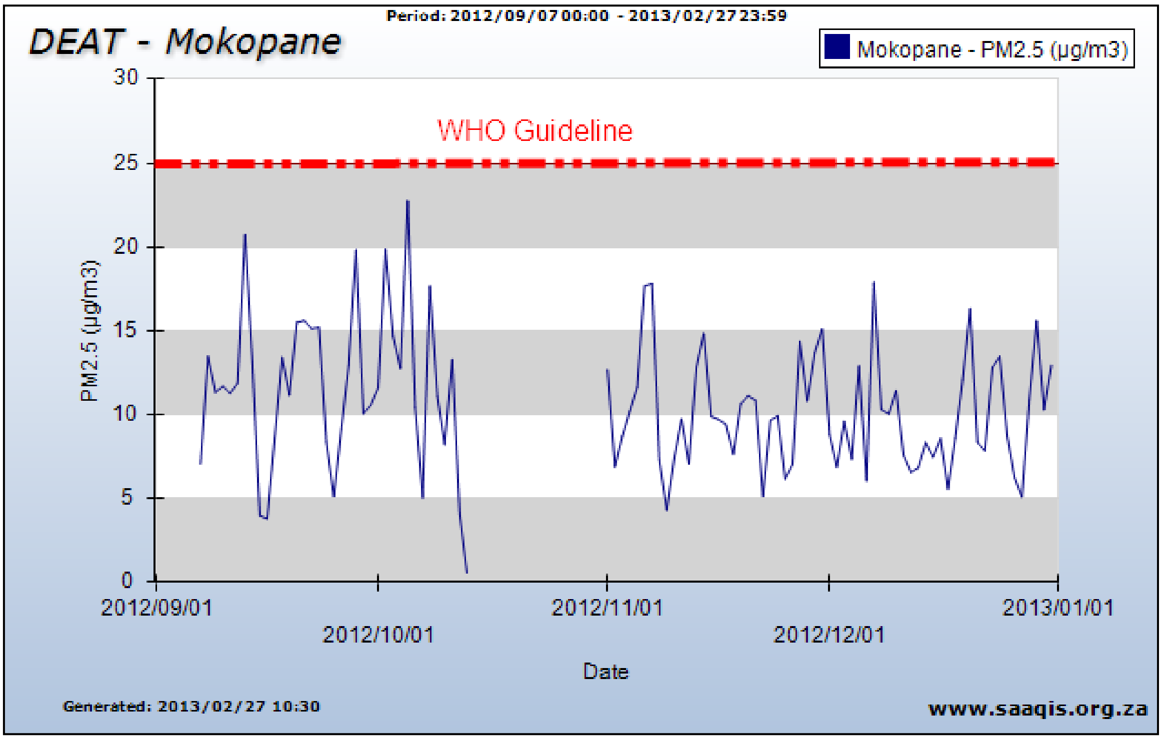

Figure 7-13: $PM_{2.5}$ concentrations from the WBPA air quality monitoring station in Mokopane

The results of the monitoring of $PM_{2.5}$ conducted by WSP Walmsley in 2003/2004 are presented below (Figure 7-14). If results obtained are compared to the current standard, two months (August and September) of the twelve months of sampling were not compliant. The values measured were exceeding the 65 µg/m³ recommended by the current standard. On the other hand, nine months recorded values in excess of the IFC (WHO Guideline) of 25 µg/m^3.

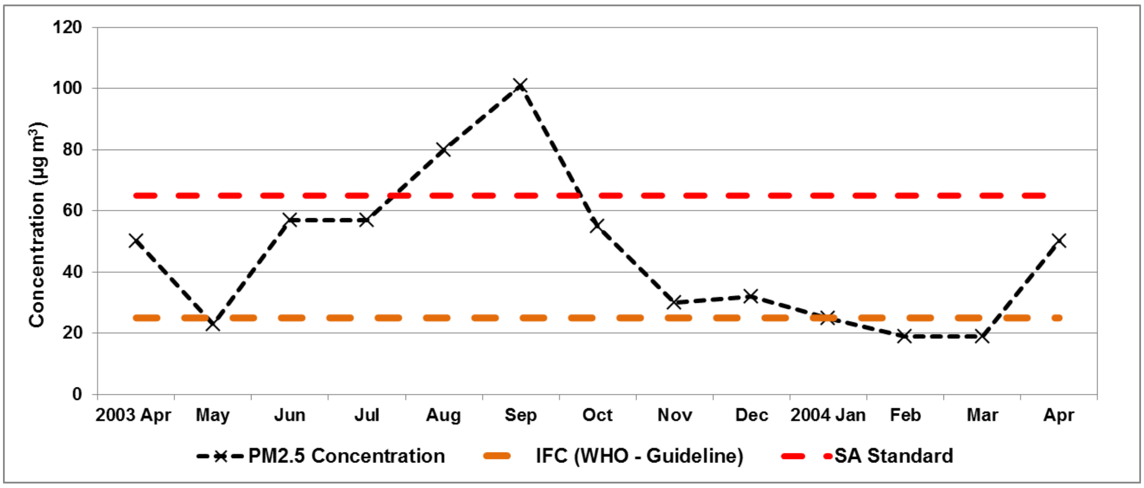

Figure 7-14: PM2.5 concentration measured in the Project area (April 2003 - April 2004)

7.7.1.3 Carbon Monoxide

The Carbon Monoxide (CO) concentration measured is below the recommended NAAQS 8-hr and 1-hr limit values of 8.7 parts per million (ppm) and 26 ppm respectively (Figure 7-15 and Figure 7-16). The peaks observed in CO concentration are not in exceedance of the standard. The pollutant is known to contribute to greenhouse effect and global warming.

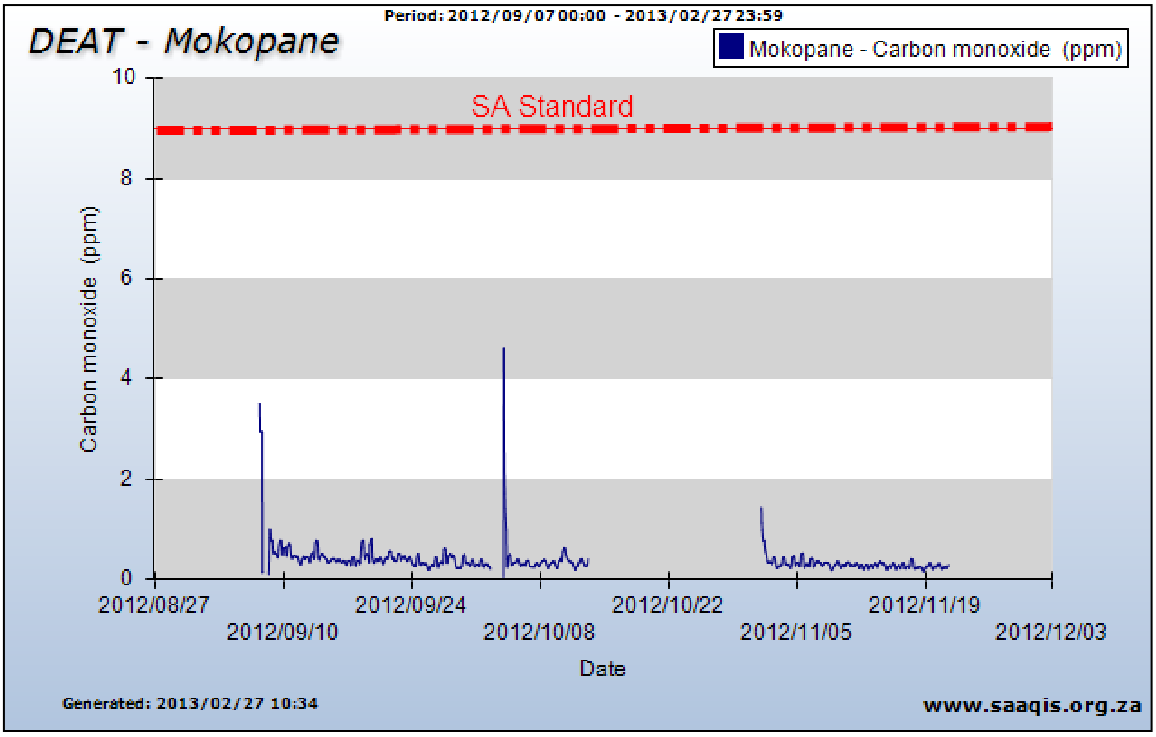

Figure 7-15: Carbon Monoxide from the WBPA air quality monitoring station in Mokopane (8 hourly average)

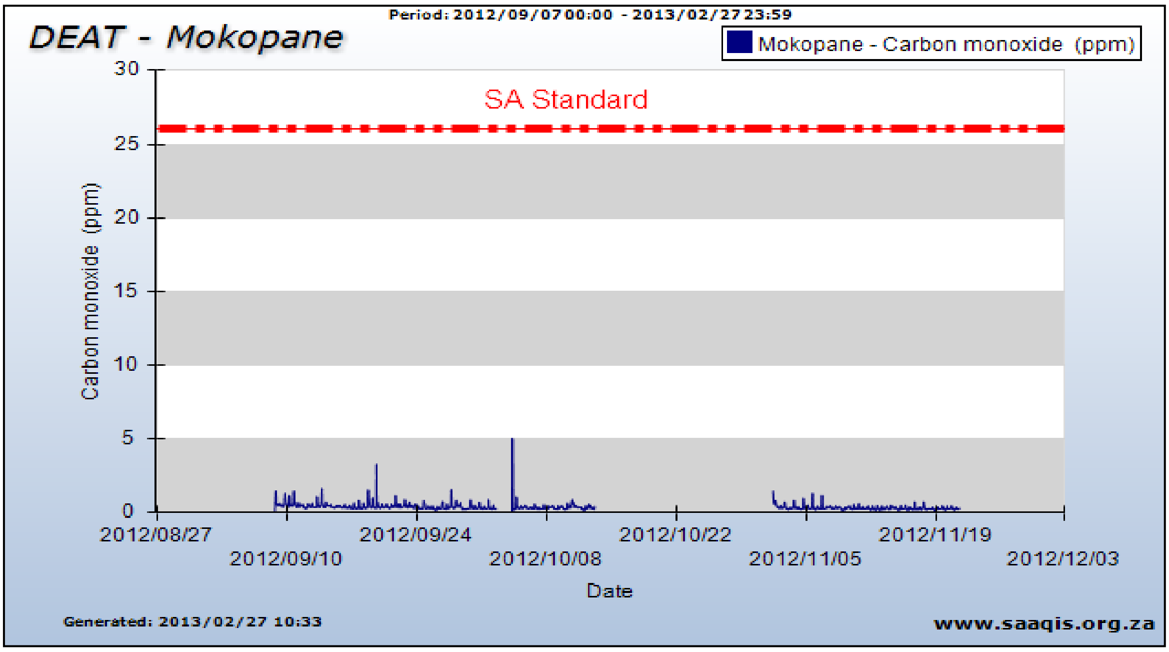

Figure 7-16: Carbon Monoxide concentrations from the WBPA air quality monitoring station in Mokopane (Hourly average)

7.7.1.4 NO_2/NO_x Concentration

The NO_2 standard specified by the WHO and South African NAAQS are the same - 200 µg/m^3 (106 ppm). It is assumed that the complete conversion of all emitted NO to NO_2 has occurred, as per US EPA's Guideline on Air Quality Models, 40 CFR Part 51, for Tier 1 screening approach. As seen in Figure 7-17, the recorded values for NO_x are generally below this limit, except an incident in October with a peak that exceeded the limit slightly.

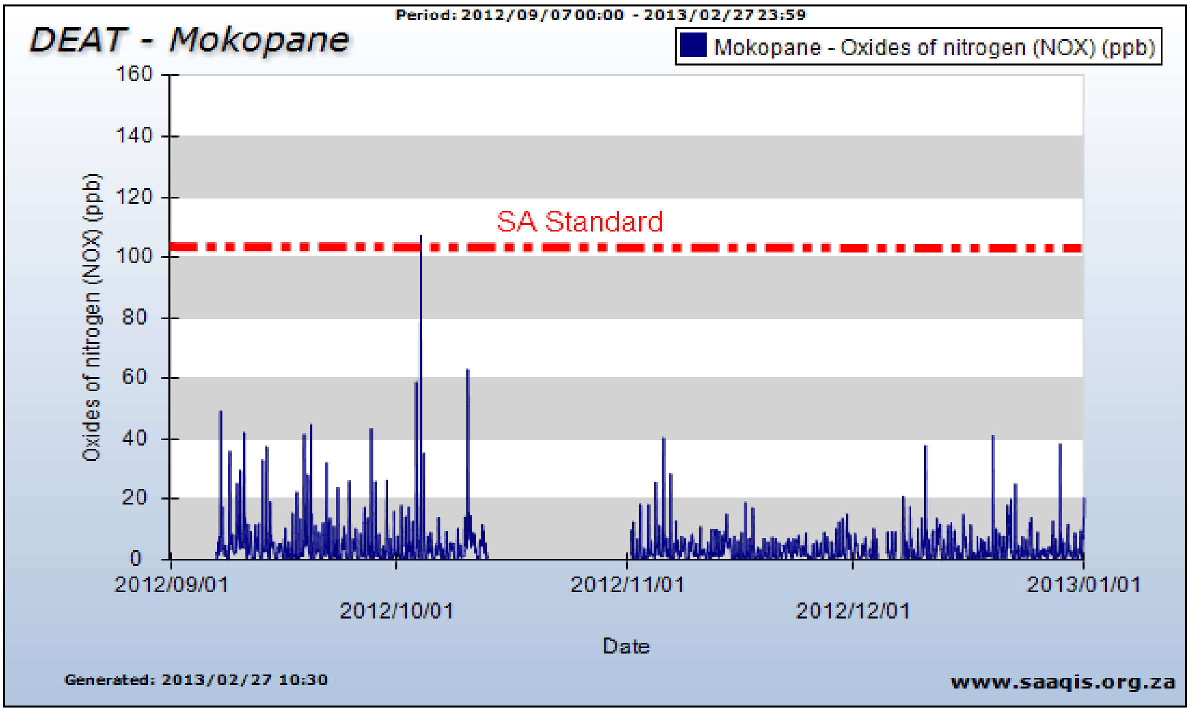

Figure 7-17: Nitrogen dioxide concentrations from the WBPA air quality monitoring station in Mokopane (Hourly average)

7.7.1.5 Sulphur Dioxide

The Sulphur Dioxide (SO_2) concentration observed over the five months period is seen to be very low with values generally below 10 ppm, a factor of 4 below the prescribed SA 24 hours limit of 48 ppb (Figure 7-18). The values are also within WHO recommended guideline value of 20 ppb.

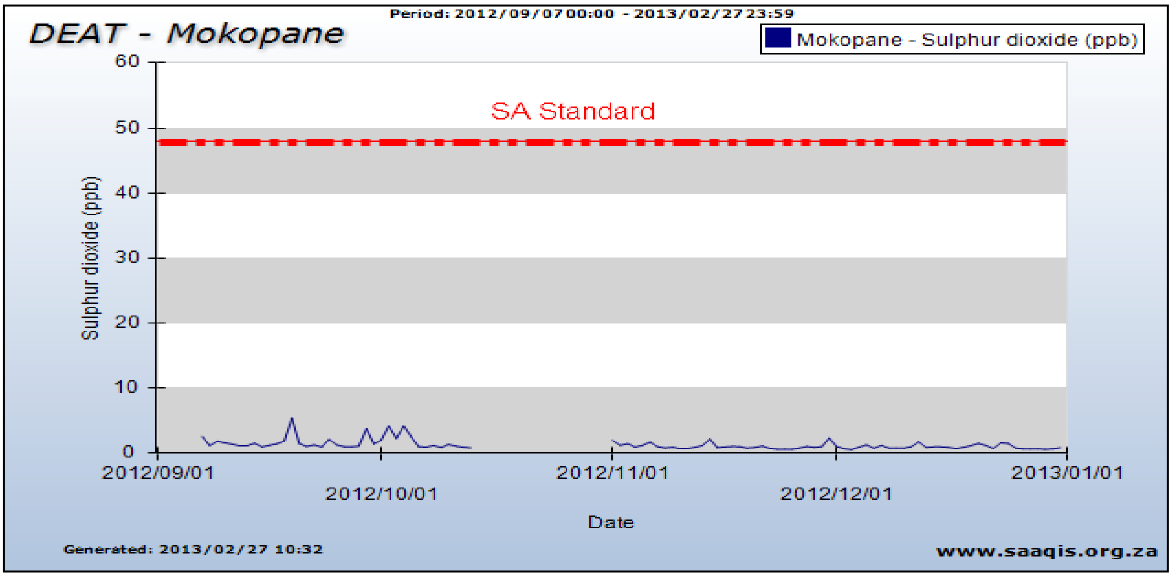

Figure 7-18: SO_2 concentrations from the WBPA air quality monitoring station in Mokopane (daily average)

Measurements observed over a 10-minutes averaging period were within SA NAAQS value of 191 ppb, except on one occasion when the recommended limit value was violated as seen in the Figure 7-19, but below the WHO guideline value of 500 ppb.

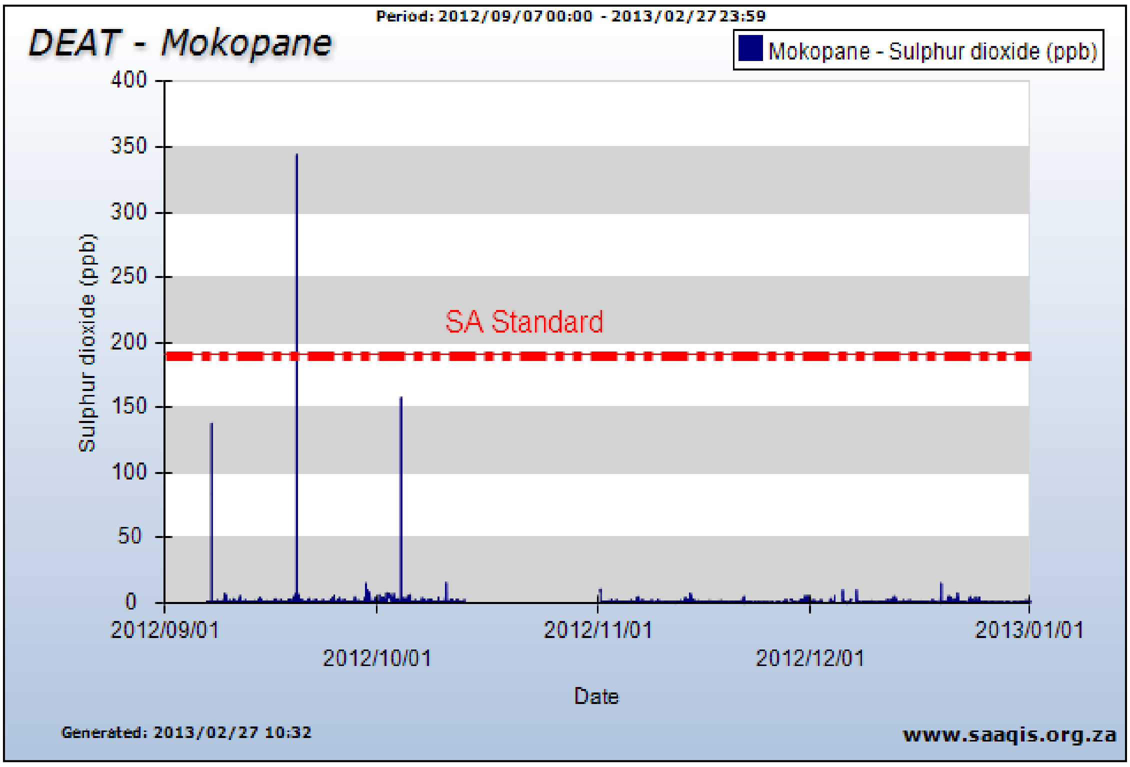

Figure 7-19: SO_2 concentrations from the WBPA air quality monitoring station in Mokopane (10 minute averages)

7.7.1.6 Benzene

The plot depicted in Figure 7-20 indicates the levels of Benzene observed over the five months period. From the measurements, there are a number of times when the NAAQS limit of 3.2 ppb was exceeded slightly. Once in September, ambient concentration went above 16 ppb.

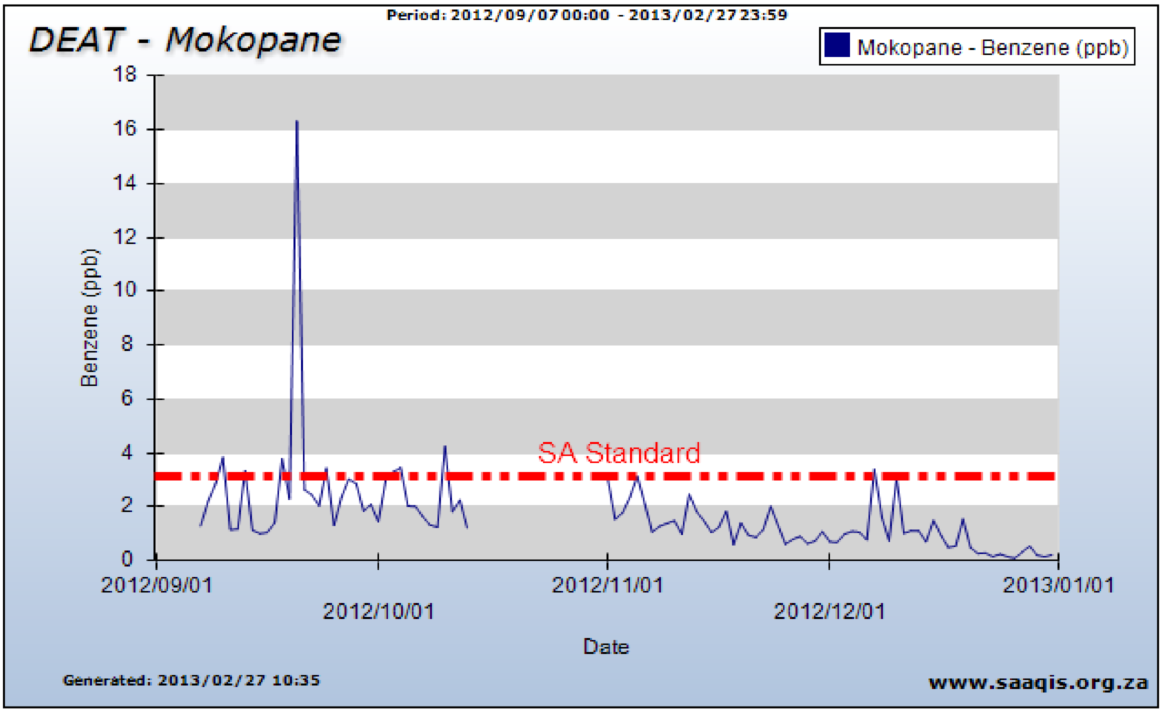

Figure 7-20: Benzene concentrations from the WBPA air quality monitoring station in Mokopane (daily average)

7.7.1.7 Ozone

Ozone (O_3) is formed in the atmosphere by the reaction of nitrogen oxides, hydrocarbons and sunlight. In Figure 7-21, O_3 levels are within the recommended South African standard of 61 ppb (120 µg/m^3), with some exceedances observed during the first few days of February 2012. If WHO guideline value is considered, several exceedances can be seen in Figure 7-21.

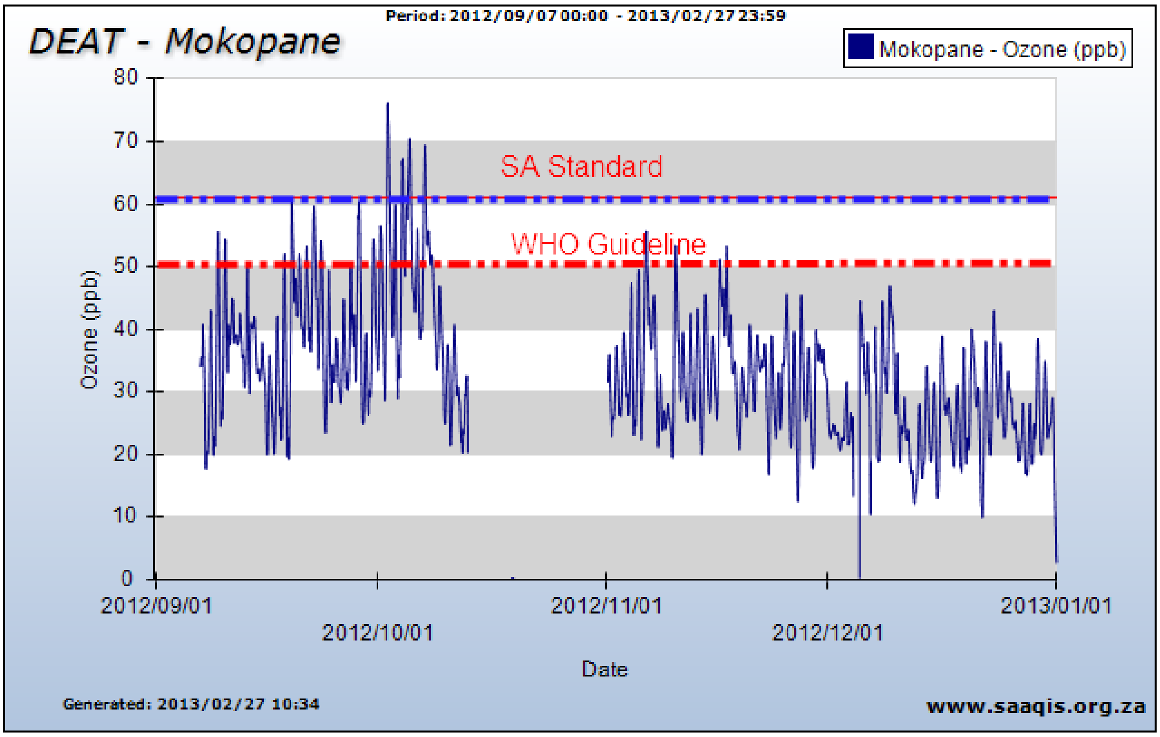

Figure 7-21: Ozone concentrations from the WBPA air quality monitoring station in Mokopane (8-hourly average)

7.7.2 Measured Dust Fallout Levels

A dust fallout monitoring network was commissioned in August 2013 to monitor the ambient dust deposition rates in the Project area. The network was commissioned at the selected sensitive receptor areas around the proposed mine area. Dust fall out monitoring will be conducted over 30 day periods and quarterly reports prepared for the mine to submit to relevant authorities.

During the monitoring window, exposure is expected to comply with the standard operating procedure of ~2 days. The dust deposition records observed are compared against the relevant standard. Since the current monitoring just commenced (due to access restrictions to the project site), reference will be made to the measurements conducted by WSP Walmsley in 2003/2004 in the Project area (Figure 7-22). If monthly dust fallout rates measured in 2003/2004 are compared to the current dust fallout limits spelt out in the National Dust Control Regulation (GN R. 827 published in Government Gazette 36974 of 1 November 2013), the area will likely be in violation of the residential and industrial limits 92% and 67% of the sampling period. Although the permitted frequency of exceedance is twice within a year (not sequential months), the area recorded seven consecutive months of exceedance, with dust deposition rates well over 1 500 mg/m^2/day. The above background results from historical data are considered a serious violation of the current standard.

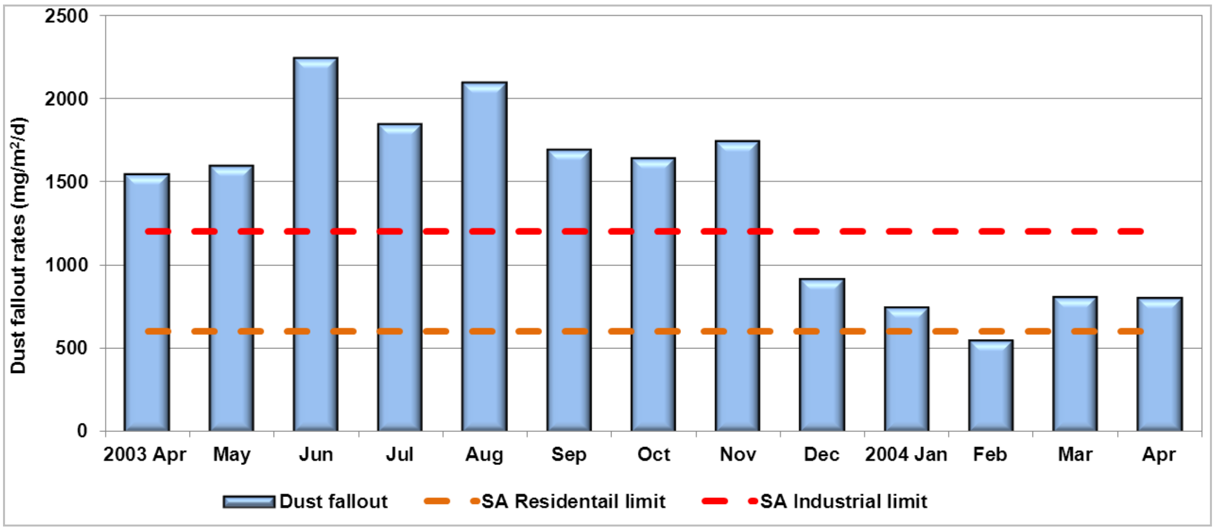

Figure 7-22: Monthly dust fallout rates observed in the Project area (April 2003 - April 2004)

The seasonal average dust deposition rates per site confirm the variability from season to season in the area (Figure 7-23). In autumn, all the sites (seven in total) exceeded the residential and industrial limit values of 600 mg/m^2/day and 1 200 mg/m^2/day – with the highest value reaching 2 760 mg/m^2/day (site – Ga-Madiba). In winter, only one site was within compliance – as the other sites exceeded residential and industrial limit values. The highest value was observed to be above 3 350 mg/m^2/day in winter. In the spring, majority of the sites were in violation of the residential and industrial standards as in previous seasons. Lastly, the values recorded in summer were within the residential and industrial limits, except at the site Moholerwe with dust deposition rates of 740 mg/m^2/day.

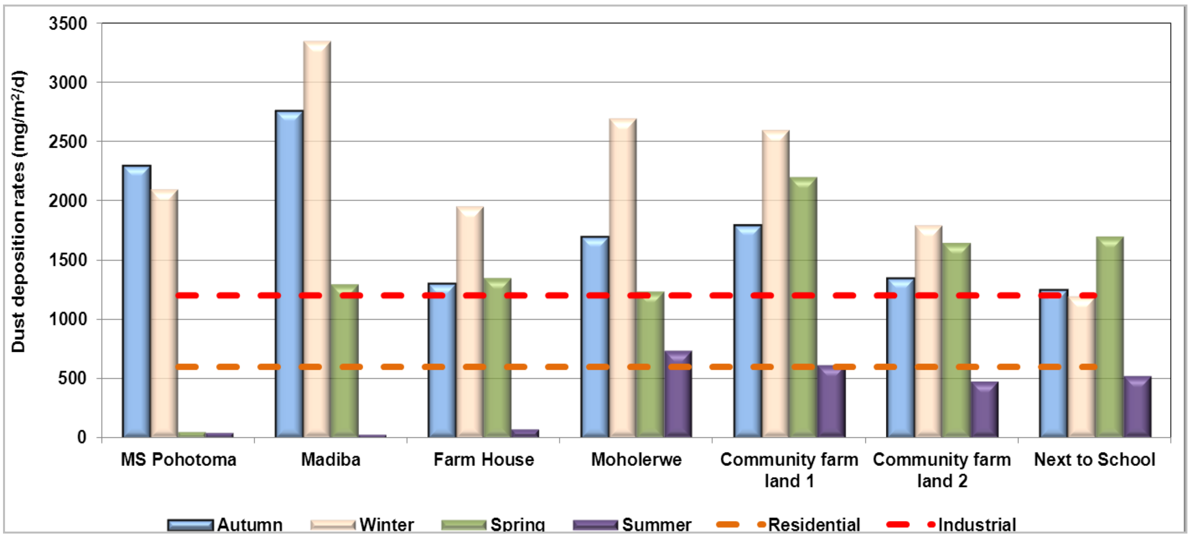

Figure 7-23: Seasonal average dust fallout rate per monitoring site (April 2003 - April 2004)

7.7.3 Dispersion Model

Dispersion models are used to predict the ambient concentration in the air of pollutants emitted to the atmosphere from a variety of processes (SANS 1929:2011). Dispersion models compute ambient concentrations as a function of source configurations, emission strengths and meteorological characteristics, thus providing a useful tool to ascertain the spatial and temporal patterns in the ground level concentrations arising from the emissions of various sources.

All emission scenarios have been simulated using the USA Environmental Protection Agency's Preferred/Recommended Models: AERMOD modelling system (as of December 9, 2006, AERMOD is fully promulgated as a replacement to ISC3 model).

For the Project, the RoM stockpile, waste rock and TSF stockpile sources have been modelled as area sources. Crusher, material handling processes (tipping to RoM stockpile, tipping to waste rock stockpile, conveyor to crusher) have been modelled as volume sources. The ventilation shaft was modelled as a point source. The paved road in the mine project areas and the link road to N11 were modelled as line volume sources.

Simulations were undertaken to determine concentrations of particulate matter with a particle size of less than 10 microns (µm) in size (PM_{10}), particle size of less than 2.5 microns (µm) in size ($PM_{2.5}$), and of deposition of Total Suspended Particulates (TSP) from operations at the proposed Platreef Platinum Mine. Scenarios with mitigation measures were simulated using control factors.

Isopleths of PM_{10} generated from the dispersion model for both unmitigated and mitigated scenarios have shown that concentrations above the recommended limit value can reach distances of ~2 km from the mine boundaries, especially for the western and southern section of the mine boundary. With mitigation measures applied, the ground level concentrations of PM_{10} observed at the selected sensitive receptors showed decreases ranging between 33% and 59%. Annual PM_{10} levels were observed to have decreased by between 25% and 47%.

Isopleths from the dispersion modelling plots have indicated that the area impacted by $PM_{2.5}$ arising from the proposed Platreef mine operation is minimal and greater portion falls within the project area. For $PM_{2.5}$, with mitigation the diurnal concentrations observed at the defined sensitive receptors decreased by between 22% and 83%. The decreases observed for the annual levels ranged between 33% and 54% respectively.

The predicted dust deposition rates before mitigation at the sensitive receptors were all within the SANS limit for residential areas (i.e. 600 mg/m²/day) except for site PLA 06. When mitigation measures are applied, the anticipated deposition decreased at the selected sensitive receptors i.e. PLA 06 – from 629 mg/m^2/day to 317 mg/m^2/day. In general the levels decreased by between 35% and 50% at the selected sensitive receptor sites.

7.7.4 Alternative TSF Sites

During the EIA investigations, two sites (namely, the Rietfontein 2KS and Bultongfontein) were nominated as preferred locations for the TSF.

These two options were evaluated in terms of the air quality pollution potential, and the preferred option is the site located on the Rietfontein 2 KS farm (Site 2). The main reason for site selection is the predominant wind direction in the area, which is northeasterly.

The proposed location of the site at Bultongfontein 239 KR (Site 3) is widely exposed to the predominant winds in the area, which would probably lead to increased particle load in the air downwind from the site. The site is also in close proximity to the existing TSF at the Mogalakwena Platinum Mine, and cumulative effects of the two TSFs may have implications downwind. The proposed Rietfontein 2 KS site will be constructed as a single compartment side-hill type TSF, which will be shielded from the predominant winds by the Thabaphaswa Hills and Mountains, thus reducing the air quality impacts associated with the proposed TSF.

7.8 Noise

An Environmental Noise Assessment report for the Project area has been compiled, see Appendix K.

7.8.1 Noise Measurement Locations

A baseline assessment was undertaken to determine the current ambient noise levels at the surrounding areas of the Project. The criteria that were used for the siting of the measurement locations were:

- The locations were the nearest noise sensitive receptors surrounding the Project and subsequently the most likely to be impacted on by the proposed mining activities; and
- The locations serve as suitable reference points for the measurement of ambient sound levels surrounding the Project area. The noise measurement locations cover the surrounding communities that represent a comprehensive soundscape of the area.

The list of noise measurement locations can be seen Table 7-20. A Cirrus, Optimus Green, and precision integrating sound level meter was used for the measurements. The instrument was field calibrated with a Cirrus sound level calibrator. The baseline locations are presented in Table 7-20 as well as on Plan 14 (Appendix A).

Table 7-20: Noise measurement locations

ID	Receptor	Receptor Type	GPS Coordinates
Plat 1	Masodi	Suburban community with little road traffic	24° 7'41.31"S 28°57'19.21"E
Plat 2	Madiba	Suburban community with little road traffic	24° 7'48.53"S 28°58'49.29"E
Plat 3	Ga-Kgobudi	Suburban community with little road traffic	24° 5'20.37"S 28°56'47.33"E
Plat 4	Magongoa	Suburban community with little road traffic	24° 4'26.58"S 28°57'58.14"E
Plat 5	Tshamahansi	Suburban community with little road traffic	24° 5'3.44"S 28°58'22.78"E

ID	Receptor	Receptor Type	GPS Coordinates
Plat 6	Molekana	Suburban community with little road traffic	23°59'29.35"S 28°57'22.32"E

7.8.2 Baseline Results and Discussions

The results from the noise meter recordings for all the sampled points as well as the rating limits according to the SANS 10103:2008 guidelines are presented in Table 7-21 below.

Table 7-21: Results of the baseline noise measurements

Sample ID	SANS Rating Limit			Measurement Details		
	Type of district	Period	Acceptable rating level dBA	$L_{Areq,T}$ dBA	Maximum/ Minimum dBA	Date
Plat 1	Suburban	Daytime	50	48	75 / 36	07/11/2011
		Night time	40	44	65 / 41	07/11/2011
Plat 2	Suburban	Daytime	50	47	75 / 33	08/11/2011
		Night time	40	43	66 / 27	08/11/2011
Plat 3	Suburban	Daytime	50	46	73 / 32	09/11/2011
		Night time	40	45	64 / 36	09/11/2011
Plat 4	Suburban	Daytime	50	51	79 / 33	10/11/2011
		Night time	40	52	70 / 30	10/11/2011
Plat 5	Suburban	Daytime	50	47	71 / 37	11/11/2011
		Night time	40	45	68 / 33	11/11/2011
Plat 6	Suburban	Daytime	50	28	80 / 20	22/08/2013
		Night time	40	27	65 / 20	22/08/2013
	Indicates $L_{Aeq,T}$ levels above either the daytime rating limit or the night time rating limit					

Plat 1:

The measurement was taken in the Masodi community. Based on the daytime results from the noise measurements it is noted that the Leq levels measured below the SANS guidelines for the maximum allowable outdoor daytime limit for ambient noise in suburban districts.

The night time ambient Leq levels measured above the SANS guidelines for the maximum allowable outdoor limit for night time ambient noise in suburban districts. The ambient night time noise levels are characterised by the continuous noise from the *Gryllidae* (crickets) at this location.

Plat 2:

The measurement was taken in the Madiba community. Based on the daytime results from the noise measurements it is noted that the Leq levels measured below the SANS guidelines for the maximum allowable outdoor daytime limit for ambient noise in suburban districts.

The night time ambient Leq levels measured above the SANS guidelines for the maximum allowable outdoor limit for night time ambient noise in suburban districts. The ambient night time noise levels are characterised by the continuous noise from the *Gryllidae* (crickets) at this location.

Plat 3:

The measurement was taken in the Ga-Kgobudi community. Based on the daytime results from the noise measurements it is noted that the Leq levels measured below the SANS guidelines for the maximum allowable outdoor daytime limit for ambient noise in suburban districts.

The night time ambient Leq levels measured above the SANS guidelines for the maximum allowable outdoor limit for night time ambient noise in suburban districts. The ambient night time noise levels are characterised by the continuous noise from the *Gryllidae* (crickets) at this location.

Plat 4:

The measurement was taken in the Magongoa community. Based on the daytime results from the noise measurements it is noted that the Leq levels measured above the SANS guidelines for the maximum allowable outdoor daytime limit for ambient noise in suburban districts. Ambient day time noise levels are characterised by the intermittent noise from the livestock (roosters crowing) at this location.

The night time ambient Leq levels measured above the SANS guidelines for the maximum allowable outdoor limit for night time ambient noise in suburban districts. The ambient night time noise levels are characterised by the continuous noise from the *Gryllidae* (crickets) at this location.

Plat 5:

The measurement was taken in the Tshamahansi community. Based on the daytime results from the noise measurements it is noted that the Leq levels measured below the SANS guidelines for the maximum allowable outdoor daytime limit for ambient noise in suburban districts.

The night time ambient Leq levels measured above the SANS guidelines for the maximum allowable outdoor limit for night time ambient noise in suburban districts. The ambient night time noise levels are characterised by the continuous noise from the *Gryllidae* (crickets) at this location.

Plat 6:

The measurement was taken in the Molekana community. Based on the daytime results from the noise measurements it is noted that the Leq levels measured below the SANS guidelines for the maximum allowable outdoor daytime limit for ambient noise in suburban districts.

The night time ambient Leq levels measured below the SANS guidelines for the maximum allowable outdoor limit for night time ambient noise in suburban districts.

The noise sources that were influencing the baseline measurements at the time of the noise survey and that were responsible for the day/night time measurements are summarised in Table 7-22.

Table 7-22: Summary of noise sources influencing baseline measurements around the proposed site

Noise source description				
ID	Day	Duration	Night	Duration
Plat 1	Vehicular traffic (did not cause noise levels to measure above SANS guideline)	Continuous	*Gryllidae* (crickets)	Continuous
Plat 2	Vehicular traffic (did not cause noise levels to measure above SANS guideline)	Intermittent	*Gryllidae* (crickets)	Continuous
Plat 3	Vehicular traffic (did not cause noise levels to measure above SANS guideline)	Intermittent	*Gryllidae* (crickets)	Continuous
Plat 4	Livestock (roosters crowing)	Intermittent	*Gryllidae* (crickets)	Continuous
Plat 5	Vehicular traffic (did not cause noise levels to measure above SANS guideline)	Continuous	*Gryllidae* (crickets)	Continuous
Plat 6	Vehicular traffic (did not cause noise levels to measure above SANS guideline)	Intermittent	*Gryllidae* (crickets)	Continuous

7.8.3 Predictive Modelling

Predictive modelling was performed for the proposed mining activities through the use of the modelling software SoundPlan. The software specializes in computer simulations of noise pollution dispersion. Estimates of the cumulative mining noise levels from the study were derived from the noise emissions from all the major noise-generating components and activities of the project.

The models were run as a conservative scenario with worst case assumptions, so the following should be noted:

- The average yearly temperature was used;

- The average yearly humidity was used;
- Calm wind conditions were used; and
- The mitigation effect of vegetation was not taken into account.

The following table indicates the noise power levels used in the model simulations. The sound power levels were derived from a number of previous studies.

Table 7-23: Sound power levels from main continuous noise causing sources

Noise Source	Sound Power Levels dB						
Octave band frequencies, Hz	63	125	250	500	1000	2000	4000
Construction phase							
Haul Truck	108	118	115	114	110	106	102
Excavators	113	117	107	108	106	101	95
Front end Loader	108	116	107	108	105	99	95
Drill	109	118	113	113	113	112	110
Dozer	110	122	113	114	110	108	104
Operational phase							
Processing plant (cumulative including milling operation)	108	106	107	103	99	94	86
Ventilation shafts	117	114	116	110	108	107	104

The blasting noise levels were calculated according to the SANS 10357:2004 - The calculation of sound propagation by the Concawe method. Table 7-24 below represents the power levels used in the calculation.

Table 7-24: Sound power levels from blasting activities

Noise source	Sound Power Levels dB						
Octave band frequencies, Hz	63	125	250	500	1000	2000	4000
Blasting	124	126	127	125	123	120	117

The noise dispersion modelling software as well as the Concawe method was used to assess whether the noise from the proposed mining activities will impact on the relevant noise sensitive receivers, by comparing the predicted propagating noise levels with the current ambient baseline noise levels.

According to the noise dispersion model for the construction phase, the noise from the construction of either TSF site 2 or site 3 and the plant will not measure above the current ambient daytime noise levels at the surrounding communities respectively. The noise levels from the above mentioned activities will also not measure above the SANS daytime suburban rating limits of 50dBA at any of the surrounding communities.

The blasting propagation was calculated separately because it will occur intermittently compared to the other construction activities. The calculation was performed according to the SANS 10357:2004 - The calculation of sound propagation by the Concawe method.

Table 7-25 below represent the noise levels from the blasting at the surrounding communities.

Table 7-25: Blasting noise levels at the surrounding communities

Community	Baseline Level (dBA)	Blasting Noise Level dBA			
		Shaft 1	Shaft 2 (vent)	Shaft 3 (vent)	Shaft 4 (vent)
Ga-Magongwa	51	58	60	64	52
Tshamahansi	47	54	54	52	53
Mzombane	48	52	50	54	60
Kgubudi	46	58	55	56	58

The noise dispersion model for the operational phase indicates that the noise from the proposed vent shafts and processing activities is expected not to measure above the current ambient noise levels at the surrounding communities as seen in Plan 14 in Appendix A.

7.9 Soils

A soil impact assessment report has been compiled for the Project area (see Appendix L)

7.9.1 Land Type Soil Information

Existing land type data was used to obtain generalised soil information and terrain types for the Project area. Land type data exists in the form of published 1:250 000 maps. These maps indicate delineated areas of similar terrain types, pedosystems (uniform terrain and soil pattern) and climate (Land Type Survey Staff, 1989).

The Project area is undulating and is located within the dominant Ae, Ah and Ib land types of the 2328 Pietersburg and 2428 Nylstroom land type maps (Land Type Survey Staff, 1989). Land type information is contained Plan 16 (Appendix A). These land types indicate that the underlying geology consist mainly of hornfels, shale, quartzite, conglomerate, granite and biotite granite. The Ae land type covers most of the southern part of the Project site while land types Ah and Ib cover the northern part of the Project site.

The Ae land type is flat with slopes of 1% – 5% while the Ah and Ib land types are undulating containing slopes of 5% – 10% and 10% – 100% respectively. The Ib land type is easily recognised as rocky outcrops within the Project area.

Crest landscape positions are indicated as 1, scarp landscape positions as 2, mid slope positions as 3, while foot slope and valley bottom positions are indicated as the 4 and 5 landscape positions respectively.

7.9.2 Land Type Ae

Crests in the Ae land type are generally dominated by red Hutton soils but there is also, in some cases shallow stony Mispah and Glenrosa soil present in the crest positions (1). The midslope (4) position is dominated by Oakleaf soil while the valley bottom positions (5) are dominated by the presence of clayey Valsrivier and Arcadia soils. The underlying geology of the Ae224 land type is very complex consisting of hornfels, shale, quartzite, conglomerate, basalt, gabbro, norite, sandstone and river alluvium. The landscape of the Ae224 land type consists of crest, 2%, foot slope, 73% and valley bottom, 25% landscape positions.

7.9.3 Land Type Ah

Land type Ah is located in the northern part of the Project area. The dominating soil types occurring in this land type are shallow Mispah and Glenrosa soil pockets within rocky outcrops in landscape positions 1 and 3 (mid slope). Sandy Clovelly and Hutton soils occupy most of the 4 landscape positions, while the 5 positions are occupied by a large variety of sandy and clayey soils. The variety was caused by the deposition of eroded soil material from higher landscape positions leading to the formation of many soil types.

Forced lateral drainage by slope steepness and the presence of underlying impermeable layers on foot slope positions caused hydromorphic soil formation such as Longlands and Fernwood form soil formation. Intermittent perched water tables allowed the formation of subsoil soft plinthite and E horizons, proving that seasonally wet conditions prevail in the landscape.

The dominant geology in this land type is represented by granite and lava. The Ah28 land type landscape consists of crest, 15%, mid slope, 40%, foot slope, 30% and valley bottom positions 15%. The crest and mid slope positions are dominated by rock and stony shallow soils, see. The foot slope and valley bottom positions are dominated by deeper red and yellow well drained soils for example Hutton, Dundee and Clovelly soils.

7.9.4 Land Type Ib

The Ib land type is dominated by rocky outcrops present in the 1, 2, 3 and 4 landscape positions containing very little usable soil in-between the rocks.

The dominant underlying geology is medium to coarse grained red biotite and granite. According to the land type data 60% of the landscape is dominated by crest and midslope positions. 90% of the crest and midslope positions are occupied by rock. 35% of the Ib447 land type is occupied by foot slope and valley bottom positions. Lower landscape positions are occupied by red well drained soils. The A horizon or topsoil is apedal (non-structured) while the B horizons may exhibit structure. Rooting depth is limited by parent rock occurring below the B soil horizon. The A horizon is likely to contain 12%-20% clay due to the influence of the dominant parent material present.

7.9.5 Major Soil Types Occupying the Project Area

The soil types occupying the Project area are indicated in Plan 16 (Appendix A). The steep crest landscape positions are generally occupied by shallow rocky soil. Lower lying mid slope areas on the old flood plain, are dominated by well drained red and yellow soil such as Hutton, Oakleaf and sandy Clovelly soil types.

Hutton soils consist of an orthic A horizon overlying a red brown B horizon. The Clovelly soil consists of an orthic A horizon overlying a yellow brown B horizon while the Oakleaf soil consists of an orthic A horizon, overlying a neocutanic brown apedal B horizon. The A and B horizons have good internal drainage properties, and therefore well drained.

The lower lying areas in the foot slope and valley bottom positions are dominated by heavy clay soils such as the Valsrivier and Arcadia soil forms. The Valsrivier soil consists of an orthic A horizon overlying a structured pedocutanic B horizon. The Arcadia soil consists of a vertic A horizon.

The Katspruit (Ks) soil is a true wetland soil and is permanently wet. This soil type is found at the lowest landscape positions such as in the valley bottom landscape position. The Ks soil consists of an orthic A horizon overlying a G horizon. The G horizon is characterised high clay content and green and grey colours due to the anaerobic soil conditions caused by waterlogging.

The agricultural potential of the dominant well drained soils, for example Oakleaf and Hutton soils in the surveyed area are determined by the combination of soil depth and favourable climatic conditions. The average rainfall in the area is medium to high (650 mm per annum) and in combination with good soil, results in high arable agricultural potential as indicated in Table 7-26.

Table 7-26: Dominant cultivated soil forms found in the Project area during the soil survey

Soil Form	Average Depth (m)	General Characteristics	Agricultural Potential
Clovelly (Found near stream bed cultivated crop is maize)	1.5	Orthic topsoil A horizon overlying a deep, red, well drained, structureless, B horizon underlain by hard or weathered rock.	Low due to very sandy nature and low soil fertility conditions.
Oakleaf	0.8 – 1.5	Orthic topsoil A horizon overlying a deep, neocutanic, brown, well drained, structured B horizon.	High due to high rainfall in the region well drained status and high water holding capacity of the soil.
Hutton	0.8 – 1.5	Orthic topsoil A horizon overlying a deep, red, well drained, structureless, B horizon underlain by hard or weathered rock.	High due to medium to high rainfall in the region well drained status and high water holding capacity of the soil.
Valsrivier	0.75	Orthic topsoil A horizon overlying a pedocutanic B horizon underlain by unspecified material.	Low due to clayey nature and potential water logging conditions.

7.9.6 Infrastructure Site

Plan 17 (Appendix A) describes the soil information for the first infrastructure site. The site is dominated by deep Oakleaf soil. A small area to the south of the infrastructure site is shallow due to the presence of a rock outcrop. The location of this proposed infrastructure site is recommended from a soil point of view.

7.9.7 Alternative Plant Site

Plan 17 (Appendix A) contains the soil data for the alternative plant infrastructure site. The site is located in the valley bottom landscape position and is occupied by a variety of soils but dominated by Oakleaf and Valsrivier soils present on the western and northern part of the alternative infrastructure site. The eastern part of the site is occupied by shallow Mispah and Glenrosa soils. It is recommended to avoid this location for infrastructure due to the presence of high clay content soil located in the western part of the site for example the Valsrivier soil. Smaller areas in close vicinity of the location of the infrastructure are occupied by vertic soil such as the Arcadia soil type. Both the Valsrivier and Arcadia soil types contain high clay content. The clay minerals present within the clay fraction are dominated by crimping and swelling montmorillonite clay minerals causing large cracks when dry, and dense wet soil conditions when wet. Swelling and crimping soils are notorious to break buildings due to shifting foundations when expensive mitigation procedures, such as using steel in foundations, are disregarded.

7.9.8 TSF Site 2

The proposed TSF site 2 is characterised and dominated by sandy shallow soils containing stones and rocks. The proposed location for TSF 2 is in a higher landscape position compared to the landscape positions of TSF 3. Drainage lines effectively divide the site. Drainage lines are characterised by heavy clay Valsrivier soil.

The sandy soils occupying TSF site 2 are difficult to manage due to their sandy nature. Stripping stockpiling and rehabilitation will be difficult to manage the prevention of erosion, due to the sandy nature of the soil and the high rainfall intensity present in the area. It is recommended that the location of TSF site 2 be avoided.

7.9.9 TSF Site 3

The proposed TSF site 3 is also characterised and dominated by sandy Glenrosa and Clovelly soils containing stones and rocks in places. Drainage lines effectively divide the site down the middle. The drainage lines are eroded and large areas can be seen where the topsoil is eroded away.

The sandy soils occupying TSF 3 will be difficult to manage due to their sandy nature. Stripping stockpiling and rehabilitation will be difficult to manage the prevention erosion, due to the sandy nature of the soil and the high rainfall intensity present in the area. It is recommended that the location of TSF 3 should be avoided from a soils point of view for use as a TSF.

7.10 Land Capability and Land Use

Land capability is determined by a combination of soil, terrain and climatic features. Land capability is defined by the most intensive long term sustainable use of land under rain-fed conditions. Simultaneously an indication is included in the definition about the permanent limitations associated with the different land use classes (Schoeman *et al*, 2000).

Table 7-27 contains a summary of the land capability classes and present land use of the Project area. The site is dominated by the Ae land type indicating that arable agriculture is potentially possible but used presently for sustainable agriculture, specifically mixed arable and grazing (cattle) but dominated by grazing.

Table 7-27: A summary of the land capability and dominating land use of land types present in the Project area

Land Type	Dominating Soil Capability Class	Dominating Land Capability Class	Dominating Land Use	Agricultural Potential
Ae224	iii	iii	Housing/Grazing	Arable
Ah28	vi	vi	Housing/Grazing	Grazing
Ib447	viii	viii	Grazing	Wildlife

7.10.1 Fertility

Table 7-28 contains the soil analytical data of the dominant cultivated Clovelly, Oakleaf, and Hutton soil forms. Organic carbon in the topsoil ranges from 0.65% – 1.07%. Generally South African cultivated soils contain an organic carbon content of around 1%. An organic carbon content of 1% is considered to be low but expected for cultivated soil under South African climatic conditions.

The phosphorus status, as contained in Table 7-28 is very low for the Project area. Phosphorus is an important macro nutrient and the phosphorus content with a low record of 0.96 and a high record of 4.6 mg kg^{-1} is very low and indicative of poor phosphorus soil status. Natural low fertility status is deteriorated even further through loss of phosphate by fixation. Phosphate fixation is a common problem in red soils thereby depleting plant available phosphate.

The soil pH is in the order of 5.8 – 6.2. This pH range is indicative of normal soil conditions not only in the topsoil but also in the subsoil.

The soils in this area are considered to have a low Cation Exchange Capacity (CEC). A low CEC reflects low soil clay and organic matter content, because CEC is a property of both clay and organic material. The CEC ranges from 5.9 to 10.8 cmol(+)kg^{-1} for the topsoils. Low CEC implies low nutrient content while the opposite is true for high CEC.

The size limits for sand, silt and clay used in the determination of soil texture classes are sand: 2.0 – 0.05 mm, silt: 0.05 – 0.002 mm and clay: < 0.002 mm. The clay content range is from 6% to 22% in the topsoil while the subsoil has a clay content ranging from 24% to 36%. This type of soil texture indicates that the soils can be cultivated easily using normal farm machinery. The texture properties of the soils analysed allow the cultivated soils to be classed as sandy clay loam soils. Sandy clay loam soils are easily cultivated using normal farming equipment.

Table 7-28: Soil laboratory results, chemical and physical analytical data

Sample Point	Soil Form	Depth cm	Org C %	CEC Cmol (+)kg^{-1}	K mg kg^{-1}	Ca mg kg^{-1}	Mg mg kg^{-1}	Na mg kg^{-1}	P (Bray1) mgkg^{-1}	pH (H_2O)	Sand %	Silt %	Clay %
1	Hutton	0-30	0.65	10.78	153	403	138	17.5	1.2	6.18	76	8	16
		30-60			70	334	280	18.2	0.15	6.06	70	6	24
2	Oakleaf	0-30	1.07	10.5	253	445	173	13.5	0.96	5.9	72	6	22
		30-60			186	711	370	29.2	0.31	6.53	56	8	36
3	Clovelly	0-30	0.53	5.87	54	120	30	17.4	4.6	5.77	92	2	6

7.11 Surface Water

GAA has been appointed by Platreef to conduct a Surface Water Impact Assessment and the report is attached in Appendix M.

The Project area falls in the Limpopo Water Management Area (WMA). The two quaternary catchments in which the Project falls are A61F and A61G. A61F is drained by the Rooisloot River and A61G by the Mogalakwena River. The Nyl River is the headwaters of the Mogalakwena River. The Nyl River flows in a north easterly direction from Modimolle located in the headwaters of the Nyl River, towards Mokopane. At Mokopane, the Nyl River becomes the Mogalakwena River and turns to flow in a north westerly direction passed Mokopane and the Project area. The Mogalakwena River flows to the west of the Project area and ultimately flows into the Limpopo River. The Mogalakwena River is characterised by the presence of vleis and wetlands along its drainage course on both the Turfspruit and Macalacaskop farms. The Sterk River is a major tributary of the Mogalakwena River and joins the Mogalakwena River from the west some 30 km below the Project area. The Doorndraai Dam is located on the Sterk River. The Doorndraai Dam is the main water supply dam for Mokopane.

There are four main water courses that drain across or adjacent to the Project area. The Dithokeng, Ngwaditse, Rooisloot and the Dorps Rivers flow in a westerly direction across the Project area into the Mogalakwena River. The Dithokeng stream crosses the corner of the mine property in the north before joining the Mogalakwena River. A dam has been constructed on this stream upstream of the town to the north east of Turfspruit. The dam is used for domestic water supply.

7.11.1 Flow and Water Quality

There is limited flow information available for the Project. There is a DWA flow gauging station A6H033 located on the Nyl River upstream of Mokopane that has been measuring flow since December 1990 and there was a DWA flow gauging station A6H032 located in the Dorps River that measured flow between 1978 and 1980.

Routine monthly surface water flow and quality monitoring commenced in September 2011. Surface water monitoring will form part of the monthly surface and groundwater monitoring programme which will be operated by the mine.

Table Table 7-29 indicates the monthly average flow and the minimum and maximum flows recorded in each month. The measured average daily flows are shown graphically in Figure 7-24 and Figure 7-25 for A6H032 and A6H033 respectively.

The available data indicates possible problems with the A6H033 station as the Nyl River is unlikely to dry up consistently, particularly in the summer months when the minimum recorded flow is reported to be 0 m^3/s. The Figure 7-25 highlights an unlikely flow pattern in the Nyl River particularly as the catchment area exceeds 3000 km^2. The flow data could also indicate extensive upstream use of water resulting in the frequent periods of low flow.

Table 7-29: Monthly average, maximum and minimum flows in m^3/s

Month	A6H032			A6H033		
	Min	Average	Max	Min	Average	Max
Oct	0.0	0.00008	0.001	0.0	0.0	0.0
Nov	0.0	0.00030	0.001	0.0	0.0	0.0
Dec	0.0	0.00023	0.002	0.0	0.00003	0.001
Jan	0.0	0.00013	0.001	0.0	0.16403	6.8
Feb	0.0	0.00053	0.004	0.0	0.10836	3.202
Mar	0.0	0.0	0.0	0.0	0.18012	4.393
Apr	0.0	0.00015	0.003	0.0	1.17732	24.165
May	0.0	0.0	0.0	0.0	0.62941	15.168
Jun	0.0	0.00017	0.001	0.0	0.11320	1.842
Jul	0.0	0.00022	0.001	0.0	0.00325	0.117
Aug	0.0	0.00015	0.001	0.0	0.00005	0.013
Sep	0.0	0.00019	0.002	0.0	0.0	0.0

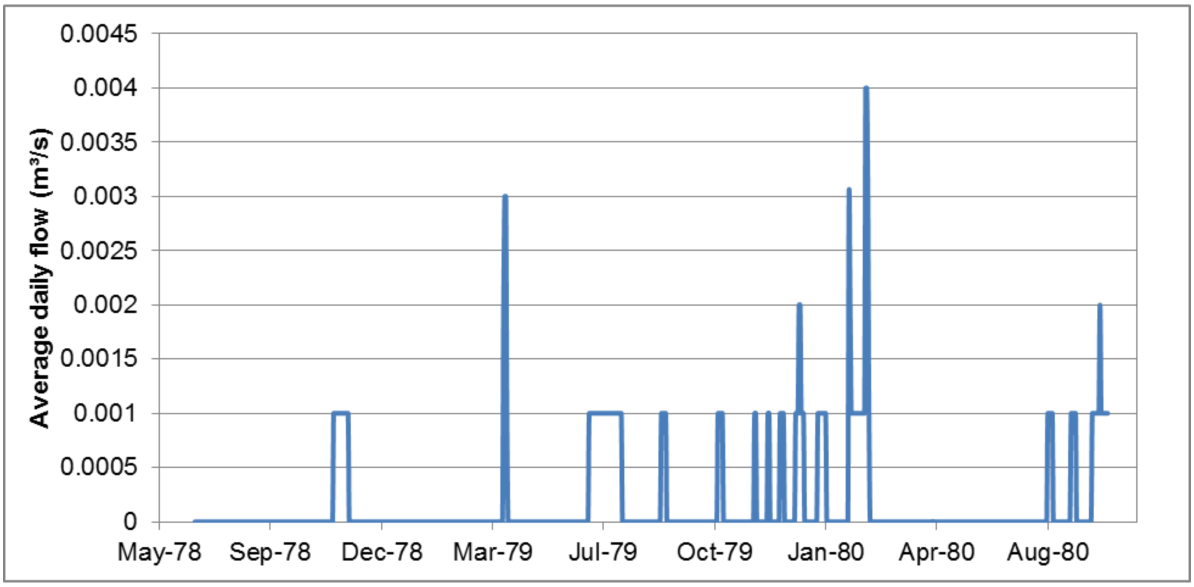

Figure 7-24: Average daily flow recorded at A6H032

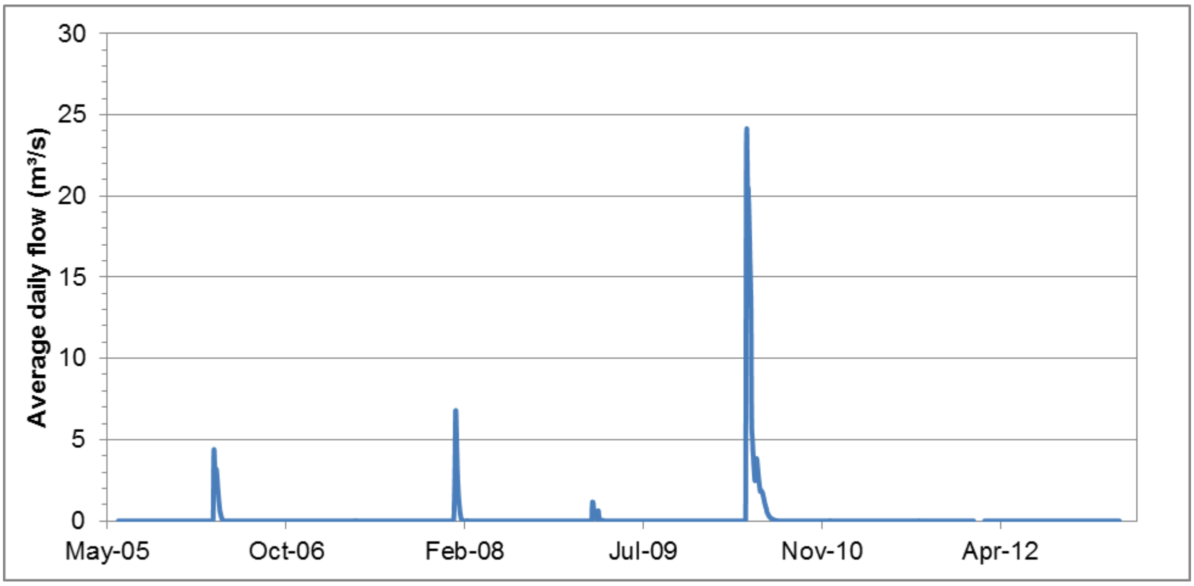

Figure 7-25: Average daily flow recorded at A6H033

The discharge was measured on the Dorps River downstream monitoring site using an OTT flow meter. As the site visit occurred during the dry season, the Dithokeng, Rooisloot and Mogalakwena streams were not flowing. The Dithokeng was dry while there were stagnant pools of water on the Rooisloot and Mogalakwena Rivers. As a result, the flow measurements at these sites were not performed. During the monitoring period it was found that most rivers were dry with the exception of the Dorps River and twice the Rooisloot. As a result the flow information is not conclusive enough to make any flow predictions from the data. Table 7-30 shows the flow measurements taken for the Dorps River and the Rooisloot while Figure 7-26 shows the flow that was measured in the Dorps River.

Table 7-30: Flow measurements taken at the Dorps and Rooisloot Rivers

Date	Dorps River		Rooisloot River	
	Water Depth (m)	Flow (m^3/s)	Water Depth (m)	Flow (m^3/s)
08-Dec-11	0	0.006		
16-Jan-12	0.145	0.01	0.215	0.063
07-Feb-12	0.122	0.012		
01-Mar-12	0.124	0.014	0.198	0.008
26-Mar-12	0.123	0.016		
24-Apr-12	0.098	0.015		
22-May-12	0.188	0.018		
21-Jun-12	0.135	0.006		
26-Jul-12	0.129	0.007		
21-Aug-12	0.133	0.006		
26-Sep-12	0.104	0.012		
24-Oct-12	0.105	0.009		
10-Dec-12	0.129	0.022		
22-Jan-13	0.144	0.029		
18-Feb-13	0.115	0.008		
19-Mar-13	0.127	0.044		
23-Apr-13	0.1666	0.058		
14-May-13	0.152	0.055		

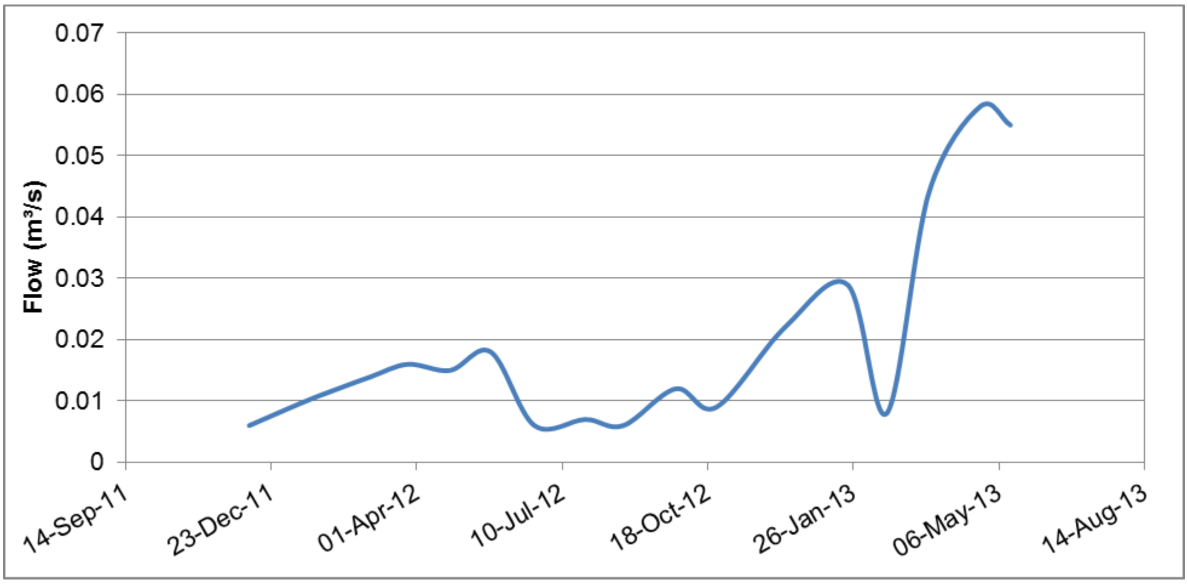

Figure 7-26: Measured flow in the Dorps River

7.11.2 DWA Water Quality Database

Water quality data was obtained from the DWA WMS database (DWA, 2011). The five water quality monitoring sites that were available on the DWA database are listed in Table 7-31 and their locations are shown in Plan 18 (Appendix A).

Table 7-31: DWA water quality monitoring sites

Number	Name	Description	Sampling Period	No of Readings
WMS A61_1000004230 (4230)	Macalacaskop 243 KR R33 Bridge downstream of Sekgakgapeng Oxidation Ponds on Dorps River	Upstream end within Project area of Dorps River	21 Jan 2009 to 25 Apr 2012	41
WMS A61_1000004237 (4237 in)	Lekalakala Township Macalacaskop 243 KR downstream of Masehlaleng Oxidation Ponds	Within Project area downstream of Lekalakala Township	21 Jan 2009 to 25 Apr 2012	51
WMS A61_1000004239 (4239)	Madiba Macalacaskop 243 KR downstream of Mahwelereng STW on Rooisloot River	Upstream of Rooisloot River area	17 Mar 2005 to 16 Mar 2010	29
WMS A61_1000004240 (4240)	Lekalakala Township Macalacaskop 243 KR upstream of Masehlaleng Oxidation Ponds	Within Project area upstream of Lekalakala Township	17 Mar 2005 to 7 Jul 2009	27
WMS A62_1000004253 (4253)	Mokopane Potgietersrus Town 44KS Bridge downstream of Mokopane STW near Dam on Mogalakwena River	Upstream of entire Project area	17 Mat 2005 to 12 Aug 2008	10

The number of readings given in Table 7-31 is the maximum number of samples that were analysed over the data period. However, not all the parameters were analysed for all the samples. Due to the small number of samples, only the minimum and maximum values are presented in Table 7-32. The values were compared to the 2011 SANS 241 standards for drinking water, Class 1 (SANS 241-1:2011). Values that exceed these standards are highlighted in red in Table 7-32.

Results indicate that the upstream water quality sometimes exceeds the standards for pH, Sodium, Fluoride and Ammonium. Within the Project area, pH, Fluoride and Ammonium were sometimes measured above the limit. At the downstream monitoring sites values that exceeded the standard were recorded for Sodium and Fluoride.

7.11.3 Water Quality

The first round of water quality sampling took place on 26 September 2009 and the monthly water quality monitoring programme was setup and started from 9 December 2011 until 14 May 2013. Results of the monitoring programme set up for the Project are presented in

Table 7-33. The measured concentrations are compared to the SANS 241 (class 1) drinking water standards and where these limits are exceeded they are shown in red.

Table 7-32: DWA water quality data

	Unit	SANS 241 Standards (Class 1)	WMS A61_1000004230		WMS A61_1000004237		WMS A61_1000004239		WMS A61_1000004240		WMS A62_1000004253	
			Dorps River		Rooisloot River						Mogalakwena River	
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Calcium	mg/l	150	21	54	32	42	21.99	44	11.06	45.20	9	23.29
Chloride	mg/l		0.025	100	46	66	6.52	70.96	16.44	112	8.3	175
Total Dissolved Solids (TDS)	mg/l	1000	294	294			191	568	160	1394	647	1054
Electrical Conductivity (EC)	mS/m	150	30.7	146.0	61.1	97.1	25.7	94.2	22.2	177.0	18.2	144.0
Fluoride	mg/l	1	0.2	0.41	0.2	0.86	0.2	0.79	0.33	3.5	0.94	2.6
Potassium	mg/l	50	0.62	8	2	5	1	17.05	0.6	23.30	8	20.97
Magnesium	mg/l	70	10	89	34	67	7.97	64	6.02	172	6	35.6
Sodium	mg/l	400	23	133	10	73	6.3	62	19.7	139	128	229
Nitrate_Nitrite as N	mg/l	10	0.05	26	0.05	15	0.02	0.21	0.02	7.19	0.07	0.52
Ammonia	mg/l	1	0.2	18	0.2	9.7	0.04	20.16	0.04	15	0.04	0.45
pH		9.5	7.3	8.3	7.4	8.8	7.7	8.8	7.8	9.0	8.0	9.2
Phosphate as P	mg/l		0.2	3.2	0.2	95	0.006	4.21	0.006	0.999	0.038	0.22
Silicon	mg/l		0	0	0	0	1.76	12.70	4.81	17.21	0.4	1.88
Sulphate	mg/l	400	34	108	5.8	20	8.25	23.53	5	147	4.83	44
Total Alkalinity	mg/l		111	622	480	511	100	445	66	742	301	460

Table 7-33: Results of Water Quality Sampling programme

Water Quality Variable	River		Dithokeng			Rooisloot						Dorps			Mogalakwena					
	Site	SANS 241 Standards (Class 1)	Dithokeng Upstream (Dam)			Rooisloot Upstream			Rooisloot Downstream			Dorps River			Mogalakwena			Mogalakwena Deep Pool		
	Unit	No of Samples taken	18			16			15			18			8			18		
		Percentile	5th	Mean	95th	5th	Mean	95th	5th	Mean	95th	5th	Mean	95th	5th	Mean	95th	5th	Mean	95th
pH	-	5 - 9.5	6.9	7.8	8.6	7.2	8.1	8.5	7.2	8.3	8.7	7.2	7.8	8.2	7.9	8.5	8.9	8.2	9.0	9.5
Conductivity	mS/m	<150	2.0	25.3	50.9	18.8	55.7	80.0	38.2	73.5	95.3	86.7	124.3	143.6	91.6	122.8	150.1	110.0	133.8	163.9
Total Dissolved Solids	mg/l	<1 000	106	323	675	293	409	499	333	498	671	646	862	1365	468	681	868	534	883	1285
Total Suspended Solids Dried at 105°C	mg/l	-		140									170						320	
Total Alkalinity as $CaCO_3$	mg/l	-	73	109	163	155	363	470	205	424	542	399	601	714	376	491	560	463	584	735
Chloride	mg/l	<200	4.16	6.57	8.73	12.76	37.82	54.25	15.81	52.98	97.60	46.78	106	176	77.95	203	273	139	227	312
Sulphate	mg/l	<400	2.60	4.27	6.44	3.09	16.67	30.00	4.86	21.89	35.80	16.22	79.25	164.6	6.81	14.88	26.30	12.40	30.24	52.35
Fluoride	mg/l	<1	0.440	0.746	1.160	0.680	0.950	1.325	0.442	0.672	1.200	0.025	0.239	0.378	0.748	0.870	1.000	0.025	0.667	1.015

Water Quality Variable	River		Dithokeng			Rooisloot						Dorps			Mogalakwena					
	Site	SANS 241 Standards (Class 1)	Dithokeng Upstream (Dam)			Rooisloot Upstream			Rooisloot Downstream			Dorps River			Mogalakwena			Mogalakwena Deep Pool		
	Unit	No of Samples taken	18			16			15			18			8			18		
Nitrite as N	mg/l	<10	0.05	0.23	0.29	0.20	1.74	7.73	0.25	5.42	27.40	0.22	3.91	21.65	0.05	0.23	0.41	0.05	0.35	0.75
Nitrate as N	mg/l	<10	0.05	0.30	0.90	0.09	1.47	4.33	0.43	16.07	36.30	0.05	17.69	46.30	0.05	0.54	1.81	0.05	0.27	0.86
Orthophosphate as P	mg/l	-	0.010	0.041	0.137	0.010	0.026	0.047	0.019	0.052	0.102	0.113	2.433	9.315	0.010	0.031	0.086	0.010	0.025	0.049
Dissolved																				
Calcium	mg/l	<150	9.30	12.62	17.15	20.00	36.50	43.75	23.50	37.47	44.30	44.40	53.78	69.95	12.35	15.13	21.85	13.55	21.50	31.30
Sodium	mg/l	<200	15.9	24.7	33.6	25.8	38.5	46.5	27.2	50.1	69.8	74.6	105.2	134.3	96.8	119.8	158.5	93.5	125.6	164.1
Magnesium	mg/l	<70	4.0	5.1	6.6	10.5	41.3	59.0	17.7	50.7	78.0	47.8	74.3	95.3	47.8	71.9	100.4	65.0	87.7	122.5
Potassium	mg/l	<50	2.13	2.93	3.52	2.15	2.86	3.83	2.70	5.51	14.44	2.27	5.44	11.45	10.35	13.63	17.30	8.96	12.84	17.15
Iron	mg/l	<0.2	0.184	1.165	3.190	0.068	0.217	0.553	0.068	0.812	3.410	0.055	0.380	0.983	0.058	0.273	0.597	0.025	0.248	0.881
Manganese	mg/l	<0.1	0.043	0.178	0.286	0.023	0.463	0.925	0.036	0.539	1.272	0.213	1.137	3.000	0.022	0.474	1.238	0.026	0.777	1.909
Aluminium	mg/l	<0.3	0.443	2.627	7.940	0.010	0.174	0.583	0.045	0.972	4.070	0.010	0.289	0.779	0.014	0.293	1.089	0.010	0.321	1.370

Water Quality Variable	**River**		**Dithokeng**			**Rooisloot**						**Dorps**			**Mogalakwena**					
	Site	**SANS 241 Standards (Class 1)**	**Dithokeng Upstream (Dam)**			**Rooisloot Upstream**			**Rooisloot Downstream**			**Dorps River**			**Mogalakwena**			**Mogalakwena Deep Pool**		
	Unit	**No of Samples taken**	**18**			**16**			**15**			**18**			**8**			**18**		
Nickel	mg/l	<0.15	0.002	0.007	0.014	0.002	0.008	0.015	0.002	0.013	0.041	0.002	0.007	0.016	0.002	0.008	0.014	0.002	0.012	0.026
Copper	mg/l	<1	0.009	0.011	0.022	0.008	0.078	0.283	0.007	0.012	0.022	0.009	0.009	0.010	0.004	0.009	0.010	0.009	0.011	0.013
Phosphorus as P	mg/l		0.015	0.158	0.418	0.015	0.076	0.130	0.042	0.194	0.650	0.338	1.330	3.170	0.084	0.123	0.165	0.015	0.107	0.187
Total																				
Calcium	mg/l		9.30	12.62	17.15	20.00	36.50	43.75	23.50	37.47	44.30	44.40	53.78	69.95	12.35	15.13	21.85	13.55	21.50	31.30
Sodium	mg/l		15.9	24.7	33.6	25.8	38.5	46.5	27.2	50.1	69.8	74.6	105.2	134.3	96.8	119.8	158.5	93.5	125.6	164.1
Magnesium	mg/l		4.0	5.1	6.6	10.5	41.3	59.0	17.7	50.7	78.0	47.8	74.3	95.3	47.8	71.9	100.4	65.0	87.7	122.5
Potassium	mg/l		2.13	2.93	3.52	2.15	2.86	3.83	2.70	5.51	14.44	2.27	5.44	11.45	10.35	13.63	17.30	8.96	12.84	17.15
Iron	mg/l		0.184	1.165	3.190	0.068	0.217	0.553	0.068	0.812	3.410	0.055	0.380	0.983	0.058	0.273	0.597	0.025	0.248	0.881
Manganese	mg/l		0.043	0.178	0.286	0.023	0.463	0.925	0.036	0.539	1.272	0.213	1.137	3.000	0.022	0.474	1.238	0.026	0.777	1.909
Aluminium	mg/l		0.443	2.627	7.940	0.010	0.174	0.583	0.045	0.972	4.070	0.010	0.289	0.779	0.014	0.293	1.089	0.010	0.321	1.370

Water Quality Variable	River		Dithokeng			Rooisloot						Dorps			Mogalakwena					
	Site	SANS 241 Standards (Class 1)	Dithokeng Upstream (Dam)			Rooisloot Upstream			Rooisloot Downstream			Dorps River			Mogalakwena			Mogalakwena Deep Pool		
	Unit	No of Samples taken	18			16			15			18			8			18		
Nickel	mg/l		0.002	0.007	0.014	0.002	0.008	0.015	0.002	0.013	0.041	0.002	0.007	0.016	0.002	0.008	0.014	0.002	0.012	0.026
Copper	mg/l		0.009	0.011	0.022	0.008	0.078	0.283	0.007	0.012	0.022	0.009	0.009	0.010	0.004	0.009	0.010	0.009	0.011	0.013
Phosphorus as P	mg/l		0.015	0.076	0.285	0.015	0.030	0.054	0.025	0.191	0.776	0.334	1.447	4.045	0.045	0.084	0.125	0.029	0.074	0.125
Orthophosphate (Total Reactive Phosphorous or PO_4)	mg/l		0.018	0.039	0.080	0.017	0.036	0.076	0.023	0.277	1.165	0.994	6.799	27.360	0.032	0.050	0.069	0.017	0.031	0.050
Orthophosphate as P	mg/l		0.010	0.041	0.137	0.010	0.026	0.047	0.019	0.052	0.102	0.113	2.433	9.315	0.010	0.031	0.086	0.010	0.025	0.049

All rivers in the area show high concentrations of iron, manganese and aluminium. This suggests that there is some geological influence for the high concentrations of these metals in the area. The Total Dissolved Solids (TDS) are not of desirable standards for drinking water, while most sites remain under the limit of 1 000 mg/l. The ideal limit for drinking water is 450 mg/l which, with the exception of Dithokeng Upstream (US) (Dam) and Rooisloot Upstream (US), most sites fail to meet. The Rooisloot River shows low concentrations of nitrates upstream of the town of Madiba but high concentrations of nitrates downstream (DS) of the town. This could be due to leaking sewers in the town and animals defecating in the rivers. The Dorps River shows a eutrophic system enriched with nutrients due to sewage effluent coming from the sewage treatment plant and urban runoff. The Mogalakwena River shows high levels of chloride and high conductivity readings. The chloride in the river could be due to anthropogenic sources and the conductivity readings could be due to the high metal contents in the rivers in the area. The conductivity could also be coming from groundwater sources feeding the river.

7.11.4 Sub-Catchments

The total drainage area of the Platreef prospecting area was divided into nine sub-catchments based on the topography of the area and the river reaches where flood lines were required. The catchment boundaries are shown in Plan 19, Appendix A (shown in purple). For the floodlines on the Uitloop farm, the Project area had to be divided into sub-catchments (see green sub-catchments in Plan 19, Appendix A). The catchment of the Nyl River was used in the calculations of the flood peaks for the original floodlines and is shown in Plan 19 (Appendix A).

7.12 Groundwater

GAA has been appointed by Platreef to conduct a Geohydrological Assessment and a report has been compiled and attached to Appendix N.

The hydrogeology of the Project area was sourced from the published hydrogeological map series at a scale of 1:500,000, compiled by DWA during 1996 to 2003. The geology has been grouped together based on their general water bearing properties, using a simplified lithological description.

Two main aquifer types are present, i.e. primary and secondary. The two farms Turfspruit and Macalacaskop are mainly underlain by intergranular and fractured aquifers, associated with the RSL. On the farm Rietfontein 2 KS, secondary aquifers are associated with formations of the Transvaal Sequence and basement granite.

7.12.1 Hydrogeological Units

7.12.1.1 Rooisloot Alluvial Aquifer

The primary aquifer is mostly restricted to the alluvium in the Mogalakwena River. Groundwater resources have been developed provided the clay component of the alluvium is negligible. Alluvial thicknesses of up to 20 metres occur and borehole yields in excess of

10 l/s have been established. Minor alluvium occurrences are associated with the Rooisloot River drainage.

In the south western portion of the farm Turfspruit and the adjacent farm Blinkwater the alluvium is underlain by shallow (<45 m deep) high yielding secondary bedrock aquifers. The combined primary and secondary aquifers in this area are known as the Rooisloot Alluvial Aquifer.

Boreholes in the Rooisloot Alluvial Aquifer are drilled to depths between 35 and 45 metres. Water levels as shallow as 2 m are present. Calculated aquifer transmissivity values range between 315 and 400 m^2/day. The aquifer storage coefficient (S) for both the alluvial and weathered bedrock aquifer is 2.7 x 10^{-3}.

7.12.1.2 Rustenburg Layered Suite – Main Secondary Aquifer

The two farms Turfspruit and Macalacaskop are mostly underlain by weathered and fractured aquifers, associated with the Rustenburg Layered Suite. The main secondary aquifer occurs at a shallow depth of less than 45 m. Several high yielding boreholes (5 to 10 l/s) have been drilled with the main water interceptions in the fractured bedrock below the weathered zone and at contact zones with intrusive dykes.

Water level depths vary from 3 to 25 mbgl. Water strike depths in the weathered bedrock range from 12 to 20 mbgl, with strike yields between 0.1 to 1.0 l/s. Water interceptions in the shallow fractured bedrock occur at 20 to 42 mbgl with strike yields between 1.0 to 10.0 l/s.

Calculated aquifer transmissivity values range between 17 and 113 m^2/day. The aquifer storativity (S) is in the order of 5 x 10^{-3}. The average saturated thickness of the main aquifer zone is 17.6 m. The base of the main aquifer zones is shallow and varies from 12 to 42 mbgl.

Seasonal water level fluctuations due to direct rainfall recharge are expected. Groundwater flow is mainly lateral following topography. Intrusive dykes may act as boundaries to lateral groundwater flow.

7.12.1.3 Rustenburg Layered Suite – Minor Fractured Aquifer

A minor fractured aquifer was intersected at depth (>45 mbgl) with strike depths varying from 45 to 156 mbgl and yields between 0.1 and 0.2 l/s. Slug testing of six deep core holes indicate very low hydraulic conductivities, between 1 x 10^{-4} m/d and 1 x 10^{-5} m/d, considered representative of the igneous rock matrix. Inspection of core samples indicate minor fracturing at the mineralized contact zone at a depth of some 800 m.

Water level depths of the deep fractured aquifer are currently similar to that of the main secondary aquifer. Artesian conditions are observed during nearby core drilling operations, which stop once drilling is discontinued, and are considered the result of the drilling process.

7.12.1.4 Banded Ironstone Formation (BIF)

The BIF of the Penge Formation outcrops as a prominent SE to NW striking topographic ridge, dipping to the south-west. One borehole (GPR-26) was drilled in proximity of a fault zone to intercept the BIF at shallow depths. The borehole was drilled into weathered and fractured BIF to a depth of 37 m.

The static water level is 7 mbgl and water strikes were encountered from 14 to 21 mbgl, with a significant final airlift yield of 12 l/s. An aquifer transmissivity of $180m^2$/day was determined from borehole test pumping.

7.12.1.5 Steeply Dipping Dolomite Formation

Karst development in the steeply dipping and elevated dolomite formations is very limited to absent. This conclusion is based on gravity surveys conducted showing very limited gravity low anomalies indicating the general absence of leached dolomite formations.

Two boreholes (GPR-22 and GPR-25) were drilled to depths of 98 and 150 mbgl with no water strikes encountered below 29 mbgl. Very low yields of 0.05 to 0.1 l/s were encountered at shallow depths (<29 mbgl) associated with bedding plane contact zones within the dolomite formation. Borehole GPR26 intersected schist, quartzite, dolomite and granite at depths between 45 and 120mbgl with no water strikes encountered.

Water level depths vary from 10 to 17 mbgl. An aquifer transmissivity of 1 m^2/day was determined from test pumping of borehole GPR-25.

7.12.1.6 Turfloop Granite

The granite on the farm Rietfontein is presented by the Turfloop granite, comprising fine to medium grained grey and pink biotite granite. The topography of the areas drilled is elevated, indicating shallow bedrock conditions.

Eleven boreholes (GPR-19, -21, -24, -27, -28, -29-, -30, -31, 32, -33 and -34) were drilled to depths to 120 m to investigate the hydraulic characteristics of the granite aquifer. A very low water strike (0.05 l/s) was intersected in one borehole at a depth of 33.5 m, with the other 10 boreholes “dry” (no blow test yield). Borehole GPR-26 (2012) intersected schist, quartzite, dolomite and granite at depths between 45 and 120 mbgl with no water strikes encountered.

Falling head permeability tests confirms an insignificant aquifer transmissivity range of «0.5 m^2/day.

The water level varies between 20 to 23 mbgl. It has been observed that the water level rise in some of the older exploration boreholes (viz. GPR-24) has taken several months to reach the local water table elevation and thus indicates the extremely low hydraulic characteristics of the Turfloop Granite (Figure 7-27).

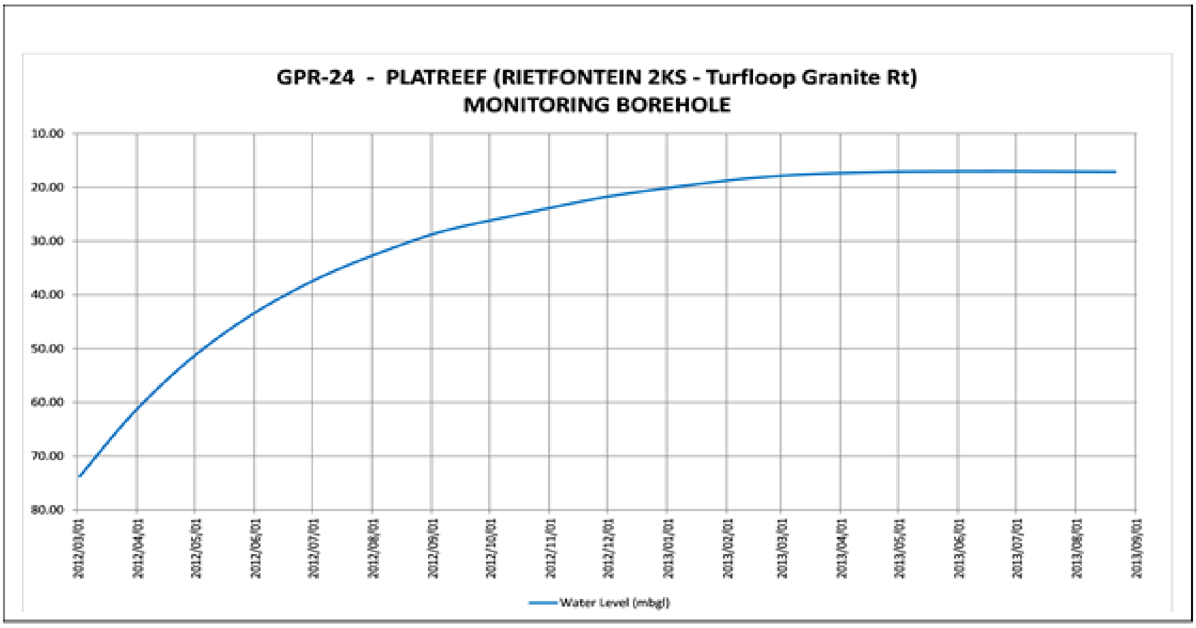

Figure 7-27: Illustrating retarded water table response in low yielding borehole on Rietfontein 2KS (200m from TSF)

7.12.2 Hydrocensus

The hydrocensus survey identified 216 borehole sites within the Project area, which includes data from the desk study, recognisance hydrocensus survey and borehole drilling undertaken by Golder in early 2011. A total of 198 GRIP database (government owned) borehole sites were searched for of which 147 were located in the field. Government owned boreholes are numbered using the prefix H03. Boreholes surveyed with no existing allocated numbers were assumed to be privately owned and allocated an electronic database number (not marked in the field) using the prefix H03-GA.

Summary borehole information from the updated hydrocensus database is presented in tables listed in of the Geohydrology report attached in Appendix N.

During the hydrocensus groundwater samples were collected from 81 boreholes, which included 43 private boreholes, Samples were taken from equipped boreholes within and in close proximity to the three farm boundaries. The samples were submitted to UIS Analytical Services in Centurion for analysis.

Privately owned boreholes are in use in all the local communities located in the study area. 34 boreholes sampled in the communities are equipped with submersible pumps and the remaining 9 with hand pumps. The potability of the water in 23 boreholes (~50%) was found not to be suitable for human consumption based on the nitrate NO_3 –N exceeding 11 mg/l (WRC Guideline, 1998). Thirteen boreholes have nitrate (N) values ranging from 40 to 129 mg/l, with a high health risk if consumed.

7.12.3 Ground Geophysical Surveys

Ground geophysical surveys were used to identify zones of deeper weathering, fracturing and possible leaching in the underlying bedrock, comprising mainly of norite, gabbro, BIF, dolomite and granite. Four different geophysical methods (magnetic, electromagnetic, resistivity imaging and gravity) were employed in view of the varying geological setting within the study area. Different combinations of geophysical techniques were used due to varying physical weathering properties of the rock types.

The geophysical surveys were conducted during October 2011 and extended in July-October 2013 on the farms Turfspruit 241 KR (Site Area), Rietfontein 2 KS (main TSF site) and Bultongfontein 239 KR (alternative TSF Site). Different combinations of geophysical techniques were used due to varying physical weathering properties of the rock types. The main objective was to investigate for zones of deep weathering and fracturing associated with geological structures which could act as preferential groundwater flow paths, and to assist in selecting positions for the drilling of the monitoring boreholes.

7.12.3.1.1 Geophysical Traverses on the Project Area

The 2011-2012 geophysical survey comprised five ad hoc traverses surveyed over geological structures that may drive a significant secondary groundwater flow regime (in faults/large fractures) that may impact on the future water-make of the shafts and the underground mine working. Ad hoc geophysical traverses B15, B18, B19, B21 and B22 were surveyed on the Project Area and covered 10km line. These traverses were selected to investigate individual geological structures mapped in the Project area.

Due to the tight layout of the different mine infrastructure components on the Project area, a high-density geophysical grid was used to conduct the surveying. The Project area Grid consists of 42.5 km line – 430 individual stations and is orientated in a west to east configuration. Individual stations were marked on a 100 m interval although physical measurements, i.e. the electromagnetic survey were done on smaller intervals (viz. 10 and 20 m).

7.12.3.1.2 Geophysical Traverses on Rietfontein 2 KS TSF Site

Five geophysical traverses were laid out on this main TSF site area. These traverses were designed to investigate the numerous lineaments and structures. The survey results were used to aid the selection of positions for the drilling of exploration/test/monitoring boreholes Geophysical Traverses on Bultongfontein 239 KR TSF Site

Four geophysical traverses were run on this alternative TSF site area. As at Rietfontein the survey was designed to investigate the structures and lineaments crossing the TSF footprint. The survey results were used to aid the selection of positions for the drilling of exploration/test/monitoring boreholes.

7.12.3.1.3 Rietfontein 2 KS TSF Site

The borehole information, test pumping assessments and monitoring data indicate that the system underlying the Rietfontein TSF site can be classified as a fractured and weathered (hard) rock system, viz. the Turfloop Granite (Rt). The status of the underlying granite varies from fresh, solid (observed as outcrops on the TSF site area) and highly weathered (clayey, almost decomposed) granite in areas where geological structures (dykes and fractures) are present.

The contact zone between diabase dykes and the host Turfloop Granite rocks based on the geological log of GPR-027 at the TSF site, are sharp, but clayey. The contact zone is non-water bearing.

The piezometric level in the Rietfontein TSF site is well below the weathered zone and the geological information indicates that the occurrence of secondary fractures is limited; thus categorising this system as a minor aquifer system and insignificant in terms of supporting a regional flow system.

7.12.3.1.4 Bultongfontein 239 KR TSF Site

The borehole information, test pumping assessments and monitoring data indicate that the groundwater system underlying the Bultongfontein TSF site can be classified as a fractured and weathered (hard) rock system, viz. the Turfloop Granite (Rt) together with an eroded inlier of the RSL (mainly consisting of harzburgite). The status of the underlying granite varies from weathered and minimum fractures to fresh, solid bedrock (observed as outcrops on the TSF site area).

Although no secondary geological features were noted on the geological maps and sheets, the drilling information indicated dolerite-like intrusions, seemingly flat lying sills (viz. GPB003, from 42 mbgl to 50 mbgl).

The blow test yields in the Bultongfontein TSF area are low (<0.3 l/s) except for GPB001 that has intercepted water at ~25 mbgl in a 4 m medium fractured zone. This borehole was test pumped at a yield of 2.6 l/s and indicated a transmissivity of 15 m^2/d.

The largest portion of the TSF footprint lies on the Turfloop Granite. The blow test yields of the boreholes that intercepted the granite, viz. <0.1l/s, indicate the hydraulic conductivity is similar to slightly higher than the values obtained at the Rietfontein TSF site («0.05 m^2/d).

The soil/regolith cover at the Bultongfontein STF site varies between nil and 8m with an average of ~3.6 m. In contrast with the Rietfontein TSF site, the underlying bedrock consists of solid, fresh granite/harzburgite.

7.12.4 Groundwater Use

At the farms Macalacaskop 243 KR, Turfspruit 241 KR and Rietfontein 2 KS water is being abstracted from groundwater sources to supply the various rural communities. Dispersed boreholes are in use throughout the area, with the highest volume abstracted for domestic water supply from the Rooisloot Alluvial Aquifer in the south western part of the farm Turfspruit 241 KR.

The community water supply use is not registered on the DWA WARMS data base. Based on the hydrocensus survey and desk study results, community water supply and private use is estimated as follows:

- Recommended daily abstraction for 31 equipped and tested government boreholes in the Project area is 3670 m^3/day. When considering the other 45 untested but equipped governmental boreholes of which 17 have motorised equipment and 23 have submersible pumps, it could be estimated that each of these boreholes supply an average of 40 m^3/day. The total current abstraction from groundwater supplied from governmental boreholes located within these three farms is estimated at 5 270 m^3/day.
- Within the Project area many privately owned boreholes are in use of which 43 were surveyed during the hydrocensus. Assuming a daily abstraction of 2 m^3 from boreholes equipped with submersible pumps the groundwater use from these boreholes amounts to 86 m^3/day.

7.12.5 Groundwater Levels and Flow Direction

Groundwater levels measured were recorded in private, government and both exploration core holes and groundwater boreholes. Water levels from the local DWA monitoring network recorded during the course of this investigation from late 2010, as well as levels measured during the drilling and testing of boreholes undertaken in 2012, were collated.

Borehole elevations were determined for boreholes with verified coordinates (accuracy <10 m) using the DEM data from Platreef with altitude accuracies <0.25 mamsl. A total of 61 water levels depths and altitudes were compiled using the latest available water level data for the period November 2010 to August 2013. The Project area groundwater level monitoring program consists of 30 monitoring sites of which 15 are equipped with electronic data logging devices set to record/store water level measurements on mainly six hourly intervals and in two instances hourly.

Water levels were measured in the Project area since March 2012 and represent baseline reference water levels for future monitoring (Table 7-34). Overall water level depths range from 3 to 36 mbgl. The distribution of water level data and groundwater piezometric contours compiled are shown in Plan 19 (Appendix A) in relation to the underlying geology. Since the groundwater monitoring programme has been initiated in the PSA, water level information on a time series principle is now available. The piezometric map portrays the March 2012 status which has not changed significantly in terms of its regional context. The water level difference between the March 2012 and April 2013 is small (<1.0 m for 29 monitoring sites).

Groundwater flow follows surface drainage with flow occurring from northeast to southwest (at right angles to the RLS succession) and eventually northwest following the Mogalakwena River. Groundwater elevations are highest (1 220 mamsl) on the farm Rietfontein underlain by granite and lowest (1 030 mamsl) on the farm Turfspruit associated with the Rooisloot Alluvial Aquifer. This represents a hydraulic head of 190 m across the Project area. Hydraulic gradients for the main hydrogeological units are:

- Turfloop Granite : 0.03
- Steeply Dipping Dolomite : 0.08
- Banded Ironstone Formation : 0.014

- Rustenburg Layered Suite : 0.016 to 0.02
- Rooisloot Alluvial Aquifer : 0.0025

The position of the Macalacaskop dyke is highlighted in Plan 20 (Appendix A) since it forms a local groundwater divide, with flow following the Rooisloot River Drainage. The Macalacaskop dyke seems to act as a barrier to lateral groundwater flow (Plan 20).

Table 7-34: Baseline (March 2012) and recent (August 2013) groundwater levels for Platreef monitoring boreholes

Borehole No.	Co-ordinates WGS 84		Borehole Depth	Baseline vs Recent Water Level Reference				Δ Trend
	Latitude	Longitude	(mbgl)	Date Measured	Depth (mbgl)	Date Measured	Depth (mbgl)	
GPR-01	-24.12082	28.97184	72	March 2012	5.14	August 2013	5.61	-0.47
GPR-02	-24.11995	28.9719	61	March 2012	5.65	August 2013	6.10	-0.45
GPR-04	-24.11398	29.00183	72	March 2012	10.65	August 2013	12.61	-1.96
GPR-05	-24.10015	28.99261	91	March 2012	16.74	August 2013	17.69	-0.95
GPR-06	-24.09977	28.98832	71	March 2012	8.03	August 2013	9.60	-1.57
GPR-07	-24.1001	28.99246	85	March 2012	16.14	August 2013	17.15	-1.01
GPR-08	-24.10005	28.99595	60	March 2012	24.38	August 2013	25.43	-1.05
GPR-09	-24.07605	28.95522	60	March 2012	9.11	August 2013	9.45	-0.34
GPR-10	-24.10004	28.9963	80	March 2012	24.67	August 2013	25.65	-0.98
GPR-11	-24.11783	28.99575	150	March 2012	15.59	August 2013	15.77	-0.18
GPR-12	-24.09402	28.96141	173	March 2012	3.17	August 2013	3.93	-0.76
GPR-13	-24.07874	28.952950	60	March 2012	13.48	August 2013	13.92	-0.44
GPR-14	-24.09982	28.949730	80	March 2012	3.93	August 2013	4.13	-0.20
GPR-15	-24.11294	28.957770	60	March 2012	5.49	August 2013	5.80	-0.31
GPR-16	-24.11063	28.940040	50	March 2012	10.33	August 2013	10.60	-0.27

Borehole No.	Co-ordinates WGS 84		Borehole Depth	Baseline vs Recent Water Level Reference				Δ Trend
	Latitude	Longitude	(mbgl)	Date Measured	Depth (mbgl)	Date Measured	Depth (mbgl)	
GPR-17	-24.11831	28.937260	71	March 2012	12.91	August 2013	12.62	0.29
GPR-18	-24.12998	28.952740	76	March 2012	7.82	August 2013	7.46	0.36
GPR-19	-24.08031	29.009000	100	March 2012	23.78	August 2013	22.80	0.98
GPR-20	-24.08778	29.001360	120	March 2012	36.43	August 2013	36.17	0.26
GPR-21	-24.07706	28.992960	80	March 2012	20.06	August 2013	19.58	0.48
GPR-22	-24.04843	28.976490	98	March 2012	10.53	August 2013	10.93	-0.40
GPR-23	-24.06190	28.983350	80	March 2012	6.19	August 2013	6.87	-0.68
GPR-24	-24.082030	29.000780	120	March 2012	74.25	August 2013	17.64	56.61
GPR-25	-24.09218	28.997970	150	March 2012	17.26	August 2013	21.99	-4.73
GPR-26	-24.06174	28.979930	120	March 2012	5.92	August 2013	6.59	0.67
BH04	-24.08378	28.96321	69	March 2012	3.79	August 2013	5.29	-1.50

Table 7-35: Groundwater level trends over the 2012-2013 Dry Cycle (May 2013 - October 2013)

Borehole No.	Co-ordinates WGS 84		Borehole Depth	Baseline vs Recent Water Level Reference				Δ Trend
	Latitude	Longitude	(mbgl)	Date Measured	Depth (mbgl)	Date Measured	Depth (mbgl)	
GPR-01	-24.12082	28.97184	72	May 2013	-4.97	October 2013	-5.23	-0.26
GPR-02	-24.11995	28.9719	61	May 2013	-5.42	October 2013	-5.71	-0.29
GPR-04	-24.11398	29.00183	72	May 2013	-11.10	October 2013	-12.35	-1.25

Borehole No.	Co-ordinates WGS 84		Borehole Depth	Baseline vs Recent Water Level Reference				Δ Trend
	Latitude	Longitude	(mbgl)	Date Measured	Depth (mbgl)	Date Measured	Depth (mbgl)	
GPR-05	-24.10015	28.99261	91	May 2013	-17.16	October 2013	-17.46	-0.30
GPR-06	-24.09977	28.98832	71	May 2013	-8.76	October 2013	-9.14	-0.38
GPR-07	-24.1001	28.99246	85	May 2013	-16.59	October 2013	-16.92	-0.33
GPR-08	-24.10005	28.99595	60	May 2013	-24.87	October 2013	-25.18	-0.31
GPR-09	-24.07605	28.95522	60	May 2013	-9.11	October 2013	-9.21	-0.10
GPR-10	-24.10004	28.9963	80	May 2013	-28.87	October 2013	-25.17	-0.30
GPR-11	-24.11783	28.99575	150	May 2013	-15.13	October 2013	-15.13	-0.32
GPR-12	-24.09402	28.96141	173	May 2013	-3.14	October 2013	-3.44	-0.30
GPR-13	-24.07874	28.952950	60	May 2013	-13.42	October 2013	-13.47	-0.05
GPR-14	-24.09982	28.949730	80	May 2013	-3.56	October 2013	-3.83	-0.27
GPR-15	-24.11294	28.957770	60	May 2013	-5.19	October 2013	-5.47	-0.28
GPR-16	-24.11063	28.940040	50	May 2013	-10.28	October 2013	-10.12	0.16
GPR-17	-24.11831	28.937260	71	May 2013	-12.38	October 2013		-0.16
GPR-18	-24.12998	28.952740	76	May 2013	-6.61	October 2013	-7.21	-0.60
GPR-19	-24.08031	29.009000	100	May 2013	-22.31	October 2013	-22.54	-0.23
GPR-20	-24.08778	29.001360	120	May 2013	-35.85	October 2013	-36.04	-0.19
GPR-21	-24.07706	28.992960	80	May 2013	-19.19	October 2013	-19.27	-0.08
GPR-22	-24.04843	28.976490	98	May 2013	-9.91	October 2013	-10.40	-0.49
GPR-23	-24.06190	28.983350	80	May 2013	-5.42	October 2013	-7.15	-1.73
GPR-24	-24.08203	29.00078	120	May 2013	-17.08	October	-16.36	0.72

Borehole No.	Co-ordinates WGS 84		Borehole Depth	Baseline vs Recent Water Level Reference				Δ Trend
	Latitude	Longitude	(mbgl)	Date Measured	Depth (mbgl)	Date Measured	Depth (mbgl)	
	0	0				2013		
GPR-25	-24.09218	28.997970	150	May 2013	-20.39	October 2013	-21.85	-1.46
GPR-26	-24.06174	28.979930	120	May 2013	-5.16	October 2013	-6.73	-1.57
BH04	-24.08378	28.96321	69	May 2013	-4.34	October 2013	-4.97	-0.63

7.12.5.1 Water Level Trends in the Project Area: 2012-2013

The water level trends in the Project area monitoring boreholes between March 2012 and August 2013 are illustrated in Table 7-34. These water level trends report on the current water use scenarios in the surrounding community area which is mostly abstractions for domestic and stock watering. The differences between the water levels for the period March 2012 to August 2013 indicate variations within ~1m with the exception of the following larger water table fluctuations:

- GPR-25 (~0.5km east of the Tshamahansi Village): 4.73 m (17.26 mbgl to 21.99 mbgl) which is probably due to local abstraction; and
- GPR-24 (in the Turfloop Granite Suite ~ 1km south of the proposed Rietfontein 2KS TSF site): 56.61 m (74.65 to 17.64 m). This significant water table rise is due to the extremely low hydraulic characteristics of the Turfloop granite and represents the actual water table recovery after drilling was completed to balance with the regional piezometric elevation.

This borehole is situated just east of the Tshamahansi community and could be impacted by local water use abstractions. The water level trend for GPR-23 is illustrated in Figure 13 it indicates a drawdown of ~5 m prior to a recharge event during the 2012-2013 hydrological cycle. Water levels towards the SW of the PSA report a long-term recharge event (+2.4m since August 2012) in this part of the aquifer system and demonstrate that the aquifer system, especially towards the SW, is currently not stressed (see Figure 7-29 GPR-18). This area is particularly sensitive due to the presence of the Rooisloot Alluvial aquifer system. The water level trends in the proposed mine infrastructure area respond to local impacts on the aquifer system, however observations report a 1 to 1.5m rise due to local recharge since August-September 2012 and December 2012, probably driven by the good rains in the area (Figure 7-30 and Figure 7-31 respectively for boreholes GPR-12 and BH-04). The aquifer is under stress further to the north and east as indicated by the regional groundwater level trend (see Plan 21, Appendix A). This illustration portrays the difference between the March 2012 and the August 2013 water levels for the PSA. Although the water trend in the PSA varies between declines of 0.5 m to a rise of 1.00 m, water levels towards the east (viz.

monitor sites GPR-04, -05, -06, -07, -10 and -25) are impacted and report drawdowns up to 5m during the dry season.

The water level behaviour in the PSA does not indicate long-term positive (recharge) or negative (recession) type trends and remains a healthy balance between local abstractions and annual recharge events although not in perfect harmony with each other (viz. Figure 7-32, GPR-01).

7.12.5.2 Regional Water Level Monitoring by Department of Water Affairs

Two current DWA regional water level monitoring stations are present within the Project area during the hydrocensus survey. The station numbers are MO3-3539 (A6N0083 – monitoring the Rooisloot Alluvial Aquifer) and MO3-2939 (A6N0587 - located northeast of Mahwelereng village, monitoring the Rooisloot River drainage), see Plan 20 (Appendix A). The monitoring boreholes are equipped with automatic water level loggers which record water levels every hour since October 2005 to date. Hydrographs for these two monitoring sites are presented in Figure 7-33 and Figure 7-34.

Water levels in M03-3539 (Rooisloot Alluvial aquifer) show a steady recovery in water levels since 2006 of 5 m which have recovered from 18.3 m to 13.3 m. The increase in water levels for this six year period represents a net recharge of the aquifer from indirect recharge from the Mogalakwena River system, direct recharge from rainfall and/or reduced groundwater abstraction. The water level curve indicates the presence of annual cyclic recharge, with no or limited annual discharge. The time series data indicates that water levels were lowered in excess of 13m from 1985 to mid-1996 (11 year cycle), due to probable excessive abstraction during a drought period.

Monitoring borehole number M03-2929 water level data indicates that there is a natural annual cyclic recharge and discharge pattern (see Figure 7-34). The recharge occurs during the rainy season (December to February), which corresponds to rainfall periods with a mean rainfall >100 mm/month (November to January) One month delay to recharge is observed after the rainfall period with a delay in water level response. The cyclical pattern is well pronounced from December 2006 to December 2010. Figure 20 indicates natural water level fluctuations of up to 2 m per annum under average rainfall conditions.

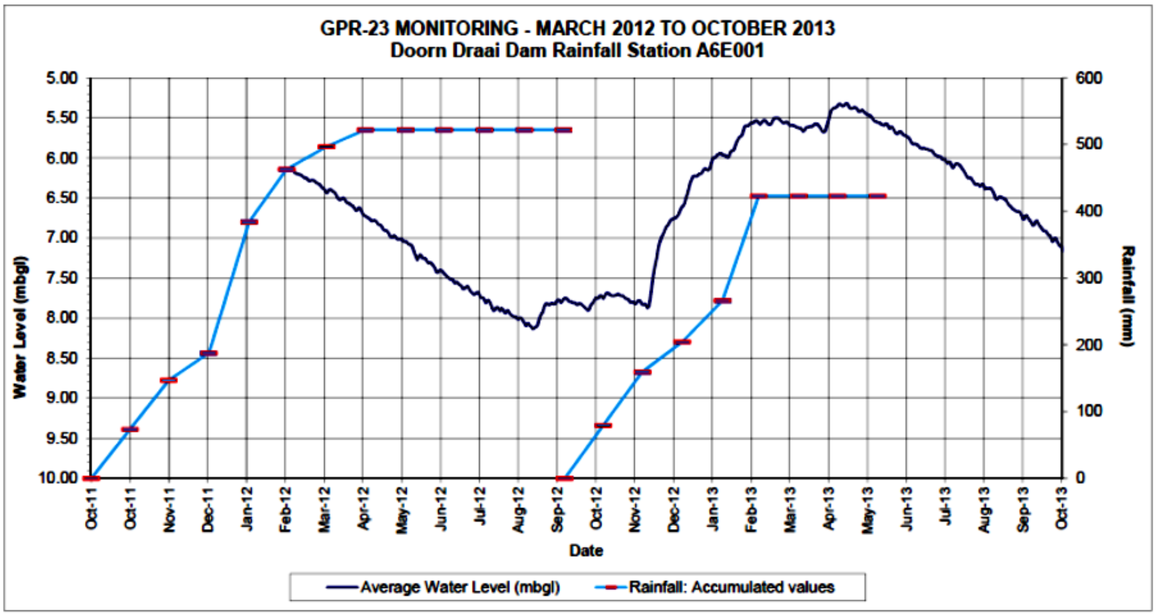

Figure 7-28: Groundwater level curve for PSA monitoring site GPR-23 (March 2012 – August 2013)

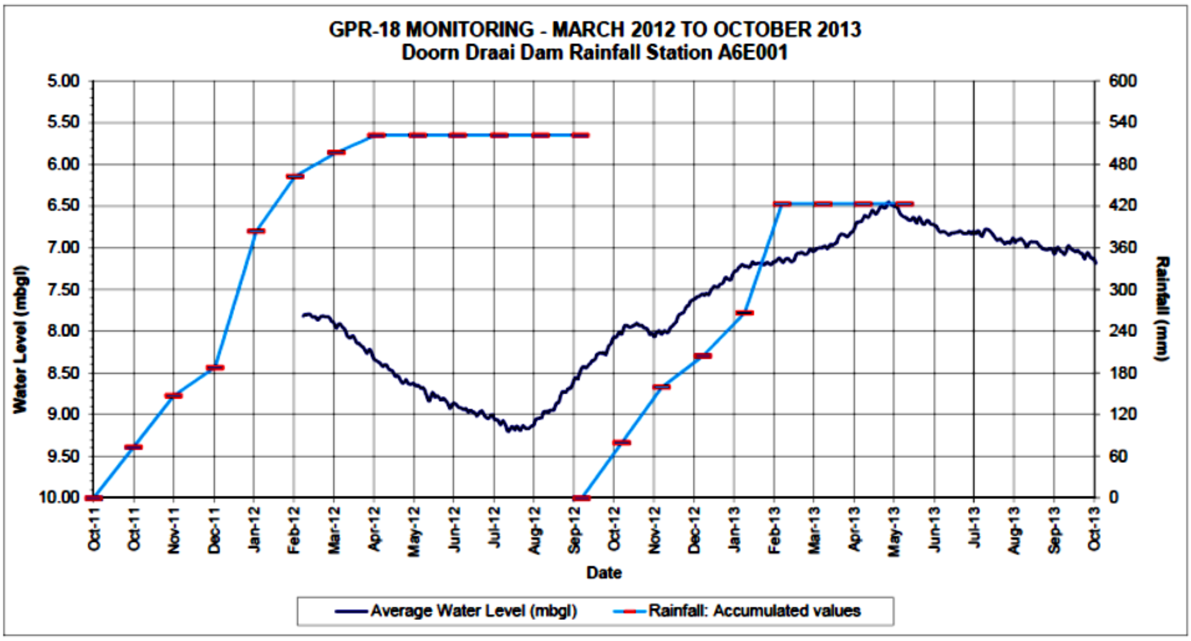

Figure 7-29: Groundwater level curve for PSA monitoring site GPR-18 (March 2012 – August 2013)

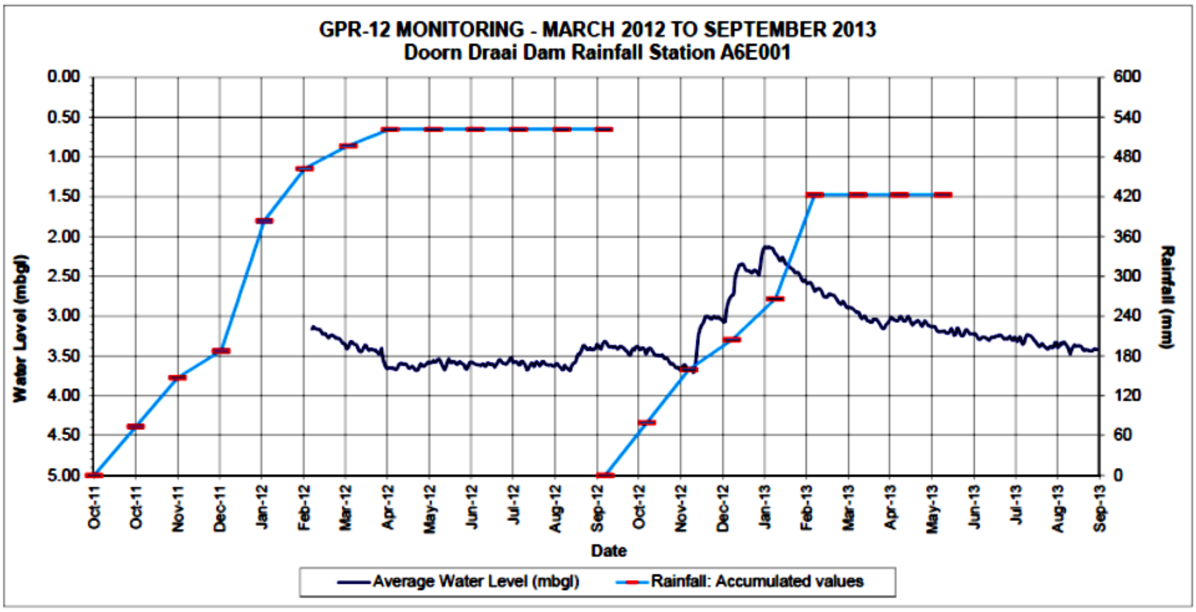

Figure 7-30: Groundwater level curve for PSA monitoring site GPR-12 (March 2012 – August 2013)

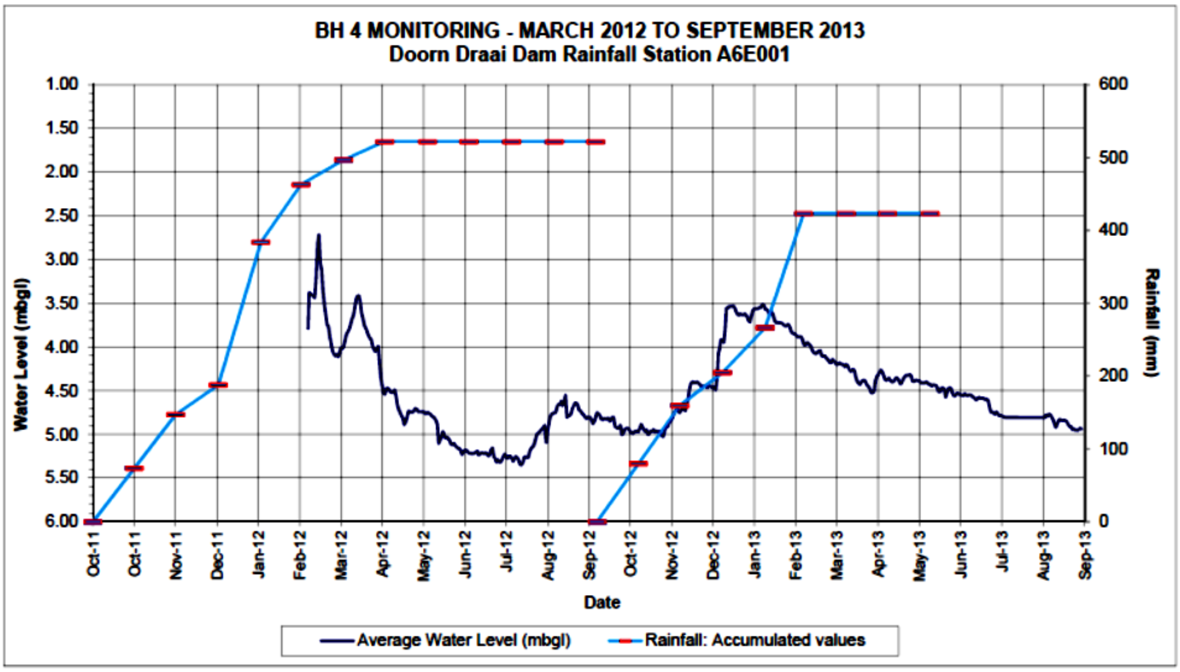

Figure 7-31: Groundwater level curve for PSA monitoring site BH-04 (March 2012 – August 2013)

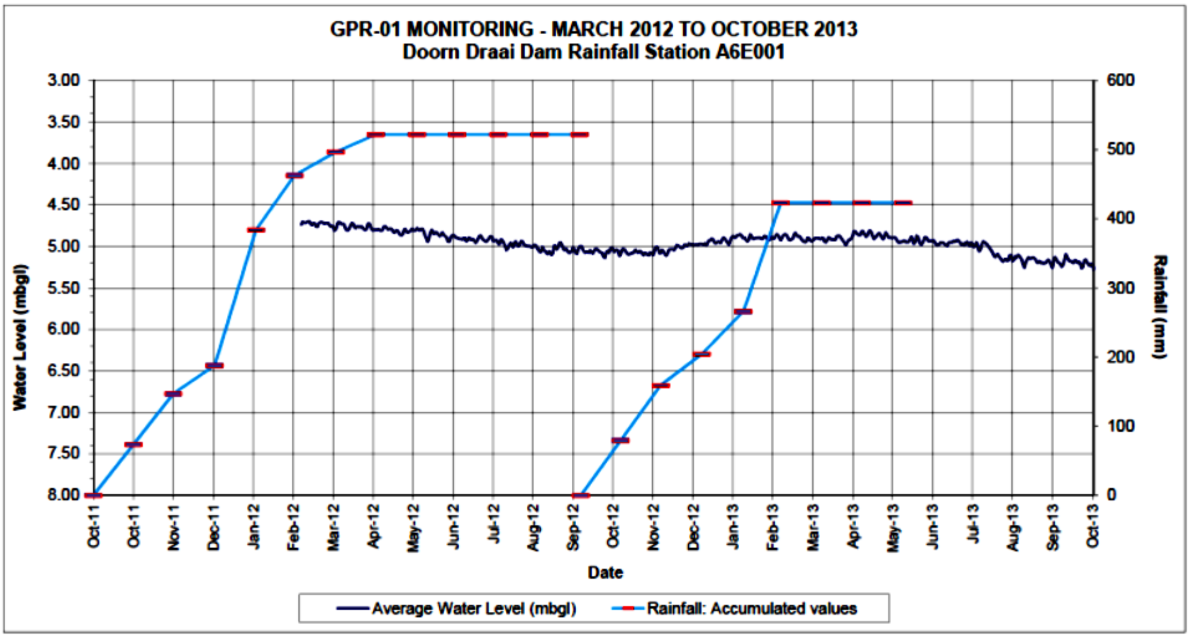

Figure 7-32: Groundwater level curve for PSA monitoring site GPR-01 (March 2012 – August 2013)

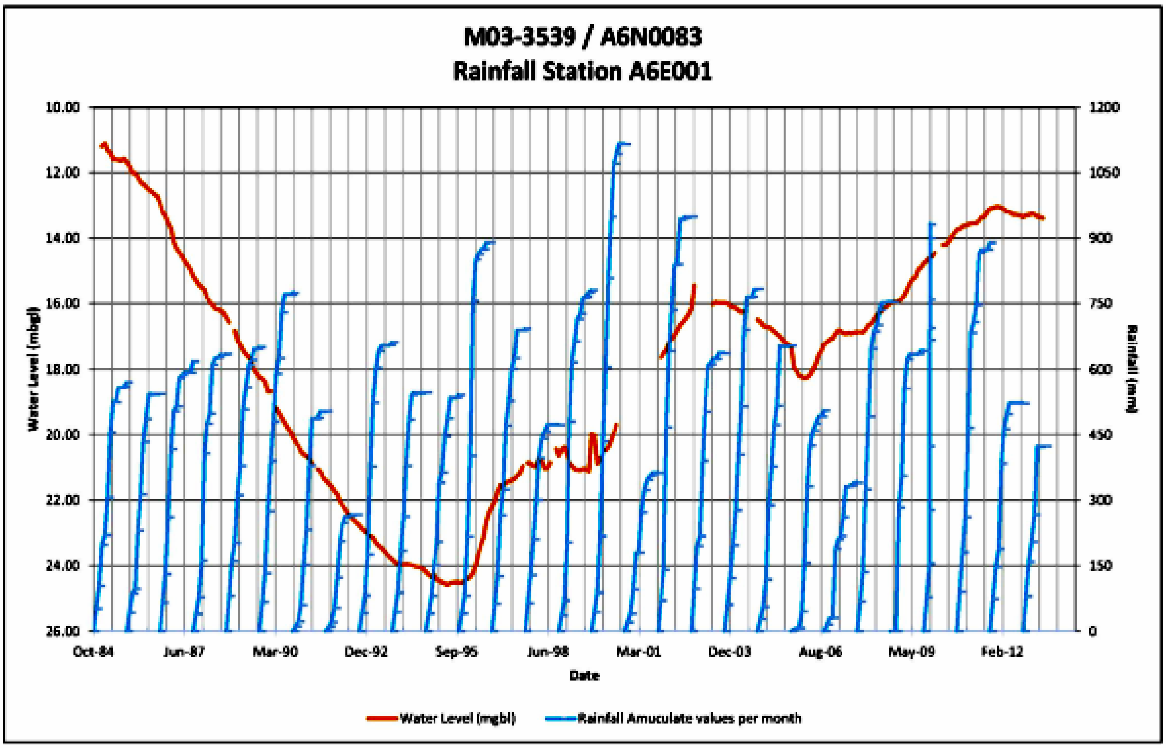

Figure 7-33: Groundwater level curve for DWA monitoring site MO3-3539 / A6N0083 (October 1984 – April 2013)

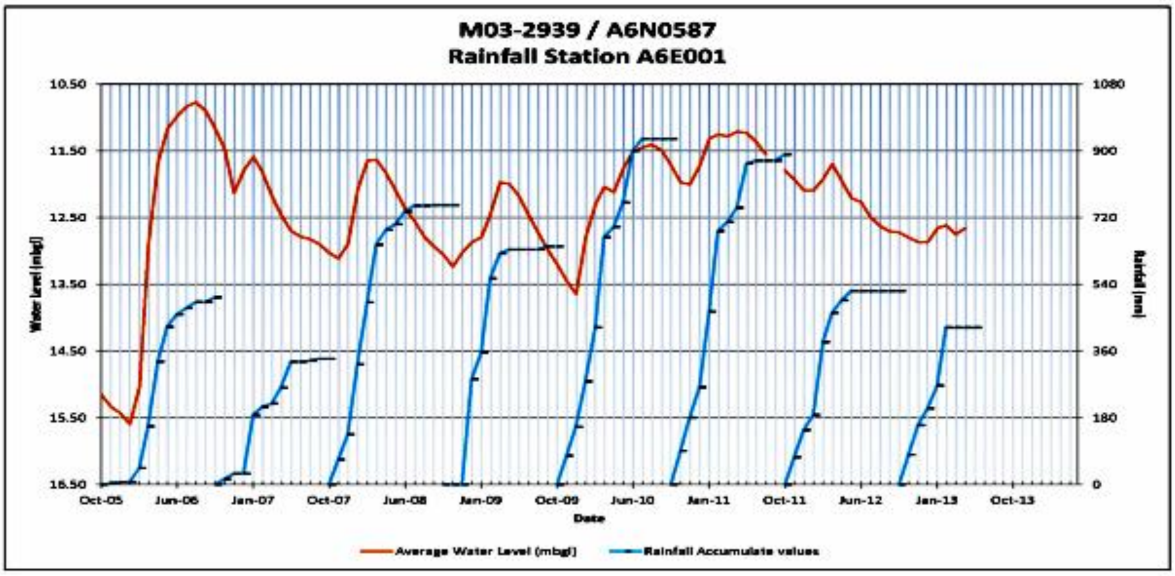

Figure 7-34: Groundwater level curve for DWA monitoring site MO3-2939 / A6N0587 (October 2005 – April 2013)

7.12.6 Groundwater Quality

The groundwater type for the Project area comprises predominantly of $MgHCO_3$ with mixing water types (no dominant ions). This is due to the geological mineralisation of the igneous rocks (RLS) which covers most of the Project area. Impacted water with elevated chloride and nitrate content are found either within the community settlements or downstream of the communities. Operational high yielding boreholes have elevated nitrate content due to high abstraction rates that draw pollutants from the surrounding or nearby community.

Summary water quality statistics are presented in Table 7-36, with the median value representing the baseline water quality for the Platreef Resources Project area.

Table 7-36: Baseline Groundwater Quality (including Hydrocensus data)

Item	Physical Parameters			Macro Determinants (Major Ions and Trace Metals)									Minor Determinant	
	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	SO_4 mg/l	NO_3 as N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l
No. of Records	106	106	106	106	106	106	106	106	106	106	106	106	106	106
10 Percentile	7.79	80	545	33	56	35	1.0	26	21	2.5	0.3	0.01	0.05	0.01
Median: Baseline Water Quality	8.09	125	898	52	91	81	2.2	87	41	20.7	0.6	0.01	0.05	0.01

Item	Physical Parameters			Macro Determinants (Major Ions and Trace Metals)									Minor Determinant	
	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	SO4 mg/l	NO3 as N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l
Average	8.06	140	975	64	97	104	5.1	117	64	31.2	0.8	0.01	0.20	0.04
90 Percentile	8.30	214	1500	108	138	206	7.2	224	143	66.1	1.4	0.01	0.05	0.06
Maximum Allowable Limit (SANS 241:2011)	<5 >9	<170	<1200	<300	<100	<200	<100	<300	<500	<11	<1.5	<5	<2	<0.5

The updated baseline groundwater reference for the Project area consisting of twelve monitoring sites, comprising of at least five quarterly sampling runs totalling 90 analyses, is listed in Table 7-37 with the median value representing the baseline water quality for the Project area.

Table 7-37: Groundwater – Quarterly Monitoring Sites, for the Project Area

Item	Physical Parameters			Macro Determinants (Major Ions and Trace Metals)									Minor Determinant	
	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Cl mg/l	SO4 mg/l	NO3 as N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l
No. of Records	90	90	90	90	90	90	90	90	90	90	90	68	68	68
10 Percentile	7.48	70.3	487	41.6	46.8	43.0	1.36	14.0	10.6	0.07	0.53	0.01	0.05	0.01
Median: Quarterly Water Quality	7.84	120.0	826	52.8	77.2	108	2.27	67.5	39.1	2.43	1.07	0.01	0.05	0.03
Average	7.85	122.3	856	59.3	79.6	127	2.54	83.1	65.1	3.87	1.24	0.02	0.07	0.07
90 Percentile	8.18	195.0	1410	83.7	112.0	285	3.64	162	184	8.41	2.31	0.05	0.09	0.13
Maximum Allowable Limit (SANS 241:2011)	<5 >9	<170	<1200	<300	<100	<200	<100	<300	<500	<11	<1.5	<5	<2	<0.5

7.13 Archaeology and Heritage

A Heritage Assessment report has been compiled and attached to Appendix O.

7.13.1 Geological Background and Paleontological Potential

Most of the development area is underlain by Precambrian igneous rocks of the RLS of the Bushveld Complex. The south-west section part of the property is underlain by the Molendraai Magnetite Gabbro of the Rustenburg Layered Suite. The south-eastern portions of the property are underlain by the Duitschland Formation and the Malmani Subgroup of the Chuniespoort Group. To the extreme south-east, a small section of the property is underlain by the Uitloop Granites of the Mashashane Suite. The Bushveld Complex is a layered igneous intrusion containing a large reserve of platinum group metals (Lee, 1996; Eales & Cawthorn, 1996). Associated with this complex is the RLS known to be the oldest mafic layered complex on earth (Wilson, 2012). As these rocks are Precambrian in age and of igneous origin it is unlikely that fossils will be affected. The Malmani Subgroup generally comprises dolomite, interbedded chert and shales, quartzite, and a variety of stromatolite structures. The dolomitic rocks this subgroup will contain stromatolites and will also have the potential to have sinkholes and caves which may have Quaternary deposits.

7.13.2 Archaeological and Historical Background

7.13.2.1 Makapansgat Valley World Heritage Site

The Makapansgat World Heritage Site (WHS) which is about 20 km east from the Project area is part of a group of sites that were nominated as a collection of sites that display the same or similar characteristics. This group includes sites such as fossil hominid sites of Sterkfontein, Swartkrans, Kromdraai and environs as well as the Taung Skull Fossil Site. The sites of Sterkfontein, Swartkrans and Kromdraai were inscribed on the World Heritage Site list in 1999 and received an extension in 2005 to include the Taung Skull Fossil Site and Makapansgat (UNESCO, 2013).

According to the United Nations Educational, Scientific and Cultural Organization (UNESCO) website, “Fossils found in the many archaeological caves of the Makapan Valley have enabled the identification of several specimens of early hominids, more particularly of Paranthropus, dating back between 4.5 million and 2.5 million years, as well as evidence of the domestication of fire 1.8 million to 1 million years ago” (UNESCO, 2013).

The sites as a whole were nominated to become UNESCO World Heritage Site according to the following criteria:

- Criterion (iii): The nominated serial site bears exceptional testimony to some of the most important Australopithecine specimens dating back more than 3.5 million years. This therefore throws light on to the origins and then the evolution of humankind, through the hominisation process.
- Criterion (vi): The serially nominated sites are situated in unique natural settings that have created a suitable environment for the capture and preservation of human and

animal remains that have allowed scientists a window into the past. Thus, this site constitutes a vast reserve of scientific data of universal scope and considerable potential, linked to the history of the most ancient periods of humankind.

- Integrity (2005): The Fossil Hominid Sites of Sterkfontein, Swartkrans, Kromdraai and environs together with Makapan Valley and Taung Skull Fossil Site comprise five separate components situated in different provinces and each has a buffer zone. Collectively these components contain the necessary evidence of sites where abundant scientific information on the evolution of modern humans over the past 3.5 million years was uncovered. Furthermore, the nominated serial site covers an area big enough to constitute a vast reserve of scientific information, with enormous potential.
- Authenticity (2005): As regards to authenticity, the sites contain within their deposits all of the key interrelated and interdependent elements in their natural palaeontological relationships. Thus, the breccia representing the cave fillings contains the fossilised remains of hominids, their lithicultural remains (from about 2.0 million years onwards), fossils of other animals, plants and pollen, as well as geochemical and sedimentological evidence of the conditions under which each member of the deposits was laid down. They represent a succession of palaeo-ecosystems. The caves, breccias and strata from which quantities of fossils or tools have been extracted, together with the landscape are generally intact, but are vulnerable to development pressures, villagers' use of the environment and tourism.

All the sites are protected as National Heritage sites in terms of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA). In terms of this legislation, no person may destroy damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of any heritage site without a permit issued by the heritage resources authority responsible for the protection of such site. The property size of the Makapansgat WHS is 2 220 ha, while the buffer zone extends 48 065 ha around the site according to the Government Gazette GR. 1197 of 2007.

7.13.2.2 Stone Age

Evidence suggests that the region surrounding the Project area has been inhabited during all periods of the Stone Age, which are the Early Stone Age (ESA), Middle Stone Age (MSA) and Later Stone Age (LSA). This is most evident and extensively documented at the Cave of Hearths in the Makapans Valley some 20 km to the east (McNabb & Binyon, 2004; Phillipson, 2005).

Previous impact assessments (Huffman, 1997; Fourie, 2002; Pistorius, 2002; Roodt, 2007; Roodt, 2008a; Roodt, 2008b) conducted within and surrounding the Project area have all reported stone tool scatters associated with the MSA and LSA. Fourie (2002) also reported on a possible ESA core found on the surface. These finds are commonly associated with water sources, such as rivers and pans. LSA stone tools are commonly associated with hunter-gathers, but are also known to occur with Iron Age communities.

Resounding rocks or "rock gongs" are features that are often associated with the San/Bushmen culture. These are natural occurring ironstone boulders which either rest on top of ironstone rocks or other rocks that have natural resonating qualities. While these features are natural and occur all over the country, not all show signs of human interaction and use. The area which was constantly beaten to produce sound shows a distinct difference in surface patina to the surrounding cortex of the rock. The rocks were either beaten by hand, other rocks or pieces of wood. The "rock gongs" were often used in rain-making rituals and medicine dances in which the concussive and resonating sound helps the shaman enter a trace like state in which he/she enters the "Spirit World" to conduct ritual activities (Ouzman, 2001).

7.13.2.3 Iron Age

Based on ceramic distributions as defined in Huffman (2007), the Project area may possibly produce sites that span from the Early Iron Age through to the Late Iron Age (LIA). Several *Eiland facies* ceramics have been identified in the region surrounding the Project area (WITS, 2010). Huffman (1997) identified two 'Moloko' settlements in the region dating to approximately 1500 CE – 1600 CE and several have been recorded by the University of the Witwatersrand. Based on these dates and ceramic distributions, these sites are likely associated with the *Madikwe facies* of the western Sotho-Tswana. It is also possible that these ceramics belonged to the Ndebele that also occupied the area but whose ceramics belonged to the *Letaba* or *Moloko* Traditions (Loubser, 1994). Sites recorded on the University of the Witwatersrand Archaeological Database (WAD) indicate that several Ndebele sites occur around this Project area. Ethnographically, the Ndebele of the region are divided into two groups with claims to similar origin in the north-west of Kwa-Zulu Natal. It is from here that they moved into the Gauteng and Limpopo region during the 16th – 17th century where they settled and subdivided into separate groups.

Metal smelting sites are prevalent within the North-West Province near Zeerust Rooiberg and the Waterberg region in Limpopo approximately 150 km south-west from the Project area (Boeyens, Küsel, & Miller, 1995). Evidence of iron, tin and copper smelting is present in these areas with smelting furnaces, tuyere pipe fragments and slag excavated from sites near Rooiberg, NW province (Miller & Hall, 2008).

7.13.2.4 Historical Period

By the 19th century, several local Ndebele communities occupied the region around the Project area, one of the most prominent being the Kekana. In 1837, the Boers arrived at Louis Trichardt marking the first contact between the Boers and Ndebele (Naidoo, 1987). During the latter part of the 19th century the Boers assumed control over the slave and ivory trade after the establishment of the town Piet-Potgietersrus (later Potgietersrus and today Mokopane) in the 1850's causing tension between the two groups (Tobias, 1945; Bonner, 1983; Delius & Trapido, 1983; Hofmeyr, 1988; Esterhuysen, Sanders, & Smith, 2009; Esterhuysen, 2010). Three incidents resulting from tensions between the Ndebele and the Boers culminated in the infamous Mugombane siege of 1854 at Historic Cave in the Makapans Valley (Tobias, 1945). After this siege in 1858 a second group of Ndebele, the

Langa of Hlubi (Nguni) origin under the Chief Mankopane, were attacked by a Boer expedition. Approximately 800 Langa Ndebele were killed. After their defeat, Chief Mankopane settled on Thutlwane Hill which is today located on the farm Kromkloof 744 LR, approximately 40 km north-west of the Project area (Jackson, 1969; Jackson, 1982). After these incidents, the Ndebele wanted nothing to do with Boers or Europeans. With regards to literacy, writing was seen as 'Boer business' and in 1864 the Ndebele refused to adopt it (Hofmeyr, 1991). Despite this, in 1865 the Berlin Mission Station was given permission to establish a mission under W. Moschutz at the foot of Sefakaola Hill (Macalacaskop) on whose summit resided the capital of Mokopane's chiefdom. Tensions between the Boers and Ndebele resulted in the mission station's abandonment and use by the Boers as a garrison where they could fire upon Mokopane's chiefdom, ultimately resulting in the destruction of the mission station. The mission was reoccupied in 1868 but in 1877, Mokopane exercised his authority and ousted the missionaries as he decided that it was a good vantage point for his enemies to spy on him. The chief erected an iron structure from the remains of the station as a symbol of his resistance to European interference. In 1890, Mokopane died and his successor was Lekgobo Valtyn. Valtyn's view of literacy was different to that of Mokopane as he embraced the idea of literacy and saw it as a resource that could be exploited (Hofmeyr, 1991) and therefore allowed the mission station to be rebuilt.

Also in 1890, a 'location' was unofficially established named after Chief Valtyn. By the early 20th century the Berlin Mission Society began to fence off portions of land which again caused tension between local inhabitants and Europeans resulting in what was termed 'The Fence War' (Hofmeyr, 1990). It was believed that Europeans were stealing land from local inhabitants. Plans for the official establishment and expansion of the location are evident in a letter dated 6 January 1937 between the Controller of Native Settlements and the Deputy Director of Native Agriculture, where it was discussed that the establishment of the Valtyn Location on the edge of Potgietersrus was intended to provide the growing town with a large cheap labour supply (National Archives and Record Service, 1996). Some measures at mitigating this tightening of control over the land in the area were attempted by Chief Kutter Seleka in the early 1930s. This included the proposed purchase of farms bordering the location, in order to try and extend the pasture for cattle. The farm Rietfontein was eventually bought with the aid of a bond taken out at the Transvaal Consolidated Land and Exploration Company (Ltd) (TCLEC) by Chief Kutter Seleka, and his followers. The bond was granted with interest set at 6%. Rietfontein was bought by the Kekana under Chief Seleka for a sum total of £1983 in November 1929 (National Archives and Record Service, 1996).

The present day settlements of Tshamahansi, Mahwelereng, GaMadiba, Maroteng and Masodi are situated on the three farms, Rietfontein, Turfspruit, and Macalacaskop that were originally expropriated from the local farmers.

7.13.3 Current Status of the Heritage Environment on the Project Area

The Project footprint area consists mainly of agricultural land, grazing land and road servitudes. These areas have been previously impacted upon due to agricultural and pastoral activities, as well as the construction of roads and exploration drill rigs. Medicinal plants that were identified during the fauna and flora report, as well as through consultation were found to occur across the Project area; however they are not endemic to the Project area. According to Dr Mohatla (the District Chairperson of Traditional Health Practitioners for the Waterberg Municipality), the plants are highly significant to the Traditional Healers within the community; however they can be sourced elsewhere.

The two archaeological sites identified at the proposed Operational Area (S.35-027) and the Alternative Plant area (S.35-106) share similar characteristics, such as a mixture of circular and rectangular stone foundations, and both sites are located in areas dominated with *Aloe sp*. While one site has monolithic stone walling and a "gong rock", it can be assumed that they were settled at the same time and both settlements may have been inhabited at the same time as they share similar characteristics. During times of peace, these sites with good access to grazing and agricultural areas would have flourished within the floodplains. Features such as "gong rock" are usually associated with hunter-gatherers; however this example may have had a role within the Iron Age/Historical community that resided in the settlement nearby (S.35-071). These sites may also have a link to the historical Ndebele that resided on Sefakaola Hill (Macalacaskop), the capital of Mokopane's chiefdom in 1854 approximately 5 km south from S.35-027 and S.35-071.

The smelting site identified at TSF location option 2 (S.35-006) may be a representation of a different group and time period, as the stone walling is different to that of the S.35-027 and S.35-071. Smelting sites are not common within the Mokopane region and this site has the potential to broaden the archaeological model of the Iron Age of the Limpopo Province. There are still community members within Tshamahansi who remember that a group was living in the hills behind the present day village and recall that they smelted iron.

Although no signs of settlements were identified within the TSF site 3 area, community members from Machikiri have strong cultural, historical and spiritual ties to the area due to their on-going rain rituals that are performed on the mountain to the east of the Project area and the collection of medicinal plants.

According to background research, the werf identified along the TSF location option 3 pipelines is a common representation of a typical structure that can be identified in the surrounding areas. Though it could not be fully accessed during the time of the survey and only a cursory assessment was conducted, it is already impacted upon by the Olifants River Water Resources Development Project and the N11 with its associated infrastructure. The werf may have historical ties to the Witvinger Nature Reserve as it is situated at the entrance to the reserve.

Burials identified within Project areas are mostly recent and are still connected to those inhabitants residing in nearby villages. They are part of the living heritage of the communities and are significant as shown by the comments made during public meetings. Community members still visit their ancestors as shown by various burial grounds showing signs of on-going maintenance

During the Heritage Impact Assessment (HIA) survey, a total of three archaeological sites, one historical werf and 55 burial grounds were identified within the Project areas. Areas associated with intangible heritage were identified within the TSF Option 2 and 3, the

Alternative Plant area and the Operational Area. All of these sites are located in proposed infrastructure footprint areas and will be impacted on by the proposed development.

7.14 Social

The social baseline discussed below has been developed from secondary information at a provincial, district, municipal and ward level. Where possible this information has been supplemented by information gathered during stakeholder consultations. The baseline provides an overview of the relevant socio-economic indicators of the Project area. A Social Impact Assessment (SIA) report has been compiled and is attached as Appendix P.

7.14.1 Land Claims

The Restitution of Land Rights Act, 1994, allowed individuals or groups to claim land from which they were previously dispossessed after 19 June 1913 following the passing of the Native Land Act. Claimants were given until 31 December 1998 to register a claim in terms of the Restitution of Land Rights Act. During this period approximately 80 000 claims were lodged throughout South Africa.

The Regional Land Claims Commissioner is responsible to verify the rightful claimant, validity of the claim, identify the beneficiaries and determine the extent of the land claim. This is the research stage of the claim. Once this has been completed, the claim is gazetted and therefore development on the land is at risk until the claim is settled. This therefore has development implications for land owners, as one may be exposed to risk if undertaking further developments on land on which a claim has been lodged.

According to the Mogalakwena IDP (2011/2012) 41% of land within the municipal area is subject to land claims, which is restricting it terms of spatial development (MLM, 2011). A land claims enquiry on the farms within the Project area and area of interest noted that there are claims on Turfspruit, Rietfontein and Bultongfontein (see Table 7-38). Claims for these properties are still pending on behalf of the Mokopane Trust and Mamahsela community as they still are in the process of being validated by the land commissioner (Matthews, 2012; MLM, 2012). At the time of the enquiry these land claims have not been gazetted and the status of the claims were '*research*' therefore the claims are still under investigation.

Table 7-38: Existing land claims

Farm	Claimant	KRP's	Status
Turfspruit 241 KR	Mokopane Trust	11524	Research
Rietfontein 02 KS	Mamahsela community	10046998	Research
Bultongfontein 239 KS	Mamahsela community	10046998	
Source: Office of the Regional Land Claims Commissioner: Limpopo, 14/04/2011; Matthews, 2012; MLM, 2012			

7.14.2 Land Ownership

According to the IDP (2012/2013) the MLM owns a substantial amount of land within the municipal area. The majority of the Project area is owned by the Government of the Republic of South Africa, but is identified as indigenous/traditional land. This means that the TA has jurisdiction over the land; however Government holds the land in trust for its people. Individuals residing in households located on this land are therefore not title deed holders or owners of their plots of land but have been given Permission to Occupy (PTO)[2] by either the headman or the chief. It needs to be noted that several factions within the community do not recognise the TA and/or the local chiefs. The implication of this is that any land agreement between the Project proponent and the traditional land custodian regarding land use, might be disputed.

An informal settlement located on land between Masodi and Tshamahansi was observed during a previous site visit; this settlement was referred to as Mzombane. Chief Kekana and many of the headmen interviewed noted that these occupiers are 'illegal' as the people occupying the land had not been given permission by either the headmen or by Chief Kekana and as such do not have a PTO over the land. The Mokopane TA is currently in legal proceedings to stop additional people moving onto this land.

The south-western section of the prospecting area overlaps with Mahwelereng (formalised township), which is a peri-urban area. Property and land ownership within this area is dictated under private tenure.

Land uses within the site-specific area include residential, agricultural and grazing uses, while land that coincides with the Project footprint is mostly used for agricultural and grazing, purposes.

7.14.3 Population

In 2011 the provincial population exceeded 5.5 million, of which almost 680 000 were located in Waterberg District and 308 000 in MLM. The population within the site-specific study area accounts for more than a third of the municipal population (see Table 7-39) (Statistics South Africa, 2013). These figures are not static, and will change depending on the natural population growth as well as migration into or out of these areas.

The annual population growth rate for the Municipal area was 1.1% in 2001; this rate is similar to the average provincial population growth rate for the same period. More recent estimates show that the average population growth rate dropped to 0.61% in 2007 and to 0.31% in 2011 (Statistics South Africa/StatsSA, 2001; StatsSA, 2008; StatsSA, 2013). Recent mining developments within the LM might result in additional population influx, while HIV/AIDS might have a negative effect on the total municipal population.

Population density indicates the potential pressure that human occupation might exert on natural resources and municipal service delivery. The national and provincial population density is just over 42.5 people per km^2; the Waterberg District has a significantly lower density at 15.2 people per km^2. The population density within Mogalakwena LM is almost 50 people per km^2 (see Table 7-39).

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[2]Permission to Occupy (PTO) is a form of leasehold whereby one may occupy land in custody of a traditional leader, and develop the land as mutually agreed.

The statistics presented in Table 7-39 shows that a large proportion of district population is concentrated within the urban centres and townships of the LM (Statistics South Africa, 2011). Therefore, it is expected that the population density throughout the site-specific study area will exceed the municipal average, seeing as this area includes several townships, informal settlements and low-cost housing areas (these areas are usually associated with a relatively high population density) (MLM, 2012).

The average household within Mogalakwena LM has 4.4 members (StatsSA, 2008). This figure conceals, however, a considerable degree of inter-household diversity: some households may have as many as 10 or more members (MLM, 2012; StatsSA, 2008). The 2011 Census data shows that since 2007 the average household size in both the Province and LM has dropped below 4 (StatsSA, 2013). This trend is attributed to the negative population growth rate, construction of more houses, and the effect of HIV/AIDS pandemic (MLM, 2012).

Table 7-39: Population statistics for 2001, 2007 and 2011

Study area	Pop/HH	Census 2001	HH Size	CS 2007	HH Size	Census 2011	HH Size
Limpopo	Pop	5 273 642	4.42	5 238 286	4.31	5 576 545	3.93
	HH	1 193 170		1 215 935		141 8103	
Waterberg	Pop	614 156	3.6	596 094	3.71	680 819	3.81
	HH	168 073		160 720		178 821	
Mogalakwena	Pop	298 440	4.26	330 644	4.39	307 683	3.89
	HH	70 077		75 313		79 080	
Site-specific	Pop	N/A	N/A	N/A	N/A	125 196	4.07
	HH	N/A		N/A		30 747	
Source: StatsSA, 2001; StatsSA, 2008; & StatsSA, 2013							

MLM has a very well defined and established development footprint. It consists of three proclaimed townships and 178 villages. There are no exact figures available for the directly affected villages; however, ward statistics derived from 2011 census data provides an indication of the number of people residing in the different wards coinciding with villages throughout the Project area. Table 7-40 shows that the approximate population for the Project area (wards 20 to 30) to be just more than 125 000. This population resides in just less than 31 000 households, with an average household size (4), which is similar than the provincial and local municipal average (StatsSA, 2013).

Table 7-40: Ward populations, 2011

Ward	Village(s)	Population
18	Machikiri and Ga-Mokaba	11 668
19	Ga-Kgobudi and Sekgoboko	8 555
20	Masodi, Tshamahansi, Magongoa, and Mzombane	10 237
21	Tshamahansi, and Mzombane	6 144
22	Masodi, and Ga-Kgobudi	9 421
23	Masodi	8 163
24	Madiba	12 156
25	Mosate, Maroteng, and Masehlaneng	10 981
26	Mahwelereng	5 956
27	Mahwelereng	9 456
28	Mahwelereng	12 595
29	Sekgakgapeng and Phola Park	11 441
30	Sekgakgapeng and Mosate	8 423
Site specific study area		125 196
Source: StatsSA, 2013		

According to the headmen consulted the population in most of the villages listed in Table 7-40 is increasing; they added that some villages are becoming so densely populated that plans have been made to expand residential areas into agricultural land. Madiba village was said to be expanding towards the north and Ga-Kgobudi was experiencing encroachment from the Mzombane informal settlement. The headmen attributed the increase in population to natural population growth and to a lesser extent to influx resulting from employment opportunities associated with mining.

7.14.4 Age and Gender Distribution

Age and gender are important socio-economic indicators of the labour-sending capacity of an area. Table 7-41 presents the gender distribution in the different study areas; and shows that females slightly outnumber males in Limpopo, Mogalakwena LM and the site-specific area (StatsSA, 2013). Figure 7-35 shows the age distribution in the study areas under consideration, and reveals that the majority of the population within these areas fall within the 15 – 64 year age bracket. This is indicative of a large potential work force (StatsSA, 2013).

Table 7-41: Gender distribution, 2011

Study Area	Male	Female
Limpopo	45%	55%
Waterberg	50%	50%
Mogalakwena	47%	53%
Site specific	48%	52%
Source: StatsSA, 2013		

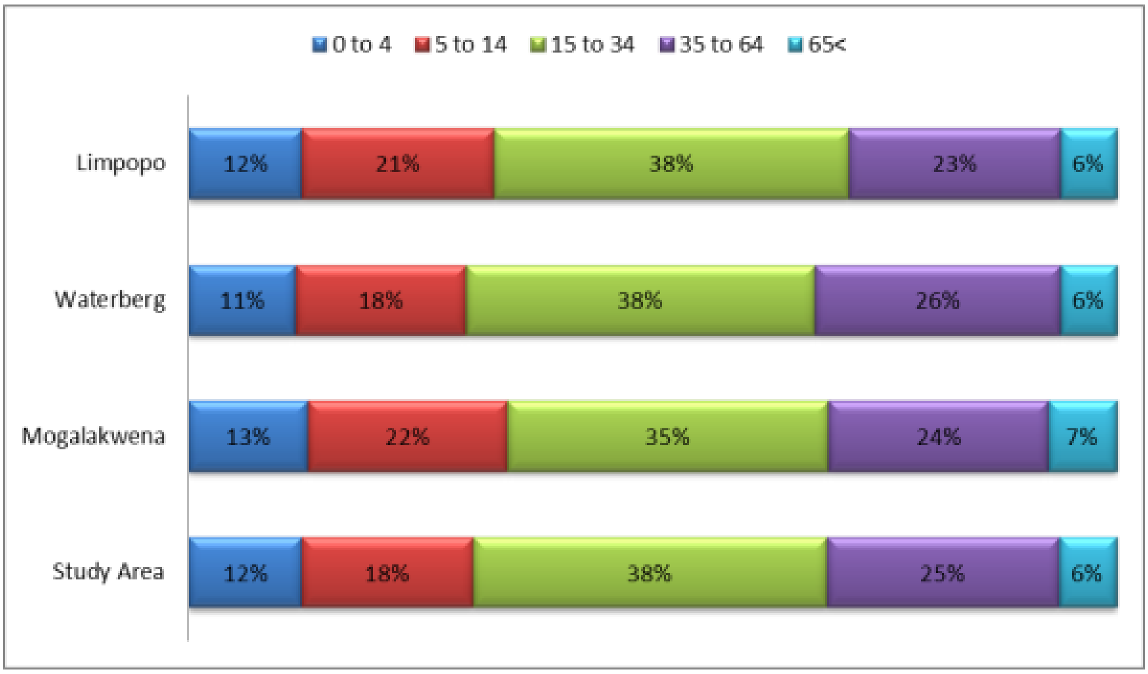

Figure 7-35: Age distribution

7.14.5 Language and Ethnicity

The most common home language within South Africa was isiZulu (30%) followed by isiXhosa (17.6%), Afrikaans (13.3%), Sepedi (9.4%), English and Setswana (8.2% each) (Statistics South Africa, 2001). In 2011 the dominant spoken languages within Limpopo, Waterberg, Mogalakwena and the site-specific study area were Sepedi followed by Xitsonga (see Table 7-42). A person's primary home language is also indicative of their ethnic grouping, which means that the dominant ethnic groups within the study areas are the Pedi and Tsonga. This trend was confirmed during discussions held with stakeholders, who indicated that the majority of people living in the area are Pedi, adding that Tsonga people mostly reside in Tshamahansi village.

Table 7-42: Language distribution, 2011

Language	Limpopo	Waterberg	Mogalakwena	Site-specific study Area
Sepedi	54%	58%	75%	61%
Xitsonga	17%	8%	9%	11%
Tshivenda	17%	1%	1%	1%
Afrikaans	3%	8%	3%	6%
Setswana	2%	12%	1%	1%
IsiNdebele	2%	4%	7%	13%
Sesotho	2%	3%	2%	4%
Other	3%	5%	2%	3%
Source: StatsSA, 2013				

When considering the racial distribution in the different study areas, it is clear that Black Africans constitute the majority of the population, with only a small representation of whites (StatsSA, 2013). Racial segregation characterises human settlement patterns in the local study area, with the white minority situated in Mokopane, and blacks residing in the rural settlements outside the town. Racial integration is gradually being achieved through some blacks moving from traditional black settlements to Mokopane; however this movement is limited to only a small number of wealthy individuals, with the poor majority remaining in rural communities. Hence, racial segregation is to a certain degree replaced by socio-economic segregation (MLM, 2012). This situation creates a need to speed up integrated human settlement in order to proactively address resultant social ills (such as crime, and skewed unsustainable development) (MLM, 2012).

Table 7-43: Racial distribution, 2011

Study Area	Black African	White	Other
Limpopo	97%	3%	0%
Waterberg	91%	8%	1%
Mogalakwena	96%	3%	1%
Site-specific	93%	6%	1%
Source: StatsSA, 2013			

7.14.6 Education and Skills Levels

Level of education attained is used as an indicator of human capital and is measured by the level of formal education among the adult population. The level of formal education is relatively similar in each of the respective study areas, with the population with no schooling being relatively high in each area (see Table 7-44). Only a small proportion of the adult population within each area have completed Grade 12 (14%-21%).

Table 7-44: Education Levels, 2011

Study Areas	Education Level					
	No schooling	Some primary	Primary	Some secondary	Grade 12	Higher
Limpopo	14%	28%	5%	33%	14%	6%
Waterberg	10%	27%	6%	34%	17%	6%
Mogalakwena	11%	29%	6%	35%	14%	5%
Site-specific	9%	25%	5%	35%	21%	5%
Source: StatsSA, 2013						

Table 7-45 shows the occupation categories in which the population older than 20 years were skilled in 2007; the table shows that the largest proportion of the population in each study area was engaged in elementary occupations, followed by those who are engaged in the craft related trades, and shop and market sales workers. These occupation types are usually associated with a relatively basic skill set, which is indicative of a lack of formal education or limited employment opportunities, or a combination thereof within the respective study areas.

Table 7-45: Occupation categories (15-65 years), 2007

Occupation	Limpopo	Waterberg	Mogalakwena
Elementary occupations	25%	24%	22%
Professionals	15%	12%	15%
Craft and related trades workers	14%	16%	15%
Service workers, shop and market sales workers	12%	9%	11%
Plant and machine operators and assemblers	9%	11%	9%
Legislators, senior officials and managers	8%	9%	8%
Clerks	7%	7%	7%
Skilled agricultural and fishery workers	5%	7%	7%
Technicians and associate professionals	5%	4%	6%
Source: StatsSA, 2013			

The Waterberg Districts skills development strategy lists several scarce skills that can be included in skills development programs to fast track local economic development (see Table 7-46)

Table 7-46: Scarce skills required within the Waterberg District, 2012

Sector	Scarce Skill	Number of Persons Required
Mining	Artisan (mining and electrical)	120
	Mining technician	90
	Machine operators	54
	Excavator	100
	Engineering manager	10
Tourism	Tourism Marketing	200
	Tour guides	1200
	Tourism information presenters	300
	Travelling and gallery	120
Agriculture	Agriculture Engineering	12
	Veterinary Medicines	45
	Meat processors	240
	Horticulturists	180
Source: WDM, 2012		

7.14.7 Workforce Characteristics

A sample survey of both skilled individuals and business enterprises was undertaken by Digby Wells in 2012 (DWE, 2012b). The primary purpose of this survey was to establish database of formal and informal businesses as well as skilled individuals within the Project's primary labour sending area. This section provides a brief overview of the findings of this survey. It is important to note that the statistics provided below do not necessarily agree with those provided above for the district, municipal and site-specific populations, as these reflect a biased sample of mostly unemployed persons who were able to participate in the survey. Nevertheless, these statistics are important, as they provide insight into that sub-set of the population that is most likely to constitute the local workforce for the Project.

7.14.7.1 Demographics

The age distribution of the registered individuals indicates that those who registered are relatively young, with 89% younger than 40 years. The gender distribution shows that female respondents (52%) slightly outnumber males (48%). The respondents are able to speak both English and Sepedi. A similar trend was found for the languages, in which respondents were able to read and write, with slightly more respondents endorsing English.

The survey asked respondents to indicate whether their residence is located within the 17 villages located near the Project area. It is crucial to note that in response, almost half (46%) of the respondents indicated that they were not from these villages, but from areas elsewhere in Mokopane, another 24% stated that they resided elsewhere in Limpopo Province.

7.14.7.2 Education and Physical Health

The survey findings showed that a small number of individuals (592) attained some primary education, the majority of these respondents completed Grade 7; an even smaller number of people who registered had no schooling. Approximately 8000 individuals did attain some secondary education, of these 55% passed matric and almost 20% of these passed Mathematics. A quarter of the individuals registered on the database attained some tertiary education, 92% of these attained a level 5 National Qualification Framework (NQF) qualification. Approximately 5% of all respondents indicated that they enrolled in a mining related training course such as welding, and operating mining equipment and heavy vehicles.

Three quarters of respondents indicated that they are able to undertake physically demanding activities on a regular basis for prolonged periods. Only 227 (3%) respondents indicated that they have a disability that significantly impedes their daily functioning; most disabilities were related to back or neck injuries.

7.14.7.3 Experience Related to Current and Past Employment

The majority (87%) of individuals who registered on the database are unemployed. It needs to be noted that some of the discrepancy between this figure and the unemployment rate (20%) in the census statistics can be ascribed to the fact that most of the employed would have had less motivation than the unemployed to register on the database. This scenario inflated the unemployment rate established during the skills survey.

Although a large proportion of the registered individuals are unemployed, most of them were previously employed and have some workplace experience. It was established that the majority of individuals were employed in the retail (12%), administration (10%) and service (10%) sectors. Another 7% of individuals were previously employed in the mining sector. Almost 60% of registered individuals indicated that they have more than one year experience in their previous employment sector.

Only 13% of registered individuals were either engaged in permanent or part-time employment. Current employment was mostly concentrated in the service (12%), retail (12%), government (8%), administration (8%) and mining (8%) sectors. With regards to work-related experience just less than 70% of the employed indicated that they have more than one year experience in their current employment sector (see Table 16).

In general work related experience for both the employed and unemployed is limited to the service and retail industries. Only a small proportion of individuals was or still is employed in the mining sector.

7.14.7.4 Employment Positions

The survey collected detailed information on the types of positions that respondents occupied at the time of the survey or the positions that they occupied during previous employment. Due to the relatively small number of respondents employed in each position, most of the following tables provide the actual number, rather than the percentage of individuals employed in each position.

7.14.7.5 Mining-related Employment

This section presents the number of respondents that are or were employed in mining related positions. A total of 225 respondents have been involved in mining related occupations. Most of these respondents (57) are or were employed in surface infrastructure positions, while a relatively large number of respondents were employed in positions related to engineering (26), underground production (29), opencast mining and metallurgical plants (39). The majority of these individuals were employed at an operator (36%) and assistant level (27%), while smaller groupings were employed as team members or supervisors.

7.14.7.6 Other Employment

The majority of respondents indicated that they were or have previously been employed in non-natural resource sectors Table 7-47 presents a summary of employment within these sectors; the table shows that a considerable number of respondents were employed within the administrative and construction sectors.

Table 7-47: Positions outside the mineral sector

Employment position	Number
Administration or secretarial	370
Building and construction	298
Teaching	104
Accounting and Finance	92
Healthcare	79
Government related employment	65
Community development	57
Mechanical	45
Human resources	13

7.14.7.7 Business Sector

A total of 537 respondents registered their businesses on the database. Unlike the residency of those registered on the skills database, the results derived from the business survey, showed that a larger number of businesses are located near the Project area. Most businesses specialise in building and construction (20%), providing services (12%), and catering (10%). Approximately 25% of these are located in Mahwelereng Village, and have been trading for more than three years. Nearly 80% of businesses are registered as Close Corporations, while only 5% were informal or unregistered businesses.

Most businesses indicated that they employ less than 5 employees, only 35% indicated that they employ 5 to 19 employees; another 12% of businesses indicated that they employ between 20 and 99 people. In most instances the demographical composition of staff proved to be representative of both youth and females.

Only one third of registered businesses indicated that they are involved in contract work. These businesses mostly specialise in the construction, service provision, and supply sectors. Of the businesses regularly involved in contract work only 49 (13%) have experience in mining related work; types of mining contracts include catering, maintenance, construction, service provision, and supply. Just less than a third of all business enterprises indicated that they provide some kind of engineering service; of these, the majority (59%) provide civil engineering services such as construction and earthworks.

7.14.8 Economic Overview

Limpopo Province contributed 6.5% to the South African Gross Domestic Project (GDP) in 2006, which at that time made it the sixth largest provincial contributor, Gauteng being the largest contributor (33%), followed by KwaZulu-Natal (16.5%) and Western Cape (14.5%) (Urban-Econ, 2006).The sector contribution to the district and municipal GDP in 2006 is shown in Figure 7-36. Figure 7-36 shows that the mining industry was the dominant contributor to the economy of the Waterberg (53%), followed by the finance sector (13%). This shows that the Waterberg economy has a relatively low level of diversity with a strong reliance on mining. In contrast, Mogalakwena's economy is more diverse with three dominant sectors, finance (21.8%), mining (21.7%) and services (18.2%). Although the tourism and agricultural sectors are underdeveloped, they have the potential to contribute significantly to the local economy.

In Mogalakwena the majority of economic activities are centred within the Mokopane/Mahwelereng area and this area is expanding at a rapid rate. This growth is attributed to the response to the needs and demands of the lower income areas. The envisaged expansion of the platinum mining sector will likely accelerate this growth. The IDP notes that there is sufficient land available for the foreseen business development. However, in the light of Mokopane's role as regional centre and its economic profile, the Central Business District (CBD) should be allowed to respond to increased demand from regional business facilities.

The so called "second economy", which is defined as an economy that is mainly informal, marginalised, unskilled, and populated by those who are unemployed in the formal sector, makes up a significant component of economic activities in the site-specific Project area and a particularly important contribution to the livelihoods of the poor. These are people who are caught in a poverty trap, unable to benefit in the growth in the first economy, and limited in their ability to access opportunities provided by development assistance initiatives (DWE, 2012b; MLM, 2012; WDM, 2012).

The second economy is mostly driven by informal enterprises undertaken by the self-employed, micro-entrepreneurs, street trading and other informal business activities (MLM, 2013). Activity in the informal sector is mostly located within the rural areas and townships; several of these areas coincide with the proposed mining area. There are a number of roadside and off-road businesses clearly visible from the N11, which runs through the middle of the site-specific study area.

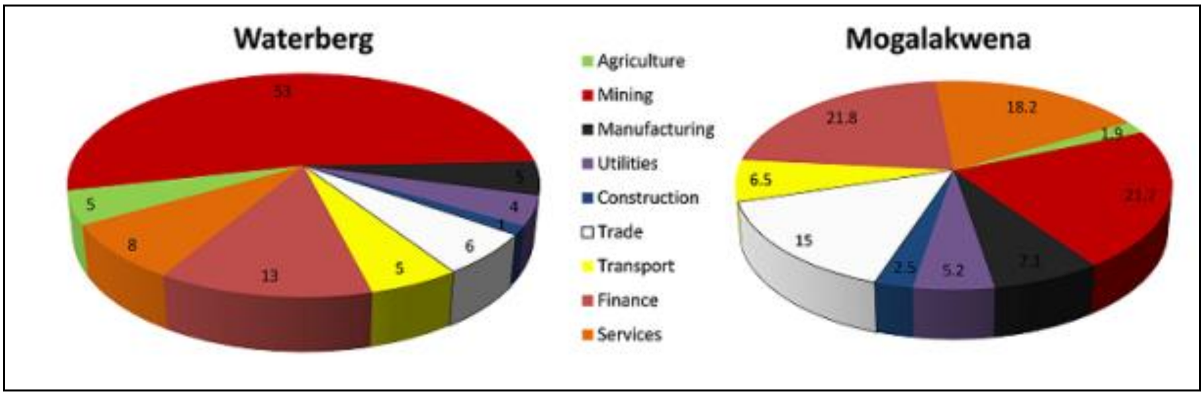

Figure 7-36: Sector contribution to Waterberg and Mogalakwena economy, 2004 (Source: Urban-Econ, 2006 (taken from Quantec Research, 2006 and Urban-Econ, 2006)

7.14.9 Mining

The mining sector contributed just more than R 87 billion (7.1% of GDP) to the national economy in 2004 (Urban-Econ, 2006). The mining sector is similarly an important contributor to the provincial, district and municipal economy, making up 57.5% of the provincial GDP in 2010 (Waterberg, 2010; WDM, 2012). Waterberg DM acknowledges the mounting importance of mining to local economic development within intensive mining areas, such as Mokopane, Lephalale and Northam -Thabazimbi (Waterberg SDF, 2009).

Major mining activities in the Waterberg include the extraction of coal and platinum. The coal resource in the Waterberg field is estimated at 76 billion tonnes, which is more than 40% of the national resource; coal operations are mostly concentrated in Lephalale. The Waterberg District is also host to 70% of the provincial platinum reserves; these resources are mostly concentrated in the Mogalakwena and Thabazimbi LMs.

As a result the Mogalakwena Municipality houses a number of mines (see Table 7-48).

The mining industry contributes considerably to the economic development within the Province and District and is a major source of employment in the municipality. Although mining offers a vast contribution to socio-economic development to the site-specific area, it also poses constraints to urban development and growth (Waterberg SDF, 2009). The Spatial Development Framework (SDF) for the district notes that apart from one or two protected areas there is no direct conflict between mining and major tourism and conservation areas.

Table 7-48: Mining Activities within Mogalakwena Local Municipality, 2010

Mine/Project name	Type of mine
Mogalakwena Platinum Mine	Platinum
Vanadis Project	Vanadium bearing magnetite deposits
Haaspan Granite (Feasibility)	Granite mining
Platreef Project	Re-evaluating and mining of platinum resources
Kadikgathlo Stone Crusher	Stone aggregates from dolerite boulders
Matlala Stone Crushers	Stone aggregates from dolerite boulders
Bestaf Granite	Granite stone
African Red Granite	Granite stone
Lonmin (Feasibility)	Platinum
Babirwa Tshabang Tlala cooperatives	Pebble collections
Setlhatlha Sand Mining	Sand Mining

7.14.10 Tourism

Tourism contributes considerably to the South Africa's economy; the World Travel and Tourism Council estimates that the South African Travel and Tourism sector accounted for 7.1% of South Africa's GDP in 2002 (R72.5 billion) employing 1.5 million people (Urban-Econ, 2006).

Limpopo Province and the Waterberg District are well-known for their nature and outdoor tourism, similarly the municipal area also offers a range of nature orientated tourism activities (Urban-Econ, 2006). Tourism is therefore an important contributor to the GDP and economy of especially the local study area. The Waterberg SDF closely links tourism and conservation in the form of eco-tourism, for which the balance and co-existence with agriculture, mining and urban development is very important. The two most well-known tourism sites in the municipality include the Waterberg Biosphere Reserve and the Makapan World Heritage Site (WDM, 2012).

The Waterberg Biosphere Reserve forms part of the World Network of biosphere reserves, registered with UNESCO. The Biosphere Reserve is also the first savannah biosphere reserve registered in Southern Africa. The Makapan Caves (Valley) is a historic area in the Mogalakwena LM and its World Heritage Status has been approved by UNESCO (MLM, 2012).

There are also several nature reserves within the Mogalakwena Municipal area namely: Marekele National Park, Wonderkop (16 100 ha), Masebe (4 540 ha), Moepel (27 500 ha), Witvinger (4 450 ha) and Percy Fyfe (2 990 ha). According to the Mogalakwena LED Strategy tourism opportunities within the municipal area have not been fully exploited and can be enhanced to provide benefits for local communities (MLM, 2012). One of the sites, which Platreef is considering as a TSF option, does overlap partially with Witvinger Reserve, but apart from this the Project footprint does not coincide with any current tourism land uses.

7.14.11 Agriculture

7.14.11.1 Agriculture in the Regional and Local Study Areas

The Waterberg District Municipality's SDF notes that the district has relatively low agricultural potential. Despite this, agriculture remains an important economic activity for the district's vulnerable households (Waterberg SDF, 2009). Maintaining a prosperous and healthy agricultural community is therefore still important for the district economy.

Waterberg District accounts for almost 30% of agricultural activity in the province, these activities contributes to 4% of the District's Gross Geographic Product (GGP); the sector also employs around 21% of the district's labour force. Although named the 'Waterberg' the district is classified as a semi-arid area with poor water resources. For crop farmers there has been a dramatic change in many commodity prices leading to changes in cropping patterns. Crops such as cotton, tobacco, maize and sorghum have been negatively affected by low international prices and over production. Consequently plantings have reduced significantly, often with negative financial and employment implications (WDM, 2012).

Agriculture is the dominant land use within the municipal area relying on over 80% of municipal land; this is in contrast to its low sector contribution to GGP (Urban-Econ, 2006). Mostly the contribution to the GDP is derived from commercial farming activities, with the most significant agricultural commodities being maize, wheat and cattle (Urban-Econ, 2006). Other agricultural crops cultivated in the municipal area include peanuts, sorghum, sunflower, cotton and tobacco. Vegetable products include potatoes, onions, tomatoes, melons, pumpkin, beet, carrots, cabbage, spinach and butternut, while fruit products are limited to oranges and grapes. There is also livestock, poultry and piggery farming with potential for game and goat farming. A survey undertaken by Mara Research Station indicates a significant shift from cattle farming to game farming throughout the Province (MLM, 2012).

According to the Mogalakwena IDP (2012/2013) agriculture is important to rural villages throughout the municipal area. Their practices differ according to the region where they are situated, with villages in the mountainous areas focused on cattle farming and villages on plains focussed on crop farming; villages in the site-specific Project area fall into the latter class. The IDP (2012/2013) notes that agricultural involvement appears to be declining; this decrease is attributed to a possible stronger dependence on other resources such as social grants and remittances. During an agricultural survey it was also established that the majority of individuals involved in farming are older community members, with the younger generation preferring formal employment opportunities for sustainable growth of wealth. Nonetheless the municipal LED Strategy suggests that agriculture should be prioritised as an important economic sector (MLM, 2012; Urban-Econ, 2006).

7.14.11.2 Agriculture in the Site-specific Study Area

With regards to the site-specific study area, the dominant land capability is arable supplemented by grazing. The agricultural potential is high due to the combination of average to medium regional rainfall and deep soil present. A considerable proportion of the land within the site-specific Project area is used for subsistence crop and animal farming.

7.14.11.2.1 Agricultural Plots, Harvesting Patterns and Yields

The survey conducted showed that it is common for individuals to own more than one plot. The majority of respondents (72.5%) cultivated their plot during the 2010/2011 season. Most farmers indicated maize as their primary crop; maize was intercropped with watermelon, groundnuts, beans, sweet potato and pumpkin.

The survey found the average maize yield to be around 1 200 kg per plot, which would equate to a yield of 1 600 kg per ha. Research carried out by Panaar Seeds indicates that subsistence agricultural environment (rain fed, no fertiliser, and no pesticide situation), such as the one in the study area, would yield on average 1 000 kg – 1 500 kg maize per ha (Mpangane *et al.,* 2004).

The survey found that yields for secondary and tertiary crops grown are in line with the planting of very small amounts. For example the average yield of watermelon indicated by the respondents is consistent with the growing of 5 to 10 plants utilising a probable land area of around 10 m² maximum.

7.14.11.2.2 Grazing Capacity

Designated communal grazing areas in the site-specific Project area bear evidence of overgrazing and consequent bush encroachment. This observation is borne out of the livestock numbers supplied by the community and the areas of grazing, which were assessed as part of the agricultural survey.

In general, grazing areas in the Project area would not be able to compete with the South African average. Based on available information, including bush encroachment and overgrazing mentioned above, the carrying capacity of grazing areas in the Project area is estimated to be between 0.16 and 0.2 LSU per ha. In properly managed grazing areas, utilising the accepted norm of around 0.33 LSU per ha, the declared livestock numbers would require grazing area of approximately 3 332ha.

7.14.12 Employment and Income

7.14.12.1 Employment

Job creation and the high rate of unemployment are some of South Africa's hallmark challenges, with many development strategies aimed at job creation. As shown in Table 7-49 the employment rates within Limpopo, Waterberg, Mogalakwena and the site-specific area are very low. The high proportion of the population that is not economically active indicates a very high dependency ratio, with almost three quarters of the population supported by less than a third who are employed. This has serious consequences for the economy of these areas.

The low employment rate reflected in the census data for the site-specific study area was confirmed by local community members consulted during this study, and was identified as a major concern. Survival strategies in the face of high unemployment rates include widespread dependence on social grants, as well as regular commuting of women to residential areas in Mokopane and elsewhere, where they work as domestic workers (Sanral, 2012). The community also reiterated their expectations regarding employment and procurement opportunities that will result from the Project.

Table 7-50 shows the major employment industries within each respective study area. Community, social and personal services provide a considerable proportion of employment, followed by the wholesale and retail trade sectors. The fact that the wholesale and retail sectors are relatively large indicates that most of the economic activity occurs in urban areas. Mining and quarrying is another important employment sector, as it supports 19% of jobs throughout the district.

Table 7-49: Employment Status, 2007 (15-65 years), 2007

Area	Employed	Unemployed	Not Economically active
Limpopo	28%	19%	53%
Waterberg	29%	19%	51%
Mogalakwena	28%	17%	55%
Site-specific	34%	20%	47%
Source: StatsSA, 2008			

Table 7-50: Industry of employment (15-65 years), 2007

Industry	Limpopo	Waterberg	Mogalakwena
Community, social and personal services	27%	19%	27%
Wholesale and retail trade	19%	16%	19%
Manufacturing	13%	11%	17%
Agriculture and hunting	12%	14%	8%
Financial and business services	9%	8%	9%
Construction	7%	8%	7%
Mining and quarrying	7%	19%	7%
Transport, storage and communication	4%	4%	5%
Water and energy services	1%	1%	2%
Source: StatsSA, 2008			

7.14.12.2 Income

In order to determine people's living standards as well as their ability to pay for basic services such as water, sanitation and health care, the income levels of the population are analysed and compared to the provincial average. Figure 7-37 shows the income categories by gender in each study area. It is notable that women tend to earn less than men in all areas. The largest gender discrepancy exists in the Waterberg region, with 57% of women having no income compared to the 41% of males who have no income. Another considerable difference in income between genders is noted for the R801 to R3 200 income bracket.

There is also a slight gender discrepancy in the study area, where 55% of the female population do not have any income compared to only 46% of males who do not receive any monthly income. The chart shows two kinds of inequality: gender inequality and financial inequality. South Africa is one of the most unequal countries in the world and thus one would expect a high Gini-coefficient in its municipal areas (Statistics South Africa, 2011). This is true for the site-specific study area, where a large number of people earn nothing and only a small proportion earn over R12 801 per month.

Figure 7-37 corroborates the generally low level of education throughout the study area (see Table 7-44), as income earned by low-skilled labourers is lower than income earned by highly skilled workers. Since education levels are low, income earned is concentrated in the lower brackets, which suggests that poverty might be a major problem in each of the respective study areas.

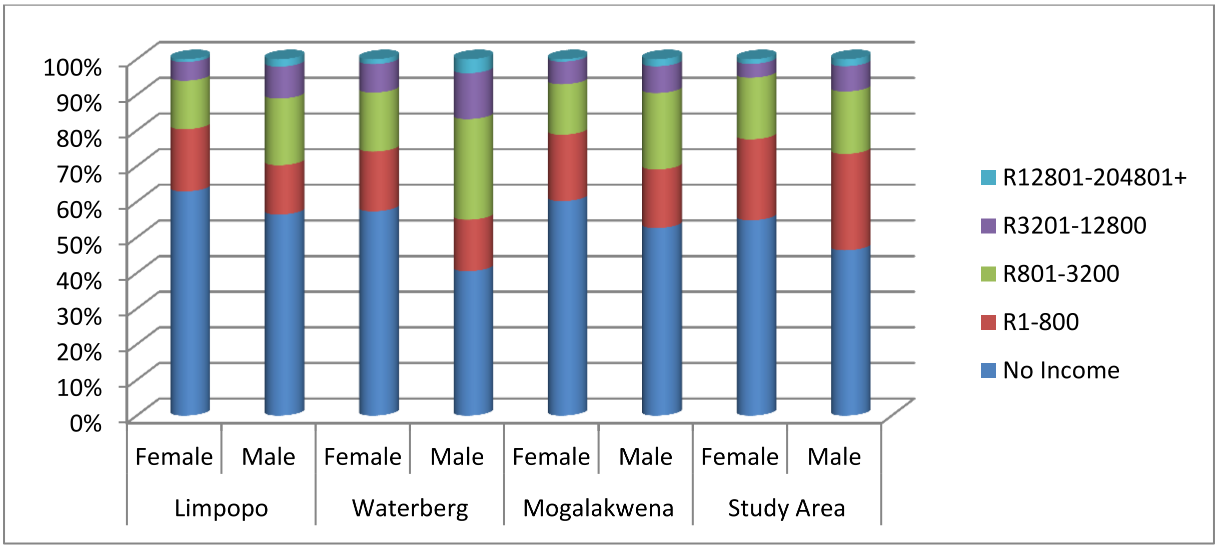

Figure 7-37: Monthly income by gender, 2007

7.14.13 Poverty and Vulnerable Groups

People can be classified as vulnerable for a number of reasons according to the IFC, vulnerable groups are people who by virtue of gender, ethnicity, age, physical or mental disability, economic disadvantage, or social status may be more adversely affected by Project impacts than others and who may be limited in their ability to claim or take advantage of Project related benefits (IFC, 2006). The most common groups identified as vulnerable are children, the elderly, child or female headed households, the poor and the disabled. Low education levels and high unemployment rates also can increase individual and household vulnerability. The low average monthly income in each respective study area combined with the high dependency ratio and unemployment rate in these areas will likely increase the vulnerability of any households that might in future be affected by the Project.

The Mogalakwena IDP (2012/2013) states that, "*one of the key social problems facing the Mogalakwena Municipality is poverty*". In particular the IDP notes that women, especially women living in rural areas, are the most affected by lack of job opportunities and other social issues such as access to education, role in society and economic opportunities. These factors together with the high prevalence of HIV/AIDS and the number of households, which are indirectly, affected by the disease increases the vulnerability of a significant number of families in the site-specific study area.

South Africa has a social grant system to assist poor and vulnerable households. Grants are administered through the South African Social Security Agency (SASSA). The highest proportion of people receiving grants is amongst the local municipal population, where just more than a third of individuals receive some type of grant (StatsSA, 2011). This figure has almost doubled since 2001, which suggests a premature inclination towards welfare instead of developing sound institutions for education and subsequent employment (StatsSA, 2011).

Table 7-51 provides a breakdown of the type of grants provided by the government (StatsSA, 2013). Of the people receiving grants an overwhelming majority (68% in WDM and 67% in MLM) receive grants for childcare, which to a certain degree compensates for the difference between females and males with respect to monthly income.

Table 7-51: Social Grants per person, 2011

Type of grant	Study area		
	Limpopo	**Waterberg**	**Mogalakwena**
Child support grant	69%	68%	67%
Old age pension	22%	22%	23%
Disability grant	6%	8%	7%
Other grants	2%	2%	2%
Source: StatsSA, 2011			

In addition to the social grant system, the South African government provides free basic services to impoverished households. In 2009, approximately 70 000 households within MLM were provided with free basic services (WDM, 2012). If one takes into consideration that the municipality hosted almost 80 000 households in 2010, it becomes clear that almost 90% of households within the municipal area are considered ‘poor’ (pronounced deprivation of well-being) (Houghton & Khandker, 2009) as they qualify for free basic services.

7.14.14 Service Delivery and Civil Infrastructure

7.14.14.1 Free Basic Services

The Constitution of the Republic of South Africa, 1996 (Act 108 of 1996) endows all South Africans with basic human rights, including the right to access basic infrastructure and services. Free Basic municipal Services (FBS) are provided by the government to those households who are unable to afford basic services; these services are assumed to be sufficient to cater for the basic needs of a poor household (MLM, 2011; WDM, 2012).

The number of households within Mogalakwena LM benefiting from FBS increased from 1982 to 2538 between 2011 and 2012; implying that more impoverished units have been provided with free services since 2011. This can indicate two scenarios; (a) there are more impoverished households, and/or (b) the municipality were able to increase their capacity to provide FBS to households, which could not be provided for in the past. It needs to be noted that the provision of free basic services puts a large financial burden on the Mogalakwena LM.

7.14.14.2 Electricity

The supply of electricity to households throughout the country is central to governments' aim of improving quality of life throughout South Africa (SA Handbook, 2011). The cost of energy in South Africa is amongst the lowest in the world (as a result of a heavy reliance on coal power); however, the demand is growing due to increase in macro-economic activities and industrialisation (SA Handbook, 2011). The demand for electricity is expected to double over the next 20 years, which will require immense infrastructure upgrades and developments. Eskom has recently announced that they also increase the cost of electricity considerably over the next couple of years. The expected increase in the cost of electricity will make this service unaffordable for a large number of impoverished households, which will in turn increase the dependence on FBS, as well as dependence on alternative energy sources.

The majority of households within the Province have access to electricity for lighting purposes (see Table 7-52). Candles were the second most common source of energy used for lighting in the site-specific study area. This trend could be attributed to either the cost or availability of alternative energy sources in the Project area. With regards to cooking and heating there seems to be a greater reliance on alternative energy sources, especially wood (see and Figure 7-38). It is reasonable to argue that wood is sourced from areas surrounding rural communities.

Table 7-52: Main source of energy for lighting, 2011

Study area	Electricity	Candles	Other
Limpopo	87%	11%	2%
Waterberg	87%	12%	1%
Mogalakwena	92%	7%	0%
Site-specific	94%	6%	0%
Source: StatsSA, 2013			

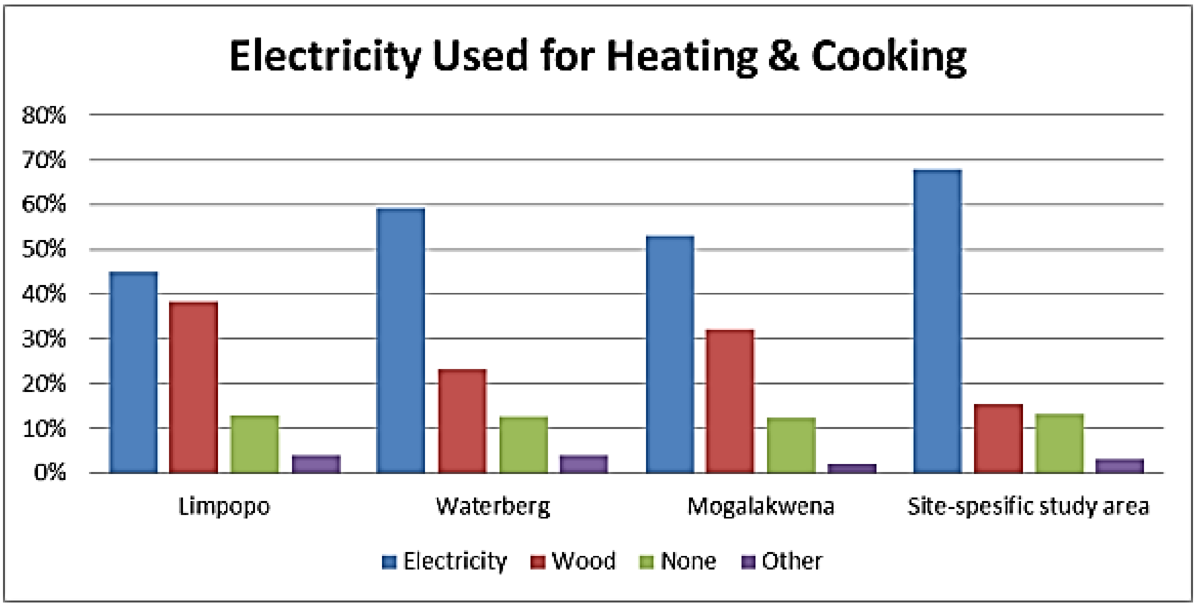

Figure 7-38: HH energy sources for Heating and Cooking, 2011 (Source: StatsSA, 2013)

The electricity backlog within the Waterberg District is relatively small in comparison to those of other District Municipalities. In 2008 the electricity backlog for the Mogalakwena Municipal area was estimated to be just more than 6 500 households (MLM, 2012). This could explain, in part, the high percentage of households not using electricity.

Provision of electricity is bestowed with Eskom as provider in rural areas of the municipality. In towns of, Bela-Bela, Mokgophong, Mogalakwena, Roedtan, Lephalale electrification is the responsibility of the local municipality. In many areas where the municipality has the function of providing electricity, the sub-stations have reached their maximum capacity, and are unable to provide electricity to new areas. The energy crisis faced by the municipalities is detrimental to provision of basic services and local economic development, however, the development of the coal, energy and petrochemical cluster in Lephalale, will likely alleviate the situation.

According to Chief Kekana, all the formal villages within the site-specific study area have access to electricity; however, Mzombane settlement does not have access to electricity as it is not viewed as a formal settlement by the local municipality.

7.14.14.3 Water

The Limpopo Province is considered a water-poor area; currently a number of water sources are being investigated to improve water security. These include pipeline extensions, such as the ORWRDP from the Flag Boshielo Dam, which delivers water from Pruissen to communities and mining Projects on the Northern Limb of the Bushveld Complex; the de Hoop Dam currently under construction; assessments as to underground sources in the immediate vicinity of the Project; and local sources from farmers downstream of the Doorndraai Dam (WDM, 2012). Ground water resources in Mogalakwena are available for use and can also supplement local water supply schemes. Safe drinking water is a basic necessity for good health, as unsafe drinking water can be a significant carrier of diseases such as trachoma, cholera, typhoid, and schistosomiasis. Drinking water can also be tainted with chemical, physical and radiological contaminants with harmful effects on human health. With regards to water quality, the municipality achieved a relatively low blue drop grading (78%); a municipality's blue drop status refers to the safety of water, which is made available for human consumption. Results derived from 2011 census indicate that most households (85%) throughout the province have access to piped water. It is concerning that only 13% of households within the site-specific area have no access to piped water; these households rely on municipal water tankers or water sourced from boreholes (StatsSA, 2013).

Mogalakwena Municipality is experiencing a backlog in terms of household water connections; this could be expected as 6% of households do not have access to piped water (see Figure 7-39). Despite this backlog, the LM is able to supply more households with piped water each year; however, this provision is unable to catch-up with the pace at which the number of households is increasing (MLM, 2012).

The Mogalakwena IDP (2012/2013) notes that the water supply infrastructure has deteriorated as a result of ageing and corrosive effects. As a result, water supply infrastructure is prone to bursts and leaks resulting in water losses. There is currently a process of addressing these issues through the refurbishment of boreholes, pipelines and water storage reservoirs (MLM, 2012). The Mogalakwena Municipal Manager noted that communal standpipes are common within the municipal area; however, the municipality needs to investigate the provision of back yard and household water connections.

According to Chief Kekana, access to water within the site-specific study area is in the form of communal standpipes; however there are plans to develop yard connections. In some cases households buy water from water vendors at a higher price putting an additional burden on poor households.

Mzumbanzi Village does not have access to water according to municipal representatives. Mzumbanzi is not viewed as a formal township and therefore permanent water supply has not been provided to this community. The village representatives have been in contact with the Department of Water Affairs requesting access to water services

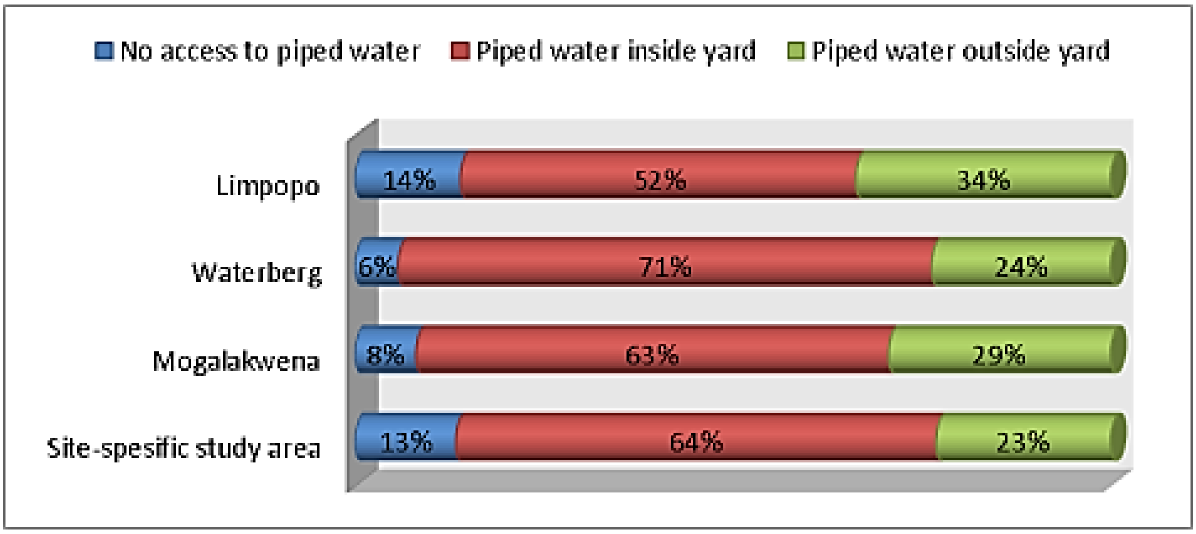

Figure 7-39: Access to piped water, 2011 (Source: StatsSA, 2013)

7.14.14.4 Sanitation

The availability of sanitation facilities not only improves the dignity of people, but also promotes health. Areas without proper sanitation systems can give rise to water borne diseases like cholera, diarrhoea, and typhoid.

According to the MLM's IDP there is only one treatment facility (in need of upgrading) situated in Mokopane and there is a delivery backlog of just less than 38 000 households that needs to be equipped with piped water and a flushing toilets (MLM, 2012)..

Figure 7-40 shows the sanitation facilities that are available in the Limpopo, Waterberg, Mogalakwena and the site-specific study area. The Province mostly relies on pit latrines for sanitation purposes, only 7% of the provincial population have no access to sanitation. It is important to note that the average for Southern Africa is substantially higher, with 67% of people having no access to sanitation. The Waterberg district has a relatively large proportion of households (50%) who have access to flush toilet facilities (Statistics South Africa, 2011). The site specific area seems to be considerably better off with regards access to flush sanitation (44%) when compared to the local municipality (28%).

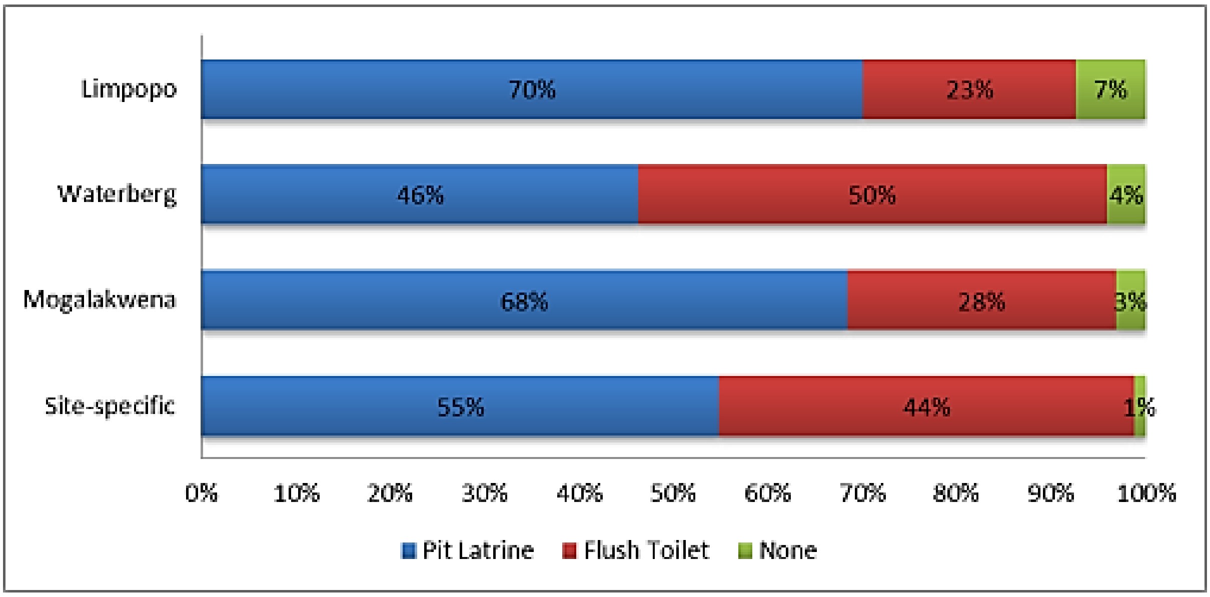

Figure 7-40: Access to Sanitation facilities, 2011 (Source: StatsSA, 2013)

7.14.14.5 Refuse Removal

South Africa generates 19 million tons of waste per year. According to Section 24 of the Constitution, all South Africans have the right to an environment that is not harmful to a person's health and wellbeing. The pollution and waste management act assigns the responsibility of waste removal to local municipalities.

The Mogalakwena Municipality only services its main urban centres namely Mokopane, Mahwelereng and Rebone; and does not provide this service to those residing in rural areas. This explains the large number of households utilising their own rubbish dump (See Table 7-53). In most mining areas, mining houses provide waste removal services.

The Mogalakwena IDP (2012/2013) state that land fill sites are operating at full capacity and are unable to cope with refuse produced by additional populations. Currently there are two official waste dump sites within the local municipal area (MLM, 2012).

Table 7-53: Refuse removal, 2011

Project Area	Own dump	Local Authority/ Private Company	No Rubbish Disposal
Limpopo	67%	22%	10%
Waterberg	46%	46%	7%
Mogalakwena	64%	28%	8%
Site Specific	52%	42%	6%
Source: StatsSA, 2013			

7.14.14.6 Health Facilities

The co-ordination of health facilities is planned at a district level and therefore not directly the responsibility of MLM. The number of health facilities located in the Waterberg District

Municipality is shown in Table 7-54 below (Day *et al*., 2010). A large majority (86.6%) of children under the age of one have been immunised. Moreover, just under three-quarters (72.3%) of women in the district delivered their last child in a health facility (Day *et al*., 2012). This is indicative of the accessibility of health facilities within the district. The closest hospitals to the Project area are the Mokopane and Voortrekker hospitals. Mokopane hospital is located within Mahwelereng town, which is situated adjacent to the Project area; the Voortrekker Hospital is situated in Polokwane. More than 80% of the population are within 120 minutes' walk from a primary health care facility (MLM. 2012).

Table 7-54: Health facility infrastructure in WDM

Type of infrastructure	Number of facilities
Clinics	57
Community Health Centres	1
Mobile Health Services	33
District Hospitals	7
Regional Hospital	1
Specialised Hospitals	1
Private Hospitals	5
Beds (public sector)	949
Beds (private sector)	204
Source: WDM, 2012	

7.14.14.7 Education Facilities

In 2007 there were 285 schools within the Mogalakwena Municipal area; including 167 primary, 104 secondary, and 13 combined schools. These schools have a total of almost 110 000 learners and 3 400 educators, this situation equates to a learner-teacher ratio of 32.2 to 1 (Mogalakwena IDP, 2011/2012). Almost 95% of the municipal population are within 30 minutes' walk or 2.5km from a school. Table 7-55 shows the percentage of primary and secondary schools within the municipal area, which had access to basic facilities in 2007. Just more than half (56%) of these schools had access to water, whilst access to electricity (72%) and sanitation (82%) were much higher.

Table 7-55: Service provision at schools within MLM, 2007

Services	Access	
	Number	Percentage
Electricity	205	72%
Water	159	56%
Sanitation	234	82%
Source: MLM, 2011		

7.14.14.8 Housing

According to data derived from 2011 census there is not an extreme need for housing throughout the province, as 88.7% of people in Limpopo reside in formal housing. This being said, both the District and Local Municipality are experiencing increased pressure to launch housing developments to alleviate housing backlogs in these areas. The district municipality attributed the housing shortage, in part, to the increase in mining Projects. The housing backlog within the Mogalakwena LM was just more than 33 000 units in 2007. The highest percentage (11.4%) of households living in informal structures is within the Waterberg District. In the Project area as much as 95% of the population have some kind of formal residence.

Table 7-56: Type of housing

Study area	Type of housing			
	Formal	Informal	Traditional	Other
Limpopo	89%	5%	4%	2%
Waterberg	86%	12%	1%	1%
Mogalakwena	94%	5%	1%	0%
Site-specific	95%	4%	1%	0%

Table 7-57 shows the tenure status of residences located in the four demarcated study areas. The site-specific study area has the highest percentage of paid off land or residences. Next highest is those who occupy rent free, this trend might be attributed to the large number of households who reside on indigenous land. Within MLM as much as 84% of houses are not paid off, which indicates poor ability to pay back debt and also a high willingness to get into debt for housing purposes. This is discouraging for LED prospects, as a high debt level will likely stifle spending in the area, which may in turn have a negative effect on consumer expenditure.

Table 7-57: Tenure status, 2011

Study Area	Tenure status			
	Private ownership		Rented	Occupied rent-free
	Paid off	Not paid off		
Limpopo	54%	28%	13%	5%
Waterberg	44%	28%	22%	6%
Mogalakwena	5%	3%	7%	84%
Site-specific	61%	23%	13%	3%
Source: StatsSA, 2013				

Informal settlements have been established throughout the MLM; the growth of these areas can partly be attributed to people moving from rural to urban areas in search of economic opportunities and a lack of affordable housing. For this reason informal settlements are also likely to appear adjacent to mining operations. This settlement pattern increases the housing shortage within the MLM. Three informal settlements have been recorded within the Local Municipality; these are Mzombane, Sterkwater and Mohlohlo.

Most informal settlements within the district have approximately 500 stands, but this number tends to increase as the proximity to urban areas decrease. Ownership and tenure are very difficult to assess in these settlements, as most dwellings in rural areas are situated on indigenous land where they supposedly have free occupation. The indigenous land allocation is a relatively new law and therefore there is a lack of clarity regarding who has the right to specific patches of indigenous land.

The type of housing structures within the Project area varies between brick structures and informal shacks. The Mzombane informal settlement is located within the site-specific area and Digby Wells have been told that this settlement is growing at a rapid rate. The municipal manager noted that the representatives from the Mzombane community have requested housing from the municipality. However, as the settlement is considered to be illegal and occupied against the wishes of Chief Kekana they have not considered providing housing to this settlement.

7.14.15 Crime and Safety

There are four police stations within the Mogalakwena Municipal area namely Gilead, Mahwelereng, Mokopane and Tinmyne. The closest police station to the site-specific study area is the Mahwelereng Station located in Mahwelereng Township south of the Project area.

According to official South African Police crime statistics (2011), there was a reduction in the number of reported crimes between 2003 and 2011; with almost 8 000 crimes reported for the 2003-2005 period, and only 5 000 crimes being reported between 2009-2011. Figure 7-41 illustrates the crime incidence for the different offence categories between 2003 and 2005. During this period the most common crimes were assault, commercial crime, residential burglary, robbery and malicious damage to property. The number of these crimes all reduced between 2005 and 2011. There was however an increase in crimes involving illegal possession[3].

Crime in general was identified by the headmen as a problem within their villages and crime prevention and safety were noted by most communities in the Project area as a priority. One of the challenges mentioned by the headmen was the high rate of alcohol abuse within the communities situated with the site-specific Project area. Alcohol abuse was also linked to vandalism of communal property.

[3] Illegal Possession includes: Illegal possession of firearms and ammunition; drug related crime; driving under the influence of alcohol or drugs

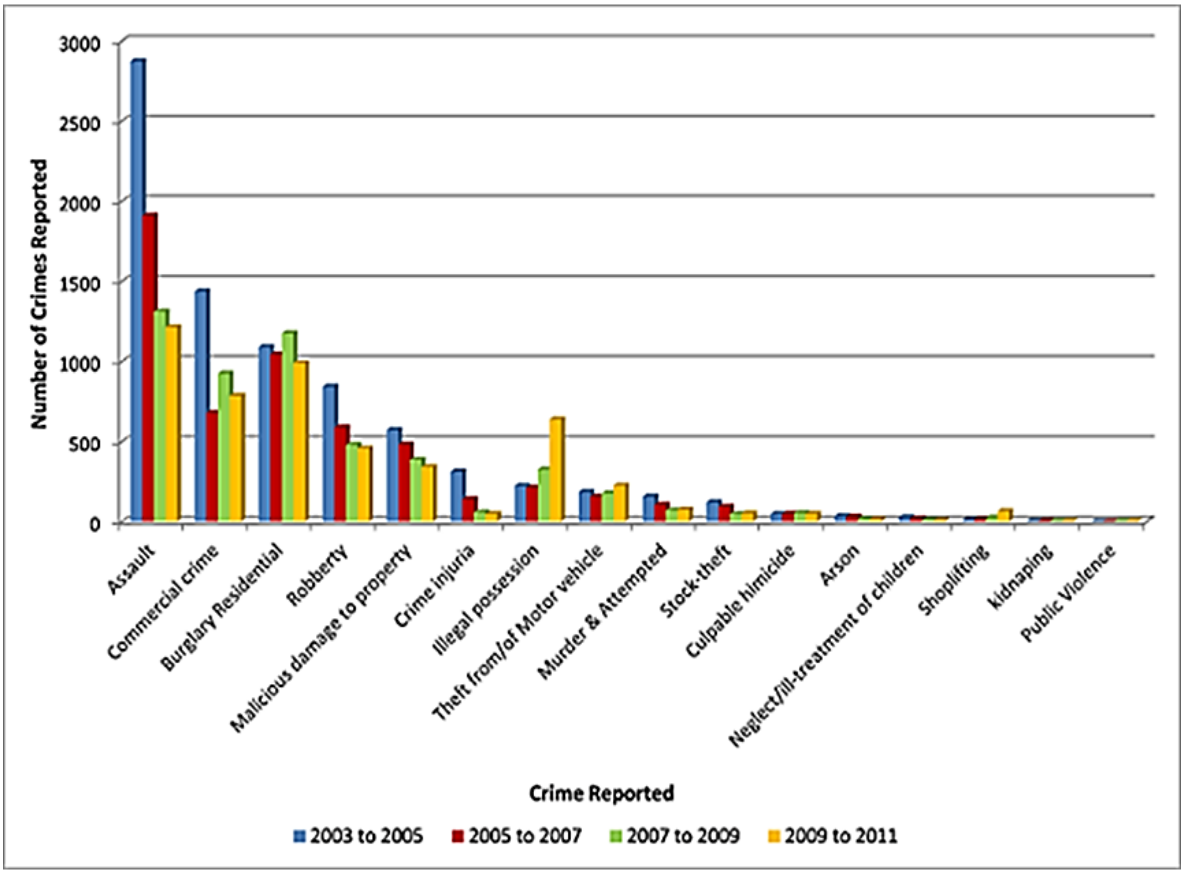

Figure 7-41: Crimes reported to the Mahwelereng police station (2003 to 2011) (Source: South Africa Police, 2011)

7.14.16 Transport and Roads

The District's road network consists of almost 22 000km, of which only 16% is surfaced. Roads within the Waterberg District Municipality are adequately connected with National, Provincial, and neighbouring District roads. The primary road network includes the N1, N11, R518, R572, R33, R510, R516, and the R101. Despite the District's high degree of interconnectivity, there is no direct route connecting the District and the Province to the North West Province.

There is concern about the rapid degrading of many roads due to the increase of economic activities throughout the District (increase in heavy vehicles with mining materials); the situation is exacerbated by a lack of maintenance and rehabilitation. It should be noted that there are a number of road building and surfacing projects in progress, which will alleviate road deterioration (WDM, 2012). The local municipal road network slightly exceeds 6 000 km, only 12% of which is surfaced. Similar to the District, the LMs road network is in a poor state (MLM, 2012).

Transport corridors formed by road networks usually play a major role in facilitating and supporting regional socio-economic development. These corridors also offer advantages to mining, manufacturing and other businesses developments planned for the area. There are several major transport corridors in Lephalale and Mogalakwena LM. Main corridors of freight near the Project site include:

- N11 Tshamahansi to Mokopane (25 km);
- Mahwelereng to Mokopane (14 km); and
- R518 Mmalapetleke to Mokopane (25 km).

Car ownership within the municipal area is low and commuters depend on public transportation. The majority of the population mostly uses public transport services (bus and taxi operations). Donkeys and trailers is another prominent mode of transport, and while the ‘horse and carriage’ is privately owned, it is very often leased out for business purposes (Sanral, 2012). There is a train/railway station in Mokopane and a railway network, however these routes only allow for long distance passengers (MLM, 2012). Despite the existing road work and various mode of transport, the immobility of communities within the local municipality area was still noted as a major concern.

Major intersections (where the N11 branch off towards communities) within the site-specific study area, have a very high volume of visible traffic, particularly at peak times. There are a number of both light and heavy vehicles that travel the road. Large trucks belonging to local mining companies regularly use the road. A significant proportion of roads within the Project area are in a poor condition. This situation is exacerbated by continued heavy traffic.

There are also internal village streets and these are generally in a bad state It was found that within the Project area both the paved and unpaved portions of the road are considered to be ‘poor’. The improvement of road quality in the Project area is therefore necessary and will be an important aspect of any Project development requirements.

A traffic impact assessment was undertaken by Impofu Engineering Services in 2013, this assessment established that the proposed Platreef Project is expected to result in an increase in traffic, but that the road network has capacity to accommodate this increase (Impofu Engineering Services, 2013). The increase in traffic will likely result in several safety risks to the public. Road upgrades are proposed to ensure the sustainability of the development traffic on the network, as well as to reduce the safety risk to the public (Impofu Engineering Services, 2013).

7.14.17 Challenges in Providing Basic Service Delivery

Currently the Mogalakwena LM’s capacity to develop and maintain infrastructure and deliver household services seems to be outpaced by population growth and the resultant increase in demand of services. The increase in the number of households, particularly in the rural areas where there are minimal services have increased backlogs in electricity provision, housing needs, roads, access to water, and sanitation needs. In particular the following issues impede service delivery in the Municipality:

- Lack of water resources and poor water quality;
- Lack of bulk infrastructure (water, electricity, and sanitation);
- Aging of existing infrastructure;

- Inadequate budgeting for operations and maintenance;
- Overflowing of sewer plants;
- Utilisation of unlicenced landfill sites;
- Sector planning is not coordinated and aligned to the municipal planning processes;
- Inadequate capital funding for all infrastructure/service delivery;
- Inadequate institutional capacity to respond to service delivery opportunities; and
- Inadequate intergovernmental integration and support.

According to the Mogalakwena IDP (2012/2013) the following are priority areas for the municipality, identified in order of urgency, as shown in Table 7-57.

According to this ranking the provision of water and sanitation is the municipality's main priority area followed by roads and storm water, economic development and employment. In contrast however, the priority areas that all wards noted as important were roads and storm water, electricity, crime prevention, safety and security. Community needs can be converted into development opportunities for private sector investment, especially as part of corporate social responsibility and local economic development plans.

Table 7-58: Municipal and ward priority areas – directly affected villages

Rank	Priority Area Identified by Municipality	Identified as Important by Community	
		Relevant Wards	Relevant Villages
1	Water and sanitation	20, 21, 22, 23	Tshamahansi, Ga-Kgobudi, Mzombane
2	Roads and storm water	20, 21, 22, 23, 24	Tshamahansi, Ga-Kgobudi, Madiba, Mzombane
3	Local economic development and unemployment	22	Ga-Kgobudi
4	Institutional arrangements	None	None
5	Electricity	20, 21, 22, 23, 24	Tshamahansi, Ga-Kgobudi, Madiba, Mzombane
6	Solid waste and environmental management	20, 22, 23, 24	Tshamahansi, Ga-Kgobudi, Madiba, Mzombane
7	Land and cemeteries	20, 22	Tshamahansi, Ga-Kgobudi, Mzombane
8	Housing	20, 22, 23	Tshamahansi, Ga-Kgobudi, Mzombane
9	Crime prevention, safety and security	20, 21, 22, 23, 24	Tshamahansi, Ga-Kgobudi, Madiba, Mzombane
10	Education	20, 21, 22, 24	Tshamahansi, Ga-Kgobudi, Madiba, Mzombane
11	Health and social development	20, 22, 23, 24	Tshamahansi, Ga-Kgobudi, Madiba, Mzombane

Rank	Priority Area Identified by Municipality	Identified as Important by Community	
		Relevant Wards	Relevant Villages
12	Sports, arts and culture	20, 21, 22, 24	Tshamahansi, Ga-Kgobudi, Madiba, Mzombane
13	Transport	20, 21	Tshamahansi, Mzombane

7.14.18 Mine-Community Relations

Community perceptions regarding the Project as well as attitudes towards it can be shaped by socio-political events and/or existing attitudes towards mining activities in the vicinity of the Project area. Anglo American's Mogalakwena operation and Lonmin's prospecting activities are located relatively close to the Project, and are also focussed on Platinum extraction.

Factions within communities surrounding Lonmin's prospecting area are resisting Lonmin's activities as a result of the killings at Lonmin's Marikana operation (Mines and Communities, 2012). Protest action within the surrounding communities provides evidence that Platinum mining is perceived in a negatively light by some groups within the resident population (Noordnuus, 2012; Piplinks, 2012; SABC, 2012).

In 2012, communities in the surrounding area launched multiple protest actions. In one instance communities protested against a road project of Anglo Platinum, which was instigated by the perception that not enough people were employed from local communities. Consequently eighty one protesters appeared in the Mahwelereng magistrate's court for transgression that occurred during the protest (Piplinks, 2012).

In recent public meetings discontent against mining houses was again manifest. During these meetings it became apparent that people perceive mines in the area to be untrustworthy, disrespectful, unfair and sowing division among community members and traditional leadership. Furthermore it became clear that massive employment expectations exist throughout local communities; if these expectations are not dealt with it might result in even more civil unrest.

Communities affected by the Anglo, Lonmin and Platreef Projects launched a combined protest action, indicating widespread discontent against Platinum mining houses within the study area (Mines and Communities, 2012). During the protest communities suggested the following considerations:

- In future community engagement should focus on the concerns of the majority of the people in the affected communities, and not only the traditional leadership of the area;
- Mining houses should go through the proper channels to get the consent of the entire community, not just the traditional leadership; and
- Stakeholders recommended that corrupt practices should be avoided, especially when canvassing support from the community for mining activities, otherwise mining houses will encounter continued community resistance.

7.15 Community Health Impact Assessment

7.15.1 Environmental Health Areas

The following section describes the baseline health status in the Project area with reference to the Environmental Health Areas (EHAs). This is based on the national and regional baseline health data that was identified during the desktop review and during the site visit from 3rd to the 11th of September 2013. Data at the local level is based on the aforementioned distributed Questionnaires were carried out during the field visit.

A Health Impact Assessment report has been compiled and attached to Appendix Q.

7.15.2 EHA #2: Vector-related Diseases

7.15.2.1 Malaria

Although malaria is not common in South Africa, twelve respondents in Sandsloot and one in Kgubudi listed malaria as one of the top three most common illnesses/diseases in their communities. Thirteen out of 613 individuals is a minute percentage of the population. Malaria can therefore be ruled out as a disease of concern.

7.15.3 EHA #1: Communicable Diseases Linked to Overcrowding and Poor Environmental/Social Conditions

7.15.3.1 General Housing and Respiratory Diseases

Based on the key informant interview it was clear that most households live in a brick structure or traditional structures on individual properties (with more than one house on the respective property) or one house on a separate stand/property. According to data derived from 2011 census there is not an extreme need for housing throughout the province as 88.7% of people in Limpopo reside in formal housing (Stats SA, 2011) Table 7-59 lists the type of housing in the Project region. The household survey conducted in the Potentially Affected Communities (PACs) showed a similar scenario as it was confirmed during the field visit that much of the population within the PACs has some kind of formal residence. Houses were traditional brick or mud structures either with a thatch or corrugated iron roof.

Table 7-59: Type of housing

Study area	Type of housing			
	Formal	Informal	Traditional	Other
Limpopo	89%	5%	4%	2%
Waterberg	86%	12%	1%	1%
Mogalakwena	94%	5%	1%	0%

Based on the KII as well as the household survey, overcrowding is a problem with some respondents claiming to have ten individuals living in a three bedroomed house. Houses are basic and sufficient. With the exception of Mzombane, squatter areas do not appear to be a problem.

According to KIIs as well as data collected from the household survey, Pulmonary Tuberculosis (TB) is the most common respiratory disease in the PACs. 416 out of the 613 questionnaires received reported TB to being one of the most common illnesses in their communities. This is approximately 68% of the total surveyed population. 111 respondents stated that asthma was one of the three most important illnesses in their communities. These results are illustrated in Figure 7-42. Less than 20% of respondents reported to influenza being one of the most common illnesses affecting their communities.

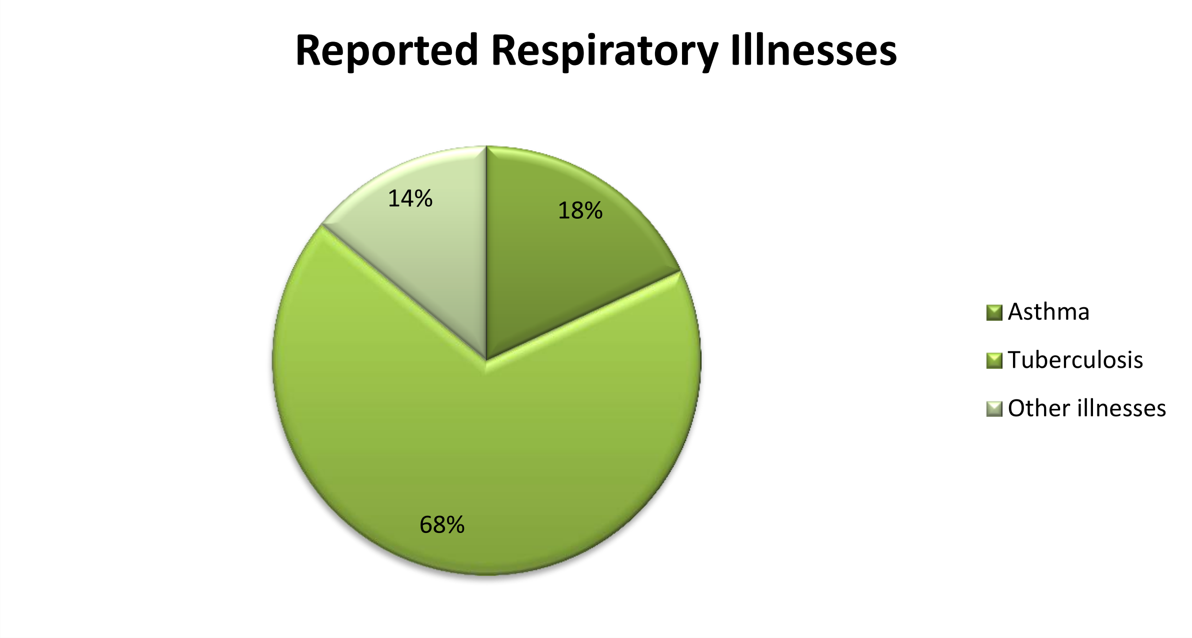

Figure 7-42: Number of times TB and asthma were mentioned during the household survey

7.15.4 EHA #3: Soil-, Water- And Waste-Related Diseases

The Mogalakwena River flows to the west of the Project Area and ultimately flows into the Limpopo River. The Mogalakwena River is characterised by the presence of vleis and wetlands along its drainage course on both the Turfspruit and Macalacaskop farms. The Sterk River is a major tributary of the Mogalakwena River and joins the Mogalakwena River from the west some 30 km below the Project Area. The Doorndraai Dam is located on the Sterk River. The Doorndraai Dam is the main water supply dam for Mokopane.

There are four main water courses that drain across or adjacent to the Project Area. The Rooisloot, Dorps and the Ngwaditse Rivers flow in a westerly direction across the Project Area into the Mogalakwena River. The Dithokeng stream crosses the corner of the mine property in the north before joining the Mogalakwena River. A dam has been constructed on this stream upstream of the town to the north east of Turfspruit. The dam is used for domestic water supply. Individuals in some of the PACs have reported drinking from and swimming in open water bodies such as these.

Water is recognised as a scarce resource in the district and municipal area and management systems are generally poor. In Mogalakwena ground water resources are available for use and can supplement the local water supply schemes. The municipality achieved a relatively low blue drop grading at 78%, a municipalities Blue drop status refers to the safety of water, which is made available for human consumption. Concerns were raised about the availability of water in the Project area to support the mine and related operations, as well as the needs for agriculture and domestic use.

The availability of sanitation facilities not only improves the dignity of people, but also promotes their health. Areas without proper sanitation systems give rise to water borne diseases like cholera, diarrhoea, and typhoid. Household surveys indicated that the majority of households do not have access to adequate sanitation services. The bulk of these occur in the rural areas where residents construct their own pit latrines, often of a poor standard. In the household survey the majority of the respondents used pit latrines and Ventilated Improved Pit-latrine (VIP) toilets in their own yards. All households inside and closer to Mokopane town such as the Extensions, and Mahwelereng reported to having adequate sanitation facilities (flush toilets) inside their houses and yards.

Cholera was the most common water and sanitation related illness reported in the Project area with 38 individuals, approximately 7% of the surveyed population, listing the disease as one of their communities biggest health challenge. The Department of Health and Social Development in partnership with the DWA conducted a door-to-door campaign and distributed disinfectants to prevent the outbreak of cholera in the Mokopane and surrounding area in March 2011. A news report on the '*New Age*' newspaper asserted that there were no reported cases of cholera in the area, and that the Department and the Mogalakwena Municipality had taken proactive steps to prevent an outbreak by conducting door- to-door campaigns to cover the Sekgakgapeng, Moshate, Masodi and Ga-Madiba areas (New Age Newspaper, 2011). Households in the PACs generally obtain their drinking water from taps and boreholes provided by the municipality, as well as "jojo tanks".

7.15.5 EHA #4: Sexually-Transmitted Infections, Including HIV/AIDS

All five key health personnel interviewed listed HIV/AIDS as one of the top five most common illnesses that they treat. All health facilities have the ability to diagnose HIV. However, only four Healthcare facilities stock Antiretroviral drugs (ARVs).

Condoms are readily available within the communities. They are available for free at health facilities and they are also available in the shops, '*spazas*', schools and shebeens. There is little stigma associated with buying condoms, although some women stated that they sometimes feel shy to take free condoms from public places.

There are regular HIV awareness campaigns within the community. The Catholic Medical Mission Board, Inc. (CMMB) has launched a comprehensive Medical Male Circumcision (MMC) HIV prevention program in the community. The district health authorities reported that there is good knowledge of HIV transmission and prevention measures.

Most members of the communities also have a good attitude towards people with HIV, whilst a handful has discriminatory attitudes towards HIV positive people.

Information collected during focus group discussions shows that a large proportion of respondents know the two main ways to prevent HIV, namely condom use and having one uninfected sexual partner. One of the respondents in Ntete village noted that although the knowledge of prevention methods is higher among men this knowledge is seldom translated into practice by men.

7.15.5.1 HIV/AIDS: Knowledge, Attitude and Behaviour

More than 95% of the surveyed population reported to having heard about HIV/AIDS. With numerous respondents across the PACs stating that HIV/AIDS is a serious problem in their communities it is clear to see that HIV/AIDS has affected all levels of these communities – from the youth to the elderly. Many people stated that the disease is one of grave concern as it is "killing the youth." It is unsurprising that the household surveys revealed that over 80% of the respondents have heard of the disease. While the remaining 20% asserted that HIV/AIDS is not a serious problem in their communities as nurses and NGOs educate the populace about this disease, and therefore expect that everyone should have knowledge on this diseases, results prove that the general levels of awareness and consistent knowledge on the disease and preventive behaviours is relatively poor. Thus, the mere acknowledgement of the disease in the absence of understanding the disease risk, the modes of transmission and associated preventive behaviours, will not support any form of behaviour change or risk taking practices.

There are high levels of stigma in the communities with associated discrimination as, although individuals were willing to purchase food from someone who they knew was HIV positive, more than half of the respondents would keep their HIV positive family member's status a secret. Apart from this being attributable to a general respect for their family member's privacy, part of this is due to the poor levels of knowledge and beliefs. Traditional, cultural and religious beliefs make it difficult to inform behavioural change information. It is felt that the more rural communities simply don't have access to adequate information about HIV and AIDS, and the high levels of illiteracy also makes behavioural change communication somewhat challenging.

Information collected during the household survey shows that a large proportion of respondents know the two main ways to prevent HIV, namely condom use, abstaining and having one uninfected sexual partner (monogamy –being faithful).

7.15.5.2 Commercial Sex

With regard to the negative impacts of the Project development it was reported by key health personnel that there are no commercial sex workers in the broader study area. This was completely different to the situation as described by the respondents that reported that commercial sex was a broader community challenge. If commercial sex is not reported in the study communities then the challenge will be to maintain this situation when the practice is considered to be a challenge in the broader community. Should the mine lead to the emergence of more prostitution in the area there would be negative social and health connotations. There was also a concern raised that an influx of single male migrants from outside the area would place a burden on scarce resources and also cause an increase in the incidence of Human Immunodeficiency Virus (HIV); and Sexually Transmitted Infections (STI). Results from the household surveys suggest that disadvantaged young girls and child-headed households would be extremely vulnerable to single men with disposal income.

7.15.6 EHA #5: Food- And Nutrition-Related Issues

Food security includes a variety of aspects such as stability of the availability of food, as well as stability of access to and utilisation of food (SAHR, 2008). Nutritional status is determined by the degree of nourishment. Under-nourishment, an indicator of food security, means consumption is continuously below. Approximately 52% of South African households experienced hunger in 2009 (WHO, 2010). Therefore food security is an important consideration in understanding potential health impact of development Projects. This EHA is affected by influx of people resulting in increased demand for food.

Based on the key informant interviews and household survey results, food shortage is a serious problem in the area. Surprisingly and somewhat contradictory, malnutrition was not rendered as a serious disease. A few respondents stated that malnutrition was a problem. This was for both children and also the elderly as vulnerable groups. Much of this was linked to poverty in the communities. Food shortage has been noted as one of the main health needs in the area. Malnutrition is linked to poverty and food security issues, as the population cannot afford basic foodstuffs. Poor feeding practices related to poor education and illiteracy are bound to worsen the existing situation.

7.15.7 EHA #6: Non-Communicable Diseases

The chief chronic conditions observed in the surveyed communities include chronic diseases such as hypertension, diabetes, stroke, and cancer. Three hundred and eighty (380), approximately 62% of the surveyed population highlighted that hypertension/“high blood pressure” and diabetes are serious problems in their communities. This is also asserted by information obtained during the KIIs, where three out of the five interviewed key health personnel listed hypertension in their top five major illnesses facing their community. One hundred and seventy three (173) respondents, approximately 28% of the surveyed population reported to cancer being one of the most common illnesses in their communities. They did not, however, state the type of cancers being referred to. Arthritis was also in the top five most common illnesses mentioned overall in the communities.

7.15.8 EHA#7: Accidents/Injuries

Accidents and injuries were commonly reported in the two of the KIIs. Road traffic accidents (RTA) are the not very common in the communities. Gender-based violence and crime related injuries such as assault are more common. There is a strong link to alcohol in domestic violence and motor vehicle accidents.

7.15.9 EHA #9: Exposure to Potentially Hazardous Materials, Noise and Malodours

During the field visit, it was apparent to Digby Wells’ Consultants that numerous households still use wood for cooking and heating, which may cause a risk from indoor air pollution and associated respiratory health concerns. As waste removal from households is a challenge many households burn waste that can emit harmful by products especially with plastics. In the more rural communities (further from Mokopane town) there are illegal and uncontrolled dump sites and those which are available can contaminate water supplies and present unhygienic conditions.

Dust generation in the Project area is principally a result of traffic of vehicles on unpaved roads in the area, but the effect should be minimal in the sparsely populated area. In a similar way noise is not regarded as a major affect in the area.

7.15.10 EHA #10: Social Determinants of Health

Substance misuse such as alcohol, tobacco or other drugs is not only an important health determinant but also closely linked to mental health (Prince *et al*., 2007) – the use of the drug 'nyaope[4]' which was reported (during the KIIs) to lead to mental illness. Misuse is associated with crime, prostitution and domestic violence. Several respondents admitted that most members of their communities drink a lot of alcohol, especially during the weekends and at the end of the month when individuals have received their wages and salaries. The key health personnel validated this by asserting that alcohol and drug abuse was a major contributor of disease.

7.15.11 EHA #11: Cultural Health Practices

Culture and traditional values play a very important role in the local communities. The SePedi and Shangaan communities place a large emphasis on traditional values and practices and this relates to health care and health seeking behaviour. Surprisingly, traditional medicine did not play a major or an integral role in health seeking behaviour and also where choices are made as to preference for health care. The vast majority sought help from Healthcare facilities as their first option. Numerous respondents stated that traditional medicine is often accessed after seeking care for a more western medical source –"I will go to the traditional healer if the doctors in the clinics cannot help me". From the KII it was apparent that some cultural traditions and religious beliefs of the local population in themselves pose a challenge in providing effective health services.

There is some collaboration between Healthcare facilities and traditional healers, for instance, four out of five interviewed key health personnel admitted to their respective facilities holding monthly meetings with traditional healers in the relevant communities. The aim here is to establish a collaborative relationship whereby the traditional healers will refer "difficult patients" (patients they cannot treat or heal) to the healthcare facilities. Professional Nurse, Francina Mailula confirmed that these monthly meetings seem to be helping as some of the traditional healer's hygiene practices have improved, and Mrs K.A Phago, Operational Manager from Mamaselela Clinic stated that some "active" traditional healers are now bringing patients to the clinics. It was also reported that some traditional healers do not always provide a consistent and safe service to patients, such as dosage of medication, or concoctions of herbs etc. There is no regulation of the practice and levels of training and understanding vary widely. Some practices are dangerous and clearly not compatible with standard medical practice.

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[4] Nyaope is a street drug that has allegedly come into widespread use in South Africa. It is famous for allegedly containing antiretroviral drugs for HIV.

7.15.12 EHA #12: Health Systems Issues

The health care infrastructure in the district and municipal area is relatively well served, but with a somewhat notable disproportion toward the urban compared with the more rural areas. While the infrastructure was reported as sound it was mentioned at the KII and also the household surveys that the major challenge for health service delivery in the area was the deteriorating state of health service delivery at the hospital and clinic levels.

Although more than half of the respondents were happy with the quality of services they receive from their local clinics and hospitals, a notable proportion of the surveyed population was unhappy with these services. They attributed their dissatisfaction to a lack of skilled staff to support the daily functioning of the facilities; the operating times of the facilities (clinics not being 24 hour facilities and sick people having nowhere to go during cases of emergency at night); a general disregard and lack of respect for patients (by the nurses); shortages of medication; failure of health practitioners to follow the Batho Pele Principles[5] with pride; long queues and overcrowding.

Key health personnel mentioned a shortage of staff, especially in the form of doctors. This creates service delivery challenges and often results in long waits for patients, and places increased stress on the current medical staff. Staff shortages were also reported at the clinic level and this associated with equipment, consumables and basic services like electricity (with regular power outages noted at Mahwelereng Clinic 1 and Mapela Clinic), and limited documentation storage/filing methods mean that these services do not function optimally.

7.16 Traffic Assessment

A Traffic Assessment report has been compiled and attached in Appendix R.
The following intersections forms part of the Project area:

- Intersection of N11 and D3502;
- Intersection of N11 and Village Access Road A;
- Intersection of N11 and Road B; and
- Intersection of N11 and Road R518.

The following is evident from visual observations and traffic survey data:

- Fairly high traffic volumes were observed on the N11 and the R518 in the AM and PM peak hours;
- Low volumes of traffic were observed on D3502, Village Access Road A and Road B during both the peak hours; and

[5] Batho Pele principles were developed to serve as acceptable policy and legislative framework regarding service delivery in the public service. These principles are aligned with the Constitutional ideals of: promoting and maintaining high standards of professional ethics; providing service impartially, fairly, equitably and without bias; utilising resources efficiently and effectively; responding to people's needs; the citizens are encouraged to participate in policy-making; and rendering an accountable, transparent, and development-oriented public administration

- Overall no capacity problems were evident in the AM and PM peaks at the intersections.

8 EIA METHODOLOGY

The impact assessment methodology, during the following ESIA phase, for the Project, will consist of two phases, namely (i) impact identification; and (ii) impact significance rating.

Impacts and risks will be identified based on a description of the existing and proposed future activities to be undertaken as part of the Project. The impact associated with each of these proposed activities will be assessed and a significant rating will be determined for each of them using the flowing formula and matrix below.

The mitigation measures and impact management controls for all identified impacts and risks will be incorporated into an EMP.

8.1 Impact Identification

Impact identification is performed by use of an Input-Output model which serves to guide the assessor in assessing all the potential instances of ecological and socio-economic change, pollution and resource consumption that may be associated with the activities required during the construction, operational, closure and post-closure phases of the Project.

Outputs may generally be described as any change to the biophysical and socio-economic environments, both positive and negative in nature, and also include the product and waste produced by the activity. Negative impacts could include gases, effluents, dust, noise, vibration, other pollution and changes to the bio-physical environment such as damage to habitats or reduction in surface water quantity. Positive impacts may include the removal of invasive vegetation, construction of infrastructure, skills transfer or benefits to the socioeconomic environment. During the determination of outputs, the effect of outputs on the various components of the environment (e.g. topography, water quality, etc.) is considered.

During consultation with I&APs perceived impacts were identified. These perceived impacts will become part of the impact assessment and significance rating in order to differentiate between probable impacts and perceived impacts.

8.2 Impact Rating

The significance rating process for impacts follows the established impact/risk assessment formula is show below:

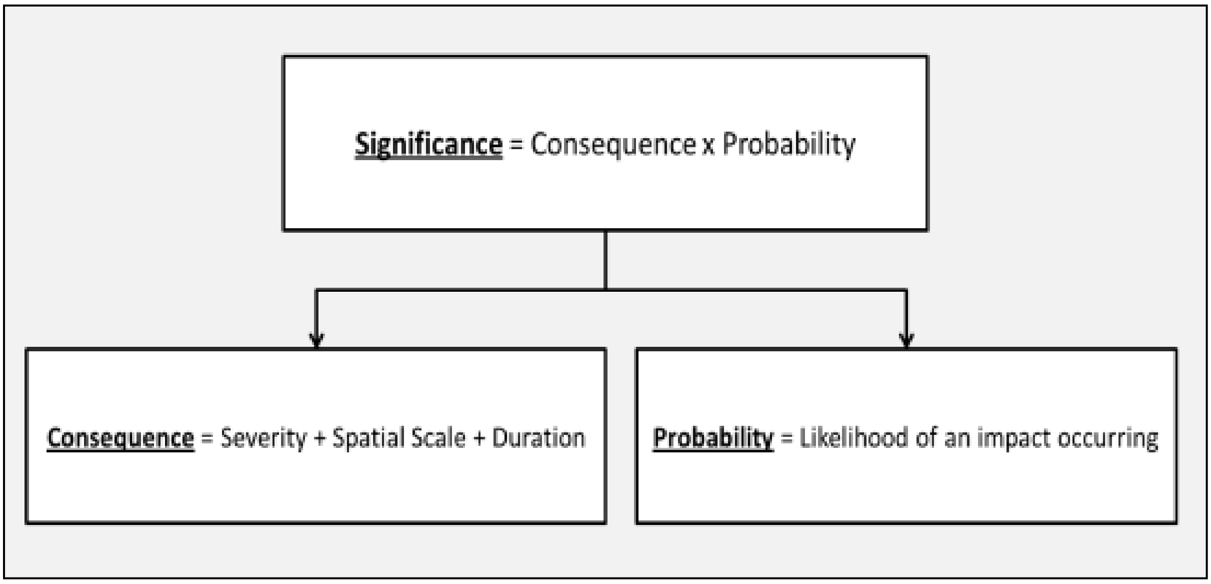

Table 8-1: Impact scoring matrix

Significance										
		Consequence (severity + scale + duration)								
		1	3	5	7	9	11	15	18	21
Probability / Likelihood	1	1	3	5	7	9	11	15	18	21
	2	2	6	10	14	18	22	30	36	42
	3	3	9	15	21	27	33	45	54	63
	4	4	12	20	28	36	44	60	72	84
	5	5	15	25	35	45	55	75	90	105
	6	6	18	30	42	54	66	90	108	126
	7	7	21	35	49	63	77	105	126	147

Table 8-2: Impacts significant matrix

Significance		
High	109- 147	
Medium-High	73 - 108	
Medium-Low	36 - 72	
Low	0 - 35	

Table 8-3: Severity table

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	Social / Cultural Heritage			
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or ecosystem. Persistent severe damage.	Irreparable damage to highly valued items of great cultural significance or complete breakdown of social order.	International	Permanent	Certain/ Definite
6	Significant impact on highly valued species, habitat or ecosystem.	Irreparable damage to highly valued items of cultural significance or breakdown of social order.	National	Permanent mitigated	Almost certain/ High probability
5	Very serious, long- term environmental impairment of ecosystem function that may take several years to rehabilitate.	Very serious widespread social impacts. Irreparable damage to highly valued items.	Province/ Region	Project life (The impact will cease after the operational life span of the Project)	Likely
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year.	On-going serious social issues. Significant damage to structures / items of cultural significance	Municipal area	Long term (6-15 years)	Probable
3	Moderate, short- term effects but not affecting ecosystem function. Rehabilitation requires intervention of external specialists and can be done in less than a month.	Ongoing social issues. Damage to items of cultural significance.	Local	Medium term (1-5 years)	Unlikely/ Low probability
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants.	Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Limited	Short term (Less than 1 year)	Rare/ improbable
1	Limited damage to minimal area of low significance, (e.g. ad hoc spills within plant area). Will have no impact on the environment	Low-level repairable damage to commonplace structures	Very Limited	Immediate (Less than 1 month)	Highly Unlikely/ None

9 IMPACT ASSESSMENT

9.1 Topography

9.1.1 Construction Phase

The construction phase is characterised by site development and infrastructure construction. This includes site clearing, topsoil removal and stockpiling, construction of surface infrastructure (access roads, pipes, storm water diversion berms, change houses, admin blocks, etc.), and drilling, blasting and development of infrastructure for mining. The construction phase will have negative impacts on the topography. The surface infrastructure is medium-scale and will therefore have a moderate impact on the topography.

9.1.1.1 Change in the Project Surface area due to Site Clearing

Criteria	**Details / Discussion**				
Description of impact	The removal of vegetation and topsoil will change the surface of the Project area and will therefore change the topography. The areas to be cleared include the infrastructure area, TSF Site 2 and the tailings pipeline servitude. The Project area is susceptible to soil erosion due to the degraded nature of the natural vegetation. This is evident from the eroded drainage lines running through TSF Site 2.				
Mitigation required	■ Only clear vegetation when and where necessary; ■ Only remove topsoil when and where necessary; ■ Ensure topsoil is stored away from surface water and drainage lines; and ■ Ensure topsoil stockpiles are contoured and not too steep.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	Local (2)	Project life (5)	Serious 4)	Certain/definite (7)	Medium-high (98)
Post-Mitigation	Local (2)	Project life (5)	Moderate (3)	Likely (5)	Medium-low (50)

9.1.1.2 Change to Topography due to Construction of Surface Infrastructure

Criteria	**Details / Discussion**				
Description of impact	The construction of surface infrastructure will add features to the topography thereby changing it. This surface infrastructure includes the access roads, water and tailings pipelines, storm water diversion berms, change houses, admin blocks, processing plant, pollution control dams (PCD's), water storage dams, waste rock dumps and the TSF. Piles of construction material will temporarily change the topography of the Project area.				
Mitigation required	■ Limit the surface area of infrastructure where possible; ■ Store construction materials away from surface water and drainage lines; and ■ Don't create numerous haul roads alongside each other.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	2	5	4	7	Medium-high (98)
Post-Mitigation	2	5	3	5	Medium-low (50)

9.1.1.3 Changes to the Topography due to Drilling, Blasting and Development of Infrastructure for Mining

Criteria	**Details / Discussion**				
Description of impact	The drilling, blasting and development of infrastructure for mining will change the topography. The development of surface infrastructure will add features to the topography while drilling and blasting will create voids				
Mitigation required	■ Only remove overburden when and where necessary; and ■ Limit the surface area of infrastructure where possible				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	2	5	4	7	Medium high (77)
Post-Mitigation	2	5	3	5	Medium-low (50)

9.1.2 Operational Phase

The operational phase is characterised by the removal of PGM's (underground mining process), the operation of surface infrastructure and the transportation of mineral off site. The operational phase will have negative impacts on the topography. The underground mining process will have a negligible impact on the topography unless subsidence occurs. The operation of surface infrastructure will have a moderate impact on the topography. This is mainly due to the waste rock dumps and TSF which will significantly change the topography of the Project area. The water management activities will change the drainage lines and affect surface water flow resulting in a moderate impact on the topography.

9.1.2.1 Subsidence as a result of the Underground Mining Process[6]

Criteria	**Details / Discussion**				
Description of impact	Underground mining techniques will be utilised and therefore the removal of PGM's (underground mining process) is unlikely to impact on the topography. If underground mining occurs close to the surface and insufficient pillars are left to support the surface then subsidence could result. This subsidence would have an impact on the topography				
Mitigation required	■ Ensure that sufficient pillars are left to support underground mining areas.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	2	1	2	1	Low (5)
Post-Mitigation	1	1	2	2	Low (4)

9.1.2.2 Change in Local Topography due to the Operation of Surface Infrastructures

Criteria	**Details / Discussion**				
Description of impact	Operation of the stockpiles, waste rock dumps and the TSF will add to the surface and thereby change the topography of the Project area. The increasing height of the TSF will continuously change the topography. The TSF will remain beyond the closure phase of the proposed Platreef Project and will, therefore, have a permanent impact on the topography. Water use and storage on site (including pollution control dams) will change the surface water flow of the Project area. This change in surface water will impact on the topography.				
Mitigation required	■ Store waste rock, tailings and stockpiled ore away from surface water and drainage lines; ■ Limit the footprint area of the waste rock dumps, TSF and ore stockpile if possible; ■ Limit the quantity and time of ore stockpiled on site; ■ Ensure ore stockpiles, waste rock dumps and the TSF are contoured and not too steep; ■ Ensure all dirty water is channelled towards pollution control dams; and ■ Ensure water diversion berms are well maintained, contoured and not too steep.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	5	7	Medium-high (91)
Post-Mitigation	2	5	4	6	Medium-low (66)

[6] Impact relates more to the mining activities

9.1.2.3 Decommissioning Phase

The decommissioning phase is characterised by rehabilitation activities including the demolition and removal of all infrastructure, spreading of soil, re-vegetation and profiling/contouring. This phase will have neutral impacts on the topography. The surface infrastructure is medium-scale and its removal will have a minor impact on the topography. The spreading of soil and re-vegetation will assist in the prevention of soil erosion. Profiling/contouring will assist to recreate the natural drainage lines and surface water flow. These will have a moderate neutral impact on the topography.

9.1.2.4 Demolition and Removal of all Infrastructure (including transportation off site)

Criteria	**Details / Discussion**				
Description of impact	The demolition and removal of all infrastructures will remove features from the surface and thereby change the topography. This is a positive change that will help to reverse some of the negative changes that occurred when the infrastructure was constructed.				
Mitigation required	■ Ensure all unnecessary infrastructures are removed.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	4	6	Medium-high (72)[7]
Post-Mitigation	2	5	5	7	Medium-high (84)[8]

[7] Positive impact

[8] Positive impact

9.1.2.5 Spreading of Soil, Re-vegetation and Profiling/Contouring

Criteria	**Details / Discussion**				
Description of impact	Rehabilitation (spreading of soil, re-vegetation and profiling/contouring) will change the topography of the Project area. This is a positive change as the aim of rehabilitation is to return the topography to a state similar to the pre-development topography. After the surface infrastructure has been removed, the Project area should be profiled and contoured to restore drainage lines. Soil should then be spread and the Project area should be re-vegetated. Re-vegetation will help to prevent soil erosion.				
Mitigation required	■ Fill the shaft voids with waste rock; ■ Ensure that the rehabilitated area is re-contoured and profiled to a topography similar to the pre-development topography; ■ Spread soil over the rehabilitated area; ■ Ensure that surface water and drainage lines are rehabilitated to pre-development condition; and ■ Re-vegetate rehabilitated areas.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	4	6	Medium-low (72)[9]
Post-Mitigation	2	5	5	7	Medium-high (84)[10]

9.1.3 Post-Closure Phase

The post-closure phase is characterised by continuous monitoring and rehabilitation. The topography needs to be returned to a state similar to the pre-development topography. Soil erosion is visible in the Project area and surrounds due to the degraded nature of the natural vegetation. Particular attention must be paid to the management of the activities that affect the topography so as to prevent the occurrence of soil erosion.

[9] Positive impact

[10] Positive impact

9.1.3.1 Environment Returned to its Natural State

Criteria	Details / Discussion				
Description of impact	The Post-closure monitoring and rehabilitation is essential to limit the impact of the proposed Platreef Project on the topography. This is a neutral impact that will help to reverse some of the negative impacts. The topography, surface water flow and drainage lines need to be returned to a state similar to their pre-development state. Continuous monitoring and rehabilitation is essential to manage the risk of soil erosion.				
Mitigation required	■ Ensure that the post-development topography is as close as possible to the pre-development topography by re-contouring and profiling the Project area; ■ Ensure that surface water and drainage lines are rehabilitated to pre-development condition; and ■ Carefully monitor rehabilitated areas to ensure that soil erosion is prevented.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	4	6	Medium-low (72)[11]
Post-Mitigation	3	6	5	7	Medium-high (98)[12]

9.2 Visual Impact Assessment

9.2.1 Construction Phase

The construction phase is characterised by site development and infrastructure construction. This includes site clearing, topsoil removal and stockpiling, construction of surface infrastructure (access roads, pipes, storm water diversion berms, change houses, admin blocks, etc.), and drilling, blasting and development of infrastructure for mining. The establishment of infrastructure and related construction activities will draw attention to the infrastructure area and TSF site making receptors aware of the development. This phase will have negative visual impacts on the receiving environment. The surface infrastructure is medium-scale and will have a moderate visual impact.

[11] Positive impact

[12] Positive impact

9.2.1.1 Site Clearing Activities Influencing the Visual Environment

Criteria	**Details / Discussion**				
Description of impact	The removal of topsoil and vegetation will have a negative visual impact on the receiving environment. The infrastructure area and TSF site will become noticeable to the nearby receptors as it will contrast the surrounding areas.				
Mitigation required	■ Topsoil and vegetation should only be removed when and where necessary; and ■ Topsoil stockpiles should be vegetated and positioned to reduce visual disturbance where possible.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	4	7	Medium-high (84)
Post-Mitigation	3	5	3	6	Medium-low (66)

9.2.1.2 Construction of Surface Infrastructure Influencing the Visual Environment

Criteria	**Details / Discussion**				
Description of impact	The construction of surface infrastructure will have a negative visual impact on the receiving environment. This surface infrastructure includes the access roads, water and tailings pipelines, storm water diversion berms, change houses, admin blocks, crusher, processing plant, pollution control dams (PCD's), water storage dams, waste rock dumps and the TSF. Infrastructure lighting will be visible at night and will have a negative visual impact on the receiving environment. These visual impacts will occur for the life of the Project.				
Mitigation required	■ The area of the surface infrastructure should be limited where possible; ■ Surface infrastructure should be painted with natural hues so as to blend into the surrounding landscape where possible; ■ Down lighting should be implemented to minimise light pollution at night; ■ Pylons and metal structures should be galvanised so as to weather to a matt grey finish rather than be painted silver. If pylons and metal structures are to be painted it is recommended that a neutral matt finish be used; ■ Construction of vegetation berms should be implemented close to infrastructure so that vegetation can be established; ■ Numerous haul roads should not be created alongside each other; and ■ Roads should be wetted frequently by means of a water bowser to suppress dust.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	4	7	Medium-high (84)
Post-Mitigation	3	5	3	6	Medium-low (66)

9.2.1.3 Drilling, Blasting and Development of Infrastructure and Shafts for Mining will Influence the Visual Aspects of the Project Area[13]

Criteria	Details / Discussion				
Description of impact	The drilling, blasting and development of infrastructure and shafts for mining will have a negative visual impact on the receiving environment. Dust from blasting will have a negative visual impact on the receiving environment. The impact of the construction will occur for the life of the Project while the impact of the dust from blasting will occur during the construction phase.				
Mitigation required	■ The area of the surface infrastructure should be limited where possible; ■ Blasting should only take place when there are no winds blowing in the direction of the residential areas; ■ Blasting must be limited to the day times only and not during the night; ■ Surface infrastructure should be painted with natural hues so as to blend into the surrounding landscape where possible; ■ Down lighting should be implemented to minimise light pollution at night; ■ Pylons and metal structures should be galvanised so as to weather to a matt grey finish rather than be painted silver. If pylons and metal structures are to be painted it is recommended that a neutral matt finish be used; and ■ Construction of vegetation berms should be implemented close to infrastructure so that vegetation can be established.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	5	7	Medium high (91)
Post-Mitigation	3	5	4	6	Medium-low (72)

9.2.2 Operational Phase

The operational phase is characterised by the removal of PGM's (underground mining process. The operational phase will have negative visual impacts on the receiving environment. The underground mining process will have a moderate visual impact. The operation of surface infrastructure will have a moderate visual impact due to the size and height of the waste rock dumps and TSF. The transportation of mineral off site using trucks/conveyor will have a minor visual impact.

[13] Impact relating more to the mining activity

9.2.2.1 Adding material to the Waste Rock Dumps, Stock Piles and TSF

Criteria	**Details / Discussion**				
Description of impact	Operation of the ore stockpile, waste rock dumps and TSF will have a negative visual impact on the receiving environment. This impact will occur while material is being added to the dumps and stockpiles. The increasing height of the TSF will continue to draw attention to the area throughout the life of the Project. The TSF will remain beyond the closure phase of the proposed Platreef Project. This will result in a permanent and irreversible negative visual impact. Operation of the crusher will result in dust and draw attention to the mining area.				
Mitigation required	■ The ore stockpile, waste rock dumps and TSF should be positioned to reduce visual disturbance where possible; ■ The quantity and time of ore stored on site should be limited where possible; ■ The height of the waste rock dumps and TSF should be limited where possible; ■ The waste rock dumps and TSF should be top soiled and vegetated where possible; and ■ Dust suppression should be used during operation of the crusher.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	5	7	Medium-high (91)
Post-Mitigation	3	5	4	6	Medium-low (72)

9.2.3 Decommissioning Phase

The decommissioning phase is characterised by rehabilitation activities including the demolition and removal of all infrastructure, spreading of soil, re-vegetation and profiling/contouring. This phase will have mainly neutral visual impacts on the receiving environment. The demolition and removal of all infrastructures will have a minor neutral visual impact. The spreading of soil and re-vegetation, profiling/contouring will have a moderate neutral visual impact. Rehabilitation will assist to reduce the negative visual impact of the proposed Platreef Project on the receiving environment.

9.2.3.1 Demolition and Removal of all Infrastructure (including transportation off site)

Criteria	**Details / Discussion**				
Description of impact	The demolition and removal of all infrastructures will remove features from the surface and thereby changing the visual aspects of the environment in the Project area. This is a positive change that will help to reverse some of the negative changes that occurred when the infrastructure was constructed.				
Mitigation required	■ Ensure all unnecessary infrastructure is removed; and ■ Ensure all concrete foundations are removed.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	4	6	Medium-low (72)[14]
Post-Mitigation	2	5	5	7	Medium-high (84)[15]

9.2.3.2 Spreading of Soil, Re-vegetation and Profiling/Contouring

Criteria	**Details / Discussion**				
Description of impact	Rehabilitation (spreading of soil, re-vegetation and profiling/contouring) will change the visual aspects of the Project area. This is a positive change as the aim of rehabilitation is to return the topography to a state similar to the pre-development topography. After the surface infrastructure has been removed, the Project area should be profiled and contoured to restore drainage lines. Soil should then be spread and the Project area should be re-vegetated. Re-vegetation will help to prevent soil erosion.				
Mitigation required	■ Fill the shaft voids with waste rock; ■ Topsoil and vegetate the TSF; ■ Rehabilitate all disturbed areas; ■ Ensure all rehabilitated area are re-contoured and profiled to a topography similar to the pre-development topography; ■ Spread soil over the rehabilitated areas; and ■ Re-vegetate all rehabilitated areas.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	4	6	Medium-low (72)[16]
Post-Mitigation	2	5	5	7	Medium-high (84)[17]

[14] Positive impact

[15] Positive impact

[16] Positive impact

[17] Positive impact

9.2.4 Post-Closure Phase

The post-closure phase is characterised by continuous monitoring and rehabilitation. The Project area needs to be returned to a state similar to the pre-development state. Soil erosion occurs within the Project area and surrounds due to the degraded nature of the natural vegetation. Particular attention must be paid to the management of the activities that could result in soil erosion so as to prevent this negative visual impact from occurring.

9.2.4.1 Environment Returned to its Natural State

Criteria	**Details / Discussion**				
Description of impact	The Post-closure monitoring and rehabilitation is essential to limit the impact of the Project on the visual aspects for the surrounding area. This is a neutral impact that will help to reverse some of the negative impacts. Continuous monitoring and rehabilitation is essential to manage the risk of soil erosion.				
Mitigation required	■ Ensure that all disturbed areas are rehabilitated to a state as close as possible to the pre-development state.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	4	6	Medium-low (72)[18]
Post-Mitigation	3	6	5	7	Medium-high (98)[19]

9.3 Flora and Fauna

9.3.1 Construction Phase

Construction of the mining infrastructure will lead to the direct loss of the vegetation on the selected site. There are five different broad vegetation units found on site, which include three main types of habitat: Ridges, Degraded Bushveld and Riparian Vegetation, with Ridges and Riparian areas rated as Highly Sensitive for the majority of the site owing to a lack of major disturbance and a predominantly natural state. Vegetation is considered as a whole, and individual plant species (and SSC) are not taken into account for this impact.

The construction of the mining infrastructure will also result in the loss of certain biodiversity aspects. General Biodiversity will be affected (this includes individual species associated with vegetation).

[18] Positive impact

[19] Positive impact

9.3.1.1 Loss of Ridge Bushveld and Impacted Ridge Bushveld Vegetation due to Construction Activities

Criteria	**Details / Discussion**				
Description of impact	Construction of the mining infrastructure will lead to the direct loss of Ridge Bushveld and Impacted Ridge Bushveld vegetation.				
Mitigation required	■ Highly Sensitive Areas should be avoided and these include all Ridge Bushveld and Impacted Ridge Bushveld areas; ■ Areas that are not directly affected by mining activities should be conserved; ■ Where SSC are encountered, permits for the removal of these species must be obtained; and ■ A nursery is recommended which will serve to propagate indigenous species in order that they can restore disturbed areas, immediately after activity has ceased.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre- Mitigation	3	5	6	6	Medium-High (84)
Post-Mitigation	3	5	3	6	Medium-Low (66)

9.3.1.2 Loss of Secondary Grassland and Agricultural fields

Criteria	**Details / Discussion**				
Description of impact	Construction of the mining infrastructure will lead to the direct loss of secondary grassland and agricultural fields.				
Mitigation required	■ Areas that are not directly affected by mining activities should be conserved; ■ Areas that are not directly affected by mining activities should be conserved; ■ Where SSC are encountered, permits for the removal of these species must be obtained; and ■ A nursery is recommended which will serve to propagate indigenous species in order that they can restore disturbed areas, immediately after activity has ceased.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre- Mitigation	3	6	3	4	Medium – Low (48)
Post-Mitigation	3	6	2	2	Low (6)

9.3.1.3 Loss of Degraded Mixed Bushveld

Criteria	Details / Discussion				
Description of impact	Construction of the mining infrastructure will lead to the direct loss of degraded Mixed Bushveld.				
Mitigation required	■ Areas that are not directly affected by mining activities should be conserved; ■ Rehabilitation of areas small areas disturbed during construction and not needed for operation should occur concurrent to mining activity; and ■ A nursery is recommended which will serve to propagate indigenous species in order that they can restore disturbed areas, immediately after activity has ceased.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre- Mitigation	3	6	5	6	Medium – High (84)
Post-Mitigation	3	6	2	3	Low (33)

9.3.1.4 Loss of General Biodiversity

Criteria	Details / Discussion				
Description of impact	Construction of the mining infrastructure will lead to the potential loss of general biodiversity within the Project Area.				
Mitigation required	■ The areas of Very High Sensitivity (e.g. wetlands and riparian edges) will be avoided, with the exception of the Ridge Bushveld that will be impacted on by the TSF site 2; and ■ All SSC, as well as the immediate habitat surrounding them, should be preserved and mining should be restricted to areas outside of their immediate habitat.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	5	7	Medium-High (77)
Post-Mitigation	3	5	3	7	Medium-low (70)

9.3.1.5 Loss of Floral SSC

Criteria	**Details / Discussion**				
Description of impact	Construction of the mining infrastructure will lead to the potential loss of floral SSC				
Mitigation required	■ The areas of Very High Sensitivity (e.g. wetlands and riparian edges) will be avoided, with the exception of the Ridge Bushveld that will be impacted on by the TSF site 2; and ■ All SSC, as well as the immediate habitat surrounding them, should be preserved and mining should be restricted to areas outside of their immediate habitat.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	6	6	Medium-High (90)
Post-Mitigation	3	3	6	6	Medium-Low (72)

9.3.1.6 Loss of Faunal SSC

Criteria	**Details / Discussion**				
Description of impact	Construction of the mining infrastructure will lead to the potential loss of faunal SSC				
Mitigation required	■ All SSC, as well as the immediate habitat surrounding them, should be preserved as per the mitigation measures in the EMP (Section 13.1) and mining should be restricted to areas outside of their immediate habitat.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	6	6	6	Medium-High (90)
Post-Mitigation	3	6	3	6	Medium-Low (72)

9.3.1.7 Fragmentation and Edge Effects

Criteria	**Details / Discussion**				
Description of impact	The construction of the mining infrastructure will cause fragmentation and edge effects on the ecosystem function of the Project area.				
Mitigation required	■ It is highly recommended that areas of contiguous natural Bushveld be managed on site and in adjacent sites where mining is proposed, as part of a Biodiversity Action Management Plan; and ■ Cleared areas should be monitored for colonisation by alien species and a proactive approach should be undertaken to control alien species as soon as they are established.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	5	4	Medium- Low (56)
Post- Mitigation	6	3	3	4	Medium-Low (48)

9.3.1.8 Influx of Alien Invasive Species

Criteria	Details / Discussion				
Description of impact	Construction activities may cause the uncontrolled influx of alien invasive species within and around the Project area.				
Mitigation required	■ Cleared areas should be monitored for colonisation by alien species and a proactive approach should be undertaken to control alien species as soon as they are established; and ■ Where possible use pesticides or techniques to control pests that will not harm the environment.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	6	6	4	5	Medium- High (80)
Post- Mitigation	3	3	3	4	Medium-Low (36)

9.3.2 Operational Phase

Operation of the mining infrastructure will lead to the direct loss of biodiversity within the Project Area.

9.3.2.1 Loss of General Biodiversity

Criteria	Details / Discussion				
Description of impact	Operation of the mining infrastructure will lead to the potential loss of general biodiversity within the Project Area.				
Mitigation required	■ The areas of Very High Sensitivity (e.g. wetlands and riparian edges) will be avoided, with the exception of the Ridge Bushveld that will be impacted on by the TSF site 2; and ■ All SSC, as well as the immediate habitat surrounding them, should be preserved and mining should be restricted to areas outside of their immediate habitat.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre- Mitigation	3	5	4	6	Medium-High (72)
Post- Mitigation	3	5	3	6	Medium-Low (66)

9.3.2.2 Loss of Floral SSC

Criteria	**Details / Discussion**				
Description of impact	Operation of the mining infrastructure will lead to the potential loss of floral SSC				
Mitigation required	■ The areas of Very High Sensitivity (e.g. wetlands and riparian edges) will be avoided, with the exception of the Ridge Bushveld that will be impacted on by the TSF site 2; and ■ All SSC, as well as the immediate habitat surrounding them, should be preserved and mining should be restricted to areas outside of their immediate habitat.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	6	3	6	Medium-High (90)
Post-Mitigation	3	6	2	6	Medium-Low (66)

9.3.2.3 Loss of Faunal SSC

Criteria	**Details / Discussion**				
Description of impact	Operation of the mining infrastructure will lead to the potential loss of faunal SSC				
Mitigation required	■ The areas of Very High Sensitivity (e.g. wetlands and riparian edges) will be avoided, with the exception of the Ridge Bushveld that will be impacted on by the TSF site 2; and ■ All SSC, as well as the immediate habitat surrounding them, should be preserved and mining should be restricted to areas outside of their immediate habitat.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	6	6	6	Medium-High (90)
Post-Mitigation	3	6	3	6	Medium-Low (72)

9.3.2.4 Fragmentation and Edge Effects

Criteria	Details / Discussion				
Description of impact	The operation of the mining infrastructure wills cause fragmentation and edge effects on the ecosystem functions of the Project area.				
Mitigation required	■ It is highly recommended that areas of contiguous natural Bushveld be managed on site and in adjacent sites where mining is proposed, as part of a Biodiversity Action Management Plan; and ■ Cleared areas should be monitored for colonisation by alien species and a proactive approach should be undertaken to control alien species as soon as they are established;				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	4	4	Medium- Low (52)
Post-Mitigation	6	3	3	4	Medium-Low (48)

9.3.2.5 Influx of Alien Invasive Species

Criteria	Details / Discussion				
Description of impact	The operation of the mining infrastructure could cause the influx of alien invasive species.				
Mitigation required	■ Cleared areas should be monitored for colonisation by alien species and a proactive approach should be undertaken to control alien species as soon as they are established; and ■ Where possible use pesticides or techniques to control pests that will not harm the environment.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	6	6	5	5	Medium- High (85)
Post-Mitigation	3	3	2	4	Low (32)

9.3.3 Decommissioning Phase

9.3.3.1 Fragmentation and Edge Effects

Criteria	Details / Discussion				
Description of impact	Demolishing of mine infrastructure will cause fragmentation and edge effects on the ecosystem function of the Project area.				
Mitigation required	■ It is highly recommended that areas of contiguous natural Bushveld be managed on site and in adjacent sites where mining is proposed, as part of a Biodiversity Action Management Plan; ■ Cleared areas should be monitored for colonisation by alien species and a proactive approach should be undertaken to control alien species as soon as they are established;				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre- Mitigation	6	3	3	4	Medium-Low (48)
Post-Mitigation	6	3	2	4	Medium-Low (44)

9.3.3.1.1 <u>Influx of Alien Invasive Species</u>

Criteria	Details / Discussion				
Description of impact	Decommissioning activities could cause an influx of alien invasive species				
Mitigation required	■ Cleared areas should be monitored for colonisation by alien species and a proactive approach should be undertaken to control alien species as soon as they are established; and ■ Where possible use pesticides or techniques to control pests that will not harm the environment.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	6	3	5	Medium- High (60)
Post-Mitigation	2	2	3	4	Low (28)

9.4 Aquatic Impact Assessment

9.4.1 Construction Phase

The proposed underground platinum mine covers a large area, activities related to mining such as the temporary storage of hazardous chemicals, products and waste as well the dewatering of mine workings present potential hazards to the aquatic environment.

Due to the proposed mine being underground large areas of the surface need not be disturbed and the river systems may not need to be modified to a great extent. However the working may require water for everyday operations.

9.4.1.1 Introduction of Hydrocarbons and Nutrients

Criteria	Details / Discussion				
Description of impact	Introduction of hydrocarbons from oil/lubricants and nutrients from explosives and sewage treatment facilities could have an impact on the aquatic environment if introduced into surface water bodies within the project area during the construction phase.				
Mitigation required	■ All hydrocarbons and hazardous materials should be stored within a bunded area, spill kits should be provided in areas where any handling of hydrocarbons/hazardous materials is occurring; ■ Ensure effective storm water management to capture dirty water in accordance with GN R. 704; ■ Water should be treated before being discharged; and ■ Ensure quality of discharged water is within a similar state as the current.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	5	5	5	4	Medium-low (60)
Post-Mitigation	5	5	5	3	Medium-low (45)

9.4.1.2 Introduction of Dissolved Elements and Sedimentation

Criteria	**Details / Discussion**				
Description of impact	Site clearing and stockpiling activities can cause the introduction of sediment and salts into drainage channels and streams, thus having a negative impact on the aquatic environment.				
Mitigation required	■ A cut-off trench should be constructed around any stockpiles of overburden and topsoil; ■ Only remove vegetation that is within the Project footprint area to ensure that runoff and seepage around the Project area is maintained; ■ Ensure effective storm water management to capture dirty water; ■ Ensure quality of discharged water is within a similar state as the current				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	5	5	5	4	Medium-low (60)
Post-Mitigation	5	5	5	3	Medium-low (45)

9.4.2 Operational Phase

9.4.2.1 Introduction of Hydrocarbons and Nutrients

Criteria	**Details / Discussion**				
Description of impact	Introduction of hydrocarbons from oil/lubricants and nutrients from explosives and sewage treatment facilities could have an impact on the aquatic environment if introduced into surface water bodies within the project area during the operational phase.				
Mitigation required	■ All hydrocarbons and hazardous materials should be stored within a bunded area, spill kits should be provided in areas where any handling of hydrocarbons/hazardous materials is occurring; ■ Ensure effective storm water management to capture dirty water; ■ Ensure quality of discharged water is within a similar state as the current				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	5	5	5	4	Medium-low (60)
Post-Mitigation	5	5	5	3	Medium-low (45)

9.4.2.2 Introduction of dissolved elements and sedimentation

Criteria	**Details / Discussion**				
Description of impact	Stockpiling activities, and the waste rock dumps could cause the introduction of sediment and salts into drainage channels and streams, thus having a negative impact on the aquatic environment.				
Mitigation required	■ A cut-off trench should be constructed around any stockpiles of overburden and topsoil; ■ Only remove vegetation that is within the Project footprint area to ensure that runoff and seepage around the Project area is maintained; ■ Ensure effective storm water management to capture dirty water; ■ Ensure quality of discharged water is within a similar state as the current				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	5	5	5	4	Medium-low (60)
Post-Mitigation	5	5	5	3	Medium-low (45)

9.4.2.3 Reduced Water Quantity

Criteria	**Details / Discussion**				
Description of impact	Surface infrastructure activities could reduce the water quantity of the surrounding surface due to the generation of contaminated stormwater. Potential hydrocarbon spillages could also have a negative impact on surrounding surface water bodies.				
Mitigation required	■ Only dirty water should be managed in the storm water management plan; ■ No un-contaminated water should be stored; ■ Runoff should be managed in such a manner that channel straightening and erosion does not result in habitat loss; and ■ Water abstraction and effluent should be managed so as to replicate the volumes of local aquatic ecosystems.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre- Mitigation	3	5	5	5	Medium-low (65)
Post-Mitigation	3	5	5	5	Medium-low (65)

9.5 Wetlands

9.5.1 Construction Phase

As the mining will take place underground, it is anticipated that none of the shafts or surface infrastructure with the exception of the proposed TSF options will coincide with any wetland areas, the impacts on wetlands are expected to be minimal. A preferred location for the TSF will be recommended. It should be noted, however, that appropriate geotechnical investigations should be conducted in order to determine the potential for subsidence of the area due to the mining operation, as well as prescribing recommendations in order to avoid or in the least mitigate surface impacts.

9.5.1.1 Construction Activities will Lead to the Removal of Wetland Areas

Criteria	**Details / Discussion**				
Description of impact	No mining infrastructure with the exception of the TSF options is anticipated to impact on the wetland systems, and in light of the proposed mining operation,				
Mitigation required	■ A 100m buffer zone should be adhered to for all mining development in the project area.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre- Mitigation	3	6	3	5	Medium-Low (55)
Post-Mitigation	2	6	2	4	Medium-Low (36)

9.5.1.2 Construction activities will lead Loss of ecological services

Criteria	**Details / Discussion**				
Description of impact	Construction activates causing potential disturbances in Wetlands will result in the loss of ecological services in these areas.				
Mitigation required	■ A 100m buffer zone should be adhered to for all mining development in the project area.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre- Mitigation	3	6	3	5	Medium-Low (55)
Post-Mitigation	2	6	2	4	Medium-Low (36)

9.5.2 Operational Phase

Please refer to Sections 9.5.1.1 and 0 impacts during operational phase will remain the same as during the construction phase.

9.5.3 Decommissioning Phase

Please refer to Sections 9.5.1.1 and 0 impacts during decommissioning phase will remain the same as during the construction phase.

9.6 Surface Water Impact Assessment

9.6.1 Construction Phase

9.6.1.1 Erosion due to Clearance of Site

Criteria	**Details / Discussion**				
Description of impact	Erosion on site and surrounding areas may be increased due to site clearance of vegetation and veld. Increased runoff due to vegetation and veld removal therefore decreasing infiltration into soil which may impact on downstream communities.				
Mitigation required	■ Keep site clearance to a minimum in order to keep runoff to a minimum; and ■ There may be a need to construct temporary stormwater channels to divert runoff away from downstream communities.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	3	4	6	Medium-low (60)
Post-Mitigation	3	3	3	5	Medium-low (45)

9.6.1.2 Surface Water Run-off

Criteria	**Details / Discussion**				
Description of impact	■ Increased runoff due to vegetation removal (for the construction of surface infrastructures) therefore decreasing infiltration into soil which may impact on downstream communities. ■ Construction vehicles may pollute the site by spilling oil, petrol, cement, concrete, other building and portable sanitation facilities materials thereby polluting the runoff from the site area				
Mitigation required	Keep site clearance to a minimum in order to keep runoff to a minimum; and Clean spillages as they happen to prevent environmental damage.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	3	4	6	Medium-low (60)
Post-Mitigation	3	3	3	5	Medium-low (45)

9.6.1.3 Temporary Storage of Hazardous Materials

Criteria	**Details / Discussion**				
Description of impact	The water quality impacts may result from the spillages, improper handling, storage and use of hazardous materials.				
Mitigation required	■ Workshops and storage areas must be located on hard park that is compacted and has a bund to prevent the spread of hazardous material off the area of spillage; ■ Only Trained and authorised personnel only should be allowed to use the hazardous material; and ■ A standard operating procedure must be developed for the handling, storage and use of hazardous material.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	4	4	Medium-low (48)
Post-Mitigation	3	4	2	2	Low (18)

9.6.2 Operational Phase

9.6.2.1 Surface water run-off

Criteria	**Details / Discussion**				
Description of impact	Increased runoff due to large concrete terraces and roads and poor quality runoff from mining activities could impact the surface water quality.				
Mitigation required	■ Develop a proper stormwater management system; and ■ Clean spillages as they happen to prevent environmental damage.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	4	5	3	7	Medium-high (84)
Post-Mitigation	3	5	3	5	Medium-low (55)

9.6.2.2 Overflow flow from PCD's

Criteria	**Details / Discussion**				
Description of impact	Water storage facilities need to be designed operated and maintained in line with the GN R 704 specifications including the maintenance of a 0.8 m freeboard and capacity to contain a 1: 50 year 24 hr storm before overflowing. Due to the potential contamination of dirty water with hydrocarbons, chemicals and acid, the PCD must be lined as described in the DWA minimum requirements for the disposal of waste. The onsite use of the dirty water especially for dust suppression could further result in surface water contamination.				
Mitigation required	■ Water containment facilities for either dirty or clean process water (PCDs and other dams) should be designed in line with the GN R 704 requirements. Monitoring around the PCDs and downstream of PCDs should be carried out to detect accidental spillages on a monthly basis; ■ PCDs should be specified dirty areas so that when spillages occur, the dirty water can be contained before it can overflow to the natural system; ■ The dams should be lined to prevent leachate of nitrates and other pyritic material to the ground as they may be acid generating; and ■ The use of dirty water for dust suppression on surface should be prevented as this might spread the contaminants on surface and into the water resources.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	3	4	Medium-low (48)
Post-Mitigation	3	4	2	2	Low (18)

9.6.2.3 Spillages Occurring during the Temporary Storage of Hazardous Materials

Criteria	**Details / Discussion**				
Description of impact	The water quality impacts may result from the spillage, improper handling, storage and use of hazardous materials.				
Mitigation required	■ Workshops and storage areas must be located on hard park that is compacted and has a bund to prevent the spread of hazardous material off the area of spillage; ■ Only trained and authorised personnel only should be allowed to use the hazardous material; and ■ A standard operating procedure must be developed for the handling, storage and use of hazardous material.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	4	4	Medium-low (48)
Post-Mitigation	3	4	2	2	Low (18)

9.6.3 Decommissioning Phase

9.6.3.1 Demolition and Removal of Infrastructure (including Transportation Offsite)

Criteria	**Details / Discussion**				
Description of impact	During the demolition process there will be various forms of rubble created that could result in water quality impacts if disposed inappropriately. There may be mobilisation of contaminants during decommissioning that may have leaked over a long time and these may create new or have cumulative water quality impacts on the Vaalwaterspruit. Due to increased activity (vehicular and human) on site there is a potential for accidental spillage and there will also be waste generated. There may be water quality impacts arising from the inappropriate disposal of various waste forms and there may also be accidental spillages of waste ranging from general, hazardous to toxic. Water quality impacts will be significantly high in any of the Vaalwaterspruit or the Klein-Olifantsrivier catchments are impacted upon irrespective of the mining method.				
Mitigation required	■ The various forms of rubble should be disposed at appropriate sites and that which can be recycled should be used as such; ■ The waste management contractor must be on-site during demolition in order to implement clean-up of long-term leaks of hydrocarbons and explosives; ■ The vehicle speed limit on-site must be set low to reduce the potential for accidental spillage and the mobile toilets must be made available for use. These must be made adequate to service the number of people on site and should be managed and disposed at appropriate sites by an accredited contractor; and ■ Waste disposal on site must be in clearly marked and appropriate skip bins to prevent water quality impacts. Only authorised contractors may handle and dispose of the waste and hazardous substances at appropriate disposal sites to prevent water quality impacts.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	4	4	Medium-low (48)
Post-Mitigation	3	4	2	2	Low (18)

9.7 Groundwater Impact Assessment

9.7.1 Construction Phase

9.7.1.1 Potential Impacts of Site Infrastructure on Groundwater

Criteria	**Details / Discussion**				
Description of impact	Mining activities might have a potential impact on the groundwater table and saturated thickness of the Project area				
Mitigation required	■ Monitor water levels in the potentially affected areas.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	4	5	3	3	Low (36)
Post-Mitigation	3	5	2	1	Low (10)

Criteria	**Details / Discussion**				
Description of impact	Seepages from the TSF of PCD's and hydrocarbon spillages around the mining area and underground workings could have a potential impact on groundwater				
Mitigation required	■ All hydro-carbon spillages should be cleaned up immediately; ■ Appropriate liners, bunding and platforms should be constructed for the waste rock dump, ore stock pile, TSF and all pollution control dams; ■ Production vehicles and equipment should be maintained frequently; ■ Monitor water groundwater quality in the potentially affected areas; and ■ Toe drains should be installed on the downslope sides of the TSF to will capture any shallow seepage within the unsaturated zone.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	3	5	3	4	Medium-Low (44)
Post-Mitigation	3	5	2	2	Low (20)

9.7.1.2 Potential Impacts from the Mine Works on Groundwater[20]

Criteria	**Details / Discussion**				
Description of impact	Dewatering/lowering of water levels in Upper Aquifer may have a negative impact on groundwater quantities.				
Mitigation required	■ Monitor water levels in the potentially affected areas.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	3	5	3	3	Low (33)
Post-Mitigation	3	5	3	2	Low (22)

[20] Impact related more to the mining process

9.7.1.3 Impacts on Groundwater if the TSF is constructed at the Rietfontein Site

Criteria	**Details / Discussion**				
Description of impact	Seepages and lateral leakages from the TSF could have a potential negative impact on the groundwater quality of the aquifer underlying the Site.				
Mitigation required	■ Monitor water groundwater quality in the potentially affected areas; and ■ Toe drains should be installed on the downslope sides of the TSF to will capture any shallow seepage within the unsaturated zone.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	2	5	4	5	Medium-Low (55)
Post-Mitigation	2	5	2	1	Low (9)

9.7.1.4 Impacts on Groundwater if the TSF is constructed at the Bultongfontein Site

Criteria	**Details / Discussion**				
Description of impact	Seepages and lateral leakages from the TSF could have a potential negative impact on the groundwater quality of the upper aquifer underlying the Site.				
Mitigation required	■ Monitor water groundwater quality in the potentially affected areas; and ■ Toe drains should be installed on the downslope sides of the TSF to will capture any shallow seepage within the unsaturated zone.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	2	5	4	5	Medium-Low (55)
Post-Mitigation	2	5	2	2	Low (18)

9.7.2 Operational Phase

9.7.2.1 Potential Impacts of Site Infrastructure on Groundwater

Criteria	**Details / Discussion**				
Description of impact	Mining activities could have a potential impact on the groundwater table and saturated thickness of the Project area				
Mitigation required	■ Monitor water levels in the potentially affected areas.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	4	5	3	4	Medium-Low (48)
Post-Mitigation	3	5	2	1	Low (10)

Criteria	**Details / Discussion**
Description of impact	Seepages from the TSF of PCD's and hydrocarbon spillages around the mining area and underground could have a potential impact on Groundwater
Mitigation required	■ All hydro-carbon spillages should be cleaned up immediately;

	■ Production vehicles and equipment should be maintained frequently; ■ Monitor water groundwater quality in the potentially affected areas; and ■ Toe drains should be installed on the downslope sides of the TSF to will capture any shallow seepage within the unsaturated zone.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	3	5	4	5	Medium-Low (60)
Post-Mitigation	3	5	2	1	Low (10)

9.7.2.2 Potential Impacts from the Mine Works on Groundwater[21]

Criteria	**Details / Discussion**				
Description of impact	Dewatering/lowering of water levels in upper aquifer may have a negative impact on groundwater quantities.				
Mitigation required	■ Monitor water levels in the potentially affected areas.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	3	5	4	4	Medium-Low (48)
Post-Mitigation	3	5	4	2	Low (24)

9.7.2.3 Impacts on Groundwater if the TSF is constructed at the Rietfontein Site

Criteria	**Details / Discussion**				
Description of impact	Seepages and lateral leakages from the TSF could have a potential negative impact on the groundwater quality of the aquifer underlying the Site.				
Mitigation required	■ Monitor water groundwater quality in the potentially affected areas; and ■ Toe drains should be installed on the downslope sides of the TSF to will capture any shallow seepage within the unsaturated zone.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	2	5	4	5	Medium-Low (55)
Post-Mitigation	2	5	2	1	Low (9)

[21] Impact related more to the mining process

9.7.2.4 Impacts on Groundwater if the TSF is constructed at the Bultongfontein Site

Criteria	**Details / Discussion**				
Description of impact	Seepages and lateral leakages from the TSF could have a potential negative impact on the groundwater quality of the upper aquifer underlying the Site.				
Mitigation required	■ Monitor water groundwater quality in the potentially affected areas; and ■ Toe drains should be installed on the downslope sides of the TSF to will capture any shallow seepage within the unsaturated zone.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	2	5	5	5	Medium-Low (60)
Post-Mitigation	2	5	3	2	Low (20)

9.7.3 Decommissioning Phase

9.7.3.1 Potential Impacts of Site Infrastructure on Groundwater

Criteria	**Details / Discussion**				
Description of impact	Mining activities might have a potential impact on the groundwater table and saturated thickness of the Project area				
Mitigation required	■ Monitor water levels in the potentially affected areas.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	3	4	1	1	Low (8)
Post-Mitigation	3	4	1	1	Low (8)

Criteria	**Details / Discussion**				
Description of impact	Seepages from the TSF of PCD’s and hydrocarbon spillages around the mining area and underground could have a potential impact on Groundwater				
Mitigation required	■ All hydro-carbon spillages should be cleaned up immediately; ■ Production vehicles and equipment should be maintained frequently; ■ Monitor water groundwater quality in the potentially affected areas; and ■ Toe drains should be installed on the downslope sides of the TSF to will capture any shallow seepage within the unsaturated zone.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	3	4	3	4	Medium-Low (40)
Post-Mitigation	3	4	2	2	Low (18)

9.7.3.2 Potential Impacts from the Mine Works on Groundwater[22]

Criteria	Details / Discussion				
Description of impact	Dewatering/lowering of water levels in Upper Aquifer may have a negative impact on groundwater quantities.				
Mitigation required	■ Monitor water levels in the potentially affected areas.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	3	4	1	1	Low (8)
Post-Mitigation	3	4	1	1	Low (8)

9.7.3.3 Impacts on Groundwater if the TSF is constructed at the Rietfontein Site

Criteria	Details / Discussion				
Description of impact	Seepages and lateral leakages from the TSF could have a potential negative impact on the groundwater quality of the aquifer underlying the Site.				
Mitigation required	■ Monitor water groundwater quality in the potentially affected areas; and ■ Toe drains should be installed on the downslope sides of the TSF to will capture any shallow seepage within the unsaturated zone.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	2	4	3	4	Medium-Low (36)
Post-Mitigation	2	4	1	1	Low (7)

9.7.3.4 Impacts on Groundwater if the TSF is constructed at the Bultongfontein Site

Criteria	Details / Discussion				
Description of impact	Seepages and lateral leakages from the TSF could have a potential negative impact on the groundwater quality of the upper aquifer underlying the Site.				
Mitigation required	■ Monitor water groundwater quality in the potentially affected areas; and ■ Toe drains should be installed on the downslope sides of the TSF to will capture any shallow seepage within the unsaturated zone.				
Parameters	***Spatial***	***Duration***	***Severity***	***Probability***	***Significant rating***
Pre-Mitigation	2	4	3	4	Medium-Low (36
Post-Mitigation	2	4	2	2	Low (16)

[22] Impact related more to the mining process

9.8 Soil Impact Assessment

Activities associated with the construction, operation and decommissioning of each component of the Project will result in impacts on the soil environment.

9.8.1 Construction Phase

9.8.1.1 Soil Compaction and Topsoil loss due to Erosion

Criteria	**Details / Discussion**				
Description of impact	Activities during early works and construction in the Project area could lead to the following impacts on soils: ■ Soil compaction and topsoil loss leading to reduced agricultural potential; and ■ Soil erosion (sediment release to land and surface water).				
Mitigation required	■ Plan site clearance and alteration activities for the dry season (May to October); ■ Restrict extent of disturbance within the Platreef Project site and minimise activity within designated areas of disturbance; ■ Minimise the period of exposure of soil surfaces through dedicated planning; ■ Stripping operations should only be executed when soil moisture content will minimise the risk of compaction (during dry season); ■ During stockpiling, preferably use the 'end-tipping' method to keep the stockpiled soils loose; ■ Ensure stockpiles are placed on a free draining location to limit waterlogging; and ■ Limit stockpile height – a safe height can be regarded as the height at which material can be placed without repeated traffic over already placed material.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	7	3	7	Medium-high (91)
Post-Mitigation	3	7	2	7	Medium-high (84)

9.8.1.2 The impact of Temporary Storage of Hazardous Products (Fuel, Explosives) and Waste on Soil

<table>
<tr><th>Criteria</th><th colspan="5">Details / Discussion</th></tr>
<tr><td>Description of impact</td><td colspan="5">The potential for contamination of soil resources exists during site preparation and construction as a result of spills and/or leaks of fuels, oils and lubricants from construction or operational vehicles or machinery. Fluids used for vehicles and machinery may spill during filling, or leak directly in the event that damage to the fluid system goes unnoticed. Soil contamination associated with leaks and spills from machinery are reduced during the operation phase since site activities will be reduced.
The likelihood of a spill is also associated with the volume of product that may be stored onsite.</td></tr>
<tr><td>Mitigation required</td><td colspan="5">■ Construction vehicles and equipment should be serviced regularly, in a designated area;
■ Service areas must be paved;
■ Construction vehicles should remain on designated and prepared compacted gravel roads;
■ Areas that are used to store hydrocarbons must be bunded and be able to contain the spillage in the event of a spillage occurring;
■ Drip trays must be used when machinery and/or vehicles are serviced; and
■ Spill containment and clean up kits should be available onsite and clean-up from any spill must be in place and executed at the time of a spillage with appropriate disposal as necessary.</td></tr>
<tr><td>Parameters</td><td>Spatial</td><td>Duration</td><td>Severity</td><td>Probability</td><td>Significant rating</td></tr>
<tr><td>Pre-Mitigation</td><td>2</td><td>5</td><td>3</td><td>6</td><td>Medium-low (60)</td></tr>
<tr><td>Post-Mitigation</td><td>2</td><td>5</td><td>3</td><td>6</td><td>Medium-low (60)</td></tr>
</table>

9.8.2 Operational Phase

9.8.2.1 Soil Compaction and Topsoil loss due to Erosion

Criteria	**Details / Discussion**				
Description of impact	Activities during early works and operation al phase in the Project area could lead to the following impacts on soils: Soil compaction and topsoil loss leading to reduced agricultural potential; and Soil erosion (sediment release to land and surface water).				
Mitigation required	■ Re-vegetate cleared areas and stockpiles to avoid water erosion losses; ■ Preserve looseness of stockpiled soil by executing fertilisation and seeding operations by hand; and ■ Soil stockpiles should be monitored for fertility via sampling and testing; and ■ Monitoring of the condition of all unpaved roads is necessary due to the high rainfall and potential water runoff and erosion of the soils present in the Platreef Project site. Water runoff from compacted road surfaces may cause erosion of road shoulders degrading the road surface. Weekly inspections need to be carried out of all unpaved roads especially during the rainy season.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	7	3	7	Medium-high (91)
Post-Mitigation	3	7	2	7	Medium-high (84)

9.8.2.2 The Impact of Temporary Storage of Hazardous Products (Fuel, Explosives) and Waste on Soil

Criteria	Details / Discussion				
Description of impact	The potential for contamination of soil resources exists during the operational phase as a result of spills and/or leaks of fuels, oils and lubricants from construction or operational vehicles or machinery. Fluids used for vehicles and machinery may spill during filling, or leak directly in the event that damage to the fluid system goes unnoticed. Soil contamination associated with leaks and spills from machinery are reduced during the operation phase since site activities will be reduced. The likelihood of a spill is also associated with the volume of product that may be stored onsite.				
Mitigation required	■ Operations vehicles and equipment should be serviced regularly; ■ Service and parking areas must be paved; ■ Operations vehicles should remain on designated and prepared compacted gravel roads; ■ Spill containment and clean up kits should be available onsite and clean-up from any spill must be in place and executed at the time of a spillage with appropriate disposal as necessary; ■ Drip trays must be used when machinery and/or vehicles are serviced; ■ Fuel and heavy hydrocarbon products storage on site should be secured by bunded facilities; and ■ It is advisable to develop a soil monitoring plan and implement it after construction through collecting and analysis of soil samples within the Platreef Project site.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	2	5	3	6	Medium-low (60)
Post-Mitigation	2	5	3	6	Medium-low (60)

9.8.3 Decommissioning Phase

9.8.3.1 Impact of site rehabilitation on soil and land capability

Criteria	**Details / Discussion**				
Description of impact	The decommissioning of the Project site infrastructure will entail the demolition of buildings and removal of infrastructure. During the decommissioning activities, impacts to soil resources may include compaction and contamination which may be significant only in the short term. Stripped topsoil will be replaced by stockpiled topsoil and rehabilitated. Re-vegetation of the disturbed areas will allow a return to pre-impact land capability for agricultural land use				
Mitigation required	■ Demolition and removal of infrastructure should be restricted to the dry season (May to October); ■ Shaft areas must be filled and reshaped and the soil replaced. Subsoil first then topsoil; ■ Total soil thickness must at least be 1 m for the arable areas and 0.35 m (topsoil) for grazing land; ■ Minimize the period of exposure of soil surfaces through dedicated planning; and ■ Foundation excavations should be filled, fertilised and re-vegetated using local vegetation.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	7	7	7	High (119)
Post-Mitigation	3	7	2	7	Medium-high (84)

9.9 Air Quality Impact Assessment

9.9.1 Construction Phase

9.9.1.1 Fugitive Dust Generation due to Site Clearing Activities

Criteria	**Details / Discussion**				
Description of impact	It is anticipated that each of the above mentioned operations will have its own duration and potential for dust generation. Fugitive dust (containing TSP (total suspended particulate, will give rise to nuisance impacts as fallout dust), as well as PM10 and PM2.5 (dust with a size less than 10 microns, and dust with a size less than 2.5 microns giving rise to health impacts)) It is anticipated that the extent of dust emissions would vary substantially from day to day depending on the level of activity, the specific operations, and the prevailing meteorological conditions.				
Mitigation required	■ Topsoil should not be removed during windy months (August, September and October); ■ Wind breaks should be considered when minimising dust fall-out; ■ The area of disturbance must be kept to a minimum and no unnecessary clearing of vegetation must occur; ■ Topsoil should be re-vegetated to reduce the exposure areas; ■ During the loading of topsoil onto trucks or stockpiles, the dropping heights should be minimised; ■ Water or other binding agents such as (petroleum emulsions, polymers and adhesives) can be used for dust suppression on earth roads; and ■ When using bulldozers and graders, there is need to minimise travel speed and distance and volume of traffic on the roads.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	2	2	7	Medium-low (49)
Post-Mitigation	3	2	2	6	Medium-low (42)

9.9.1.2 Fugitive Dust Generations due to the Construction of Surface Infrastructure

Criteria	Details / Discussion				
Description of impact	Activities of vehicles on access roads, levelling and compacting of surfaces, as well localised drilling and blasting will have implications on ambient air quality. The above mentioned activities will result in fugitive dust emissions containing TSP (total suspended particulate, giving rise to nuisance impacts as fallout dust).				
Mitigation required	■ Topsoil should not be removed during windy months (August, September and October); ■ The area of disturbance must be kept to a minimum and no unnecessary clearing of vegetation must occur; and ■ During the loading of topsoil onto trucks or stockpiles, the dropping heights should be minimised.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	2	2	7	Medium-low (49)
Post-Mitigation	3	2	2	5	Low (35)

9.9.1.3 Fugitive Dust Generation due to the Transportation of Materials and Workers on Site

Criteria	Details / Discussion				
Description of impact	The production of fugitive dust (containing TSP, as well as PM10 and PM2.5) due to suspension of friable materials from earth roads.				
Mitigation required	■ Speed limits need to be observed and erecting speed humps; ■ Application of wetting agents or application of dust suppressant to bind soil surfaces to avoid soil erosion; and ■ During the loading of topsoil onto trucks or stockpiles, the dropping heights should be minimised.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	2	3	7	Medium-low (56)
Post-Mitigation	3	2	2	5	Low (35)

9.9.2 Operational Phase

9.9.2.1 Fugitive Emissions and Dust generated during the Underground Mining Activities

Criteria	**Details / Discussion**				
Description of impact	Drilling is an intermittent exercise that emits fugitive dust. There will be fumes from diesel trucks transporting ore to the conveyor belt. The conveyor belts deposit the ore into the crusher, the crushing process releases fugitive dust. Activities by machinery underground will lead to exhaust fumes from vehicles and dust from drilling and blasting processes. Fugitive dust (containing TSP, as well as PM10 and PM2.5) occurs as a result of the aforementioned processes.				
Mitigation required	■ Water sprays, filtration systems can be utilised to remove the pollutants from the air prior to their release to the surface via the vent, and ■ Use efficient diesel fuel (low sulphur ppm) for heavy underground machinery.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	6	3	7	Medium-low (72)
Post-Mitigation	3	5	2	4	Medium-low (40)

9.9.2.2 Crushing of Ore[23]

Criteria	**Details / Discussion**				
Description of impact	The use of the secondary crusher and TSF are the most likely to have implications on ambient air quality. The crushing process releases fugitive dust, especially if there are no enclosure and water sprays. Dust contained within the RoM ore can be released into the atmosphere during this process i.e. fugitive dust (containing TSP, as well as PM10 and PM2.5). Wind erosion from TSF can be a perennial source of dust if not properly managed during and post mining operations.				
Mitigation required	■ Install water sprays around the crushing area; ■ Ensure the crusher is enclosed; and ■ The TSF should undergo routine maintenance throughout the lifespan of the mine – with on-going re-vegetation to avoid exposed surface amenable to wind erosion.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	5	7	Medium-high (91)
Post-Mitigation	2	5	4	5	Medium-low (55)

[23] Impact related more to the mining process

9.9.3 Decommissioning Phase

9.9.3.1 Demolition & Removal of all Infrastructures (incl. transportation off site)

Criteria	**Details / Discussion**				
Description of impact	Potential for impacts during this phase will depend on the extent of demolition and rehabilitation efforts during closure as well as features which will remain. The impacts on the atmospheric environment during the decommissioning phase will be similar to the impacts during the construction phase. The process includes dismantling and demolition of existing infrastructure, transporting and handling of topsoil on unpaved roads in order to bring the site to its initial/rehabilitated state. Demolition and removal of all infrastructures will cause fugitive dust emissions.				
Mitigation required	■ Demolition should not be performed during windy periods (August, September and October); and ■ The area of disturbance must be kept to a minimum.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	2	3	5	Medium-low (40)
Post-Mitigation	3	2	2	5	Low (35)

9.9.4 Post-closure Phase

9.9.4.1 Post-closure Monitoring and Rehabilitation

Criteria	**Details / Discussion**				
Description of impact	The impacts on the atmospheric environment during rehabilitation will be limited to the vehicular activity during spreading of soil and profiling/contouring.				
Mitigation required	■ Rehabilitation by re-vegetating cleared areas should begin during the operational phase.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	2	4	6	Medium-low (54)
Post-Mitigation	3	2	2	4	Low (28)

9.10 Noise Impact Assessment

9.10.1 Construction Phase

9.10.1.1 Noise Generated due to Site clearing, Construction of Surface Infrastructure and Sinking of Vertical/Decline and Ventilation Shafts

Criteria	**Details / Discussion**				
Description of impact	The equipment and machinery involved such as excavators, bulldozers and haul trucks may impact on the surrounding ambient noise levels at the noise sensitive receivers near the Project area				
Mitigation required	■ As far as possible keep constructions activities to daylight hours; ■ Mining-related machine and vehicles must be serviced on a regular basis to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers; ■ Switching off equipment when not in use; and ■ Fixed noise producing sources such as generators, pump stations to be either housed in enclosures or barriers put up around the noise source.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	2	2	3	3	Low (21)
Post-Mitigation	2	2	3	2	Low (14)

9.10.2 Operational Phase

9.10.3 Noise Generated due to the Operation and Maintenance Infrastructure and Operation and Maintenance of Shafts

Criteria	**Details / Discussion**				
Description of impact	The vent shaft and the processing plant including milling activities will be a source of continuous noise in terms of the processing activities.				
Mitigation required	■ Mining-related machine and vehicles must be serviced on a regular basis to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers; ■ Switching off equipment when not in use; and ■ Fixed noise producing sources such as generators, pump stations to be either housed in enclosures or barriers put up around the noise source.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	1	5	2	3	Low (24)
Post-Mitigation	1	5	2	2	Low (16)

10 HERITAGE IMPACTS

10.1 Evaluation of Significance

The value of heritage resources located within the proposed Platreef Project will be determined based on criteria contained in Section 3(3) of the NHRA. These criteria have been summarised into four dimensions – aesthetic, scientific, historic, and/or social value. The value of heritage resources will be determined by assigning an importance rating to each dimension taking into account the resources' integrity and authenticity. The assigned ratings will be based on credible information sources, building on information collected for the Heritage Statement report and field based data collection. The methodology that will be used in evaluating heritage significance is summarised in the following formula:

The following formula therefore applies:

Value = Importance x Integrity
where
Importance = average sum of Aesthetic + Historic + Scientific + Social Significance

The evaluation will be done using a heritage value matrix specifically designed by Digby Wells to ensure that values are assigned as objectively as possible. In addition, the methodology aims to allow ratings to be reproduced independently should it be required, provided that the same information sources are used.

The rationale behind the heritage value matrix takes into account the fact that a heritage resource's value is a direct indication of its sensitivity to change (impacts). Value therefore needs to be determined prior to the completion of any assessment of impacts. The matrix further provides field ratings or grading's as required in terms of Section 7 of the NHRA and the SAHRA Minimum Standards for Heritage Impact Assessments.

10.2 Impact Assessment

Assessment of impacts on heritage resources will take into consideration accepted levels of change to resources in relation to the assigned values. Impacts will be quantified and ranked using a standard environmental impact matrix. The matrix has however been adapted to include heritage value.

Impacts will be rated in terms of the spatial scale, duration and intensity of changes in relation to the value of heritage resources. This will accordingly provide a consequence rating. The consequence of impacts/changes will then be considered relative to the confidence or probability of impacts/changes occurring to provide an impact magnitude. The methodology is summarised in the following formula:

Magnitude = Consequence x Probability
Where
Consequence = (Spatial Scale + Duration + Intensity) x Heritage Significance Value

The magnitude will then be applied to pre- and post-mitigation scenarios with the intention of removing all impacts on heritage resources. Where Project related mitigation does not avoid or sufficiently reduce negative changes/impacts on heritage resources with high values, mitigation of these resources may be required. This may include alteration, restoration or demolition of structures under a permit issued by Limpopo Heritage Resource Authority (LIHRA) and/or SAHRA.

Table 10-1: Heritage impacts identified within the Project area

Statement of Significance / Heritage Value			Impact Assessment	Impact Rating			Heritage Mitigation	
				Pre - Mitigation		Post - Mitigation		
Resource ID	**Resource Type**	**Description**	**Source of Risk**	**Nature of Change (N/P)**	**MAGNITUDE**	**MAGNITUDE**	**Field Rating**	**Minimum Required Mitigation**
PLA1677/S.35-006	Iron Age Smelting Site	Smelting site with terraced walls, middens and slag heap	The construction of the proposed TSF location option 2 will destroy the site. In addition, any removal of vegetation and ground clearing may expose more extensive deposit potentially existing subsurface.	N	103	32	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-023	Single grave	One grave	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-025	Single grave	One grave	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.35-027	Iron Age/Historical settlement	Stone walling with circular and rectangular foundations	The construction of the infrastructure within the Project will destroy the site. In addition, any removal of vegetation and ground clearing may expose more extensive deposit potentially existing subsurface	N	74	23	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-028	Single grave	One grave	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-029	Burial Ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction

Statement of Significance / Heritage Value			Impact Assessment	Impact Rating			Heritage Mitigation	
PLA1677/S.36-030	Burial Ground	10 graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-031	Burial Ground	20 graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-032	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-033	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-034	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-035	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction

Statement of Significance / Heritage Value			Impact Assessment	Impact Rating			Heritage Mitigation	
PLA1677/S.36-036	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-037	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-038	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-039	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-040	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-041	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction

Statement of Significance / Heritage Value			Impact Assessment	Impact Rating			Heritage Mitigation	
PLA1677/S.36-042	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-043	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-044	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-045	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-046	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-047	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction

Statement of Significance / Heritage Value			Impact Assessment	Impact Rating			Heritage Mitigation	
PLA1677/S.36-048	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-049	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-050	Burial ground	2 graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-051	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-052	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-053	Burial ground	11 graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction

Statement of Significance / Heritage Value			Impact Assessment	Impact Rating			Heritage Mitigation	
PLA1677/S.36-054	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-055	Burial ground	10 graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-056	Burial ground	6 graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-058	Burial ground	2 graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-059	Burial ground	2 graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-060	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction

Statement of Significance / Heritage Value			Impact Assessment	Impact Rating			Heritage Mitigation	
PLA1677/S.36-061	Burial ground	3 graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-062	Single grave	One grave	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-063	Single grave	One grave	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-064	Single grave	One grave	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-065	Single grave	One grave	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-066	Single grave	One grave	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction

Statement of Significance / Heritage Value			Impact Assessment	Impact Rating			Heritage Mitigation	
PLA1677/S.36-067	Burial Ground	8 graves within the burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-068	Single grave	One grave	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-069	Single grave	One grave	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-070	Burial ground	6 burials, 2 formal granite headstone (Sarah Ledwaba Ramadimetja 1992/09/28; Johannes Malesela Ledwaba 1962/08/11, four informal stone dressed graves	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in Alternative Plant area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.35-071	Iron Age/Historical settlement	Stone walling with circular and rectangular foundations and gong rock	The construction of the plant will destroy the site. In addition, any removal of vegetation and ground clearing may expose more extensive deposit potentially existing subsurface.	N	74	23	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-072	Burial ground	7 informal burials with large stones as headstones painted white; one grave has a metal marker (Madimetsa Maleka Raphtsaga)	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in Alternative Plant area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-073	Burial ground	4 formal burials with stone walling present nearby, with decorated pottery	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in Alternative Plant area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction

Statement of Significance / Heritage Value			Impact Assessment	Impact Rating			Heritage Mitigation	
PLA1677/S.36-074	Burial ground	One formal burial with granite headstone (In Loving Memory of Kapeye Lesetja Galane 1908/06/19-1966/03/20 Robala ka khutšo tlou	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in Alternative Plant area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-075	Burial ground	5 graves, 1 formal granite headstone (In Loving Memory of Raisibe Roti Martha Malindisa 1928/06/11-1956/10/15 buried on 1956/10/17 Robala ka khutšo mokane) and 4 informal with stone dressing (2 of the burials had large white stones as headstones)	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in Alternative Plant area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-076	Burial ground	3 informal burials, one child burial and 2 adult burials. The child burial had a metal plate at the headstone and one of the adult burials had a large metal bowl at the headstone. Decorated pottery was found next to the child burial and large un-diagnostic pottery was identified next to one of the adult burials	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in Alternative Plant area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-078	Burial ground	One grave	Immediate threats or risks include ground and vegetation clearance for the construction of pipeline. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-079	Burial ground	One grave	Immediate threats or risks include ground and vegetation clearance for the construction of pipeline. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-080	Burial ground	Undetermined amount of graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of pipeline. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.36-081	Burial ground	6 graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of pipeline. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction

Statement of Significance / Heritage Value			Impact Assessment	Impact Rating			Heritage Mitigation	
PLA1677/S.36-082	Burial ground	6 graves within burial ground	Immediate threats or risks include ground and vegetation clearance for the construction of pipeline. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	91	30	Field Rating IV A - General	Mitigation before destruction
PLA1677/S.34-083	Historical werf	Farmstead complex at entrance to Witvinger Nature Reserve, main residence approximately 100m from N11, with barn or outbuilding situated immediately adjacent to N11. Main residence surrounding by sisal plants, coral trees and naboom trees. No access possible	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure associated with the TSF Option 3 pipelines. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of werf by construction workers on site.	N	26	4	Field Rating IV C - General	No site mitigation required
PLA1677/S.36-085	Formal cemetery	Large fenced formal cemetery	Immediate threats or risks include ground and vegetation clearance for the construction of pipeline. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	N	99	32	Field Rating IV A - General	Mitigation before destruction
Makapansgat	World Heritage Site	Cave complex		N	24	6	Grade I - National	National heritage nomination; conservation

11 SOCIAL IMPACTS

The organisation and presentation of the full range of socio-economic impacts that are expected to arise because of a Project or activity is challenging, for a number of reasons.

First, potential impacts and the elements that combine to determine the socio-economic status of affected populations are multi-dimensional and interrelated. For example, insufficient access to services such as water, sanitation and health care is both a cause and an effect of poverty. (On the one hand, the lack of access to such services impacts negatively on health status, the opportunity to acquire market-related skills and the amount of time available for productive activities; and on the other hand, poor people are often forced to live in areas where service delivery is limited or absent.) Thus, if a Project increases the availability of services in an area, the ability of surrounding communities to take advantage of these services may, to some extent depend on their current socio-economic status.

Second, the linkages between various potential Project impacts are complex and can be mutually reinforcing. For example, in-migration and increased incomes can combine to put pressure on economies and infrastructure. Impacts may also have both positive and negative dimensions. For example, employment creation is an important Project benefit, but it may also generate a context for negative impacts such as social conflict or excessive in-migration.

The impact assessment methodology explained in Section were used during the assessment and evaluation of the social impacts identified below.

11.1 Construction Phase

This section deals with the social impacts that will originate during the construction phase of the Project, most of the identified impacts will continue beyond this phase. Predicted construction phase impacts include:

- Five positive impacts, namely job creation due to construction activities, multiplier effects on the local economy, economic empowerment of previously disenfranchised communities, skills transfer and development, community development induced by LED and Corporate Social Investment (CSI); and
- Nine negative impacts, namely economic displacement, disruption of movement patterns, visual/ acoustic/ vibration/ and air quality impacts, conflict or competition between newcomers and the incumbent population, increased pressure on local services and resources, increased social pathologies, establishment and growth of informal settlements, construction-related health and safety impacts, and opposition because of perceived negative impacts.

These impacts are discussed in greater detail below, and appropriate mitigation measures are recommended to ameliorate negative impacts and enhance positive ones. Where relevant, the reader is referred to the appropriate specialist studies, in which more comprehensive and quantitatively-orientated information is provided regarding aspects that contribute to the identified social impacts.

11.1.1 Job Creation during Construction

<table>
<tr><th colspan="2">Criteria</th><th colspan="3">Details / Discussion</th></tr>
<tr><td colspan="2">Description of impact</td><td colspan="3">The project has the potential to provide considerable employment to people within the local and site-specific project area during the construction phase.</td></tr>
<tr><td colspan="2">Mitigation required</td><td colspan="3">■ Recruitment to be coordinated through the Department of Labour;
■ Update and optimal use of the skills database;
■ Promotion of female and youth employment;
■ Effective implementation of training and skills development initiatives;
■ Monitoring subcontractors in terms of local employment targets; and
■ Labour-intensive construction methods should be promoted were possible.</td></tr>
<tr><td>Dimension</td><td>Rating</td><td colspan="3">Motivation</td></tr>
<tr><td colspan="5">Pre-mitigation</td></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>Equal to the duration of the construction phase of the project</td><td rowspan="3">Consequence: Slightly beneficial (9)</td><td rowspan="4">Significance: Minor - positive (36)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Platreef’s employment and recruitment policies already promotes local employment</td></tr>
<tr><td>Intensity x type of impact</td><td>Moderate - positive (3)</td><td>Platreef intends to employ at least 40% local labour</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">Without appropriate mitigation, local employment targets might not be achieved.</td></tr>
<tr><td colspan="5">Post-mitigation</td></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>As for pre-mitigation</td><td>Consequence: Moderately beneficial (12)</td><td>Significance: Moderate - positive (84)</td></tr>
</table>

11.1.2 Multiplier Effects on the Local Economy

<table>
<tr><th>Criteria</th><th colspan="4">Details / Discussion</th></tr>
<tr><td>Description of impact</td><td colspan="4">The project will result in several economic benefits for local communities through direct and multiplier effects stimulated by capital expenditure and construction activities.</td></tr>
<tr><td>Mitigation required</td><td colspan="4">■ Give preference first to capable subcontractors located in the local municipal area;
■ Establish linkages with other mining proponents in the area involved in skills and Small, Medium and Micro-sized Enterprises (SMME) development;
■ Align skills development to build capacity of SMMEs;
■ Utilise electronic business database to identify local SMMEs; and
■ Utilise the accommodation database to identify local accommodation options.</td></tr>
<tr><td>Dimension</td><td>Rating</td><td colspan="3">Motivation</td></tr>
<tr><td colspan="5">Post-mitigation</td></tr>
<tr><td>Duration</td><td>Long term (4)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Highly beneficial (14)</td><td rowspan="4">Significance: Moderate - positive (84)</td></tr>
<tr><td>Extent</td><td>District (4)</td><td>SMME capacity building will limited procurement from outside</td></tr>
<tr><td>Intensity x type of impact</td><td>Very high - positive (6)</td><td>Mitigation will likely increase intensity of multiplier effects</td></tr>
<tr><td>Probability</td><td>Highly probable (6)</td><td colspan="2">Increased local employment and procurement will enhance likelihood of benefits to local economy</td></tr>
</table>

11.1.3 Economic Empowerment of Previously Disenfranchised Communities

<table>
<tr><th colspan="2">Criteria</th><th colspan="3">Details / Discussion</th></tr>
<tr><td colspan="2">Description of impact</td><td colspan="3">An important contribution of the Project will be the empowerment of previously disenfranchised communities.</td></tr>
<tr><td colspan="2">Mitigation required</td><td colspan="3">■ Develop capacity of local Historically Disadvantaged South Africans (HDSA) SMMEs; and
■ Monitor compliance with procurement policy</td></tr>
<tr><td>Dimension</td><td>Rating</td><td colspan="3">Motivation</td></tr>
<tr><td colspan="5">Pre-mitigation</td></tr>
<tr><td>Duration</td><td>Long term (4)</td><td>Will continue through the life of mine</td><td rowspan="3">Consequence: Slightly beneficial (9)</td><td rowspan="4">Significance: Negligible - positive (27)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Will be beneficial to local business and local communities</td></tr>
<tr><td>Intensity x type of impact</td><td>Low - positive (2)</td><td>Will involve local procurement and local shareholding</td></tr>
<tr><td>Probability</td><td>Unlikely (3)</td><td colspan="2">HDSA service providers might not be available, and those that are available might not have the capacity or skills to provide goods and services</td></tr>
<tr><td colspan="5">Post-mitigation</td></tr>
<tr><td>Duration</td><td>Beyond project life (6)</td><td>Successful empowerment of HDSA will continue after mine closure</td><td rowspan="3">Consequence: Highly beneficial (15)</td><td rowspan="4">Significance: Moderate - positive (75)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>Very high - positive (6)</td><td>Mitigation will likely increase the capacity of HDSA operated SMMEs</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">As for pre-mitigation</td></tr>
</table>

11.1.4 Skills Transfer and Development

<table>
<tr><th>Criteria</th><th colspan="4">Details / Discussion</th></tr>
<tr><td>Description of impact</td><td colspan="4">A significant proportion of the construction and operational workforce will benefit from work experience as well a formal training programmes stipulated in the mine’s SLP, especially those individuals who start with a low level skill set..</td></tr>
<tr><td>Mitigation required</td><td colspan="4">Early involvement of project beneficiaries;
Collaboration with other existing/planned skills development programmes;
Skills development programmes should where possible focus on scarce skills; and
Guidelines encapsulated in Platreef’s HRD and LED policies will optimise skills development.</td></tr>
<tr><td>Dimension</td><td>Rating</td><td colspan="3">Motivation</td></tr>
<tr><td colspan="5">Pre-mitigation</td></tr>
<tr><td>Duration</td><td>Long term (4)</td><td>Benefits will likely occur during construction and operational phase</td><td rowspan="3">Consequence: Slightly beneficial (9)</td><td rowspan="4">Significance: Minor - positive (54)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Households and individuals in affected villages will be the primary beneficiary's</td></tr>
<tr><td>Intensity x type of impact</td><td>Low - positive (2)</td><td>Skills development will benefit some community members, employees and businesses</td></tr>
<tr><td>Probability</td><td>Highly probable (6)</td><td colspan="2">The mine is obliged by the SLP to carry out skills development</td></tr>
<tr><td colspan="5">Post-mitigation</td></tr>
<tr><td>Duration</td><td>Beyond project life (6)</td><td>Successful implementation will see benefits continuing beyond life of mine</td><td rowspan="3">Consequence: Highly beneficial (15)</td><td rowspan="4">Significance: Moderate - positive (90)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>Very high - positive (6)</td><td>Recommended measures will enhance stakeholder involvement and positive impact on beneficiaries</td></tr>
<tr><td>Probability</td><td>Highly probable (6)</td><td colspan="2">Recommended measures will improve likelihood of skills development programmes being implemented effectively</td></tr>
</table>

11.1.5 Community Development Induced By LED and CSI

<table>
<tr><th>Criteria</th><th colspan="4">Details / Discussion</th></tr>
<tr><td>Description of impact</td><td colspan="4">LED and CSI programmes have the potential to facilitate and catalyse socio-economic development within the project affected communities, as most of these communities have a relatively low socio-economic base.</td></tr>
<tr><td>Mitigation required</td><td colspan="4">Assuring stakeholder buy-in and participation; and
Aligning LED and CSI initiatives with those of other development role-players</td></tr>
<tr><td>Dimension</td><td>Rating</td><td colspan="3">Motivation</td></tr>
<tr><td colspan="5">Pre-mitigation</td></tr>
<tr><td>Duration</td><td>Long term (4)</td><td>LED and CSI activities are planned for the life of mine</td><td rowspan="3">Consequence: Slightly beneficial (9)</td><td rowspan="4">Significance: Negligible - positive (27)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Will be beneficial to communities in the site-specific and local project area</td></tr>
<tr><td>Intensity x type of impact</td><td>Low - positive (2)</td><td>Community currently experiences high unemployment and poverty levels, and low literacy levels</td></tr>
<tr><td>Probability</td><td>Unlikely (3)</td><td colspan="2">Without adequate stakeholder involvement, LED projects is unlikely to be sustainable</td></tr>
<tr><td colspan="5">Post-mitigation</td></tr>
<tr><td>Duration</td><td>Beyond project life (6)</td><td>If sustainably managed and effectively marketed, could extend beyond the life of the mine</td><td rowspan="3">Consequence: Highly beneficial (15)</td><td rowspan="4">Significance: Moderate - positive (75)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>Very high - positive (6)</td><td>Recommended measures will enhance stakeholder involvement and positive impact on beneficiaries</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">Recommended measures will improve likelihood of project sustainability</td></tr>
</table>

11.1.6 Economic Displacement

Criteria	**Details / Discussion**
Description of impact	Economic displacement refers to a loss of access to cultivated land or other livelihood resources, while physical displacement refers to a situation where people or households have to be moved to a different location to make way for project infrastructure or due to considerable risk to personal safety It must be noted that Platreef has expressed the intention of ensuring that project design and implementation are conducted in such a way that no physical displacement will be required. A large proportion of the site-specific study area is currently used for purposes other than mining. The nature and location of most project surface infrastructure options will result in some economic displacement.
Mitigation required	■ Resettle Action Plan (RAP) development; ■ Surface lease agreements; and ■ For non-vulnerable households and individuals, negotiate favourable outcome on a case-by-case basis.

Dimension	Rating	Motivation		
Pre-mitigation				
Duration	Permanent (7)	Affected households and individuals will be permanently relocated and land uses could be discontinued permanently		
Extent	Limited (2)	Although physical displacement will be minimal, economic displacement will occur in the project footprint	Consequence: Highly detrimental (-15)	Significance: Moderate - negative (-75)
Intensity x type of impact	Very high - negative (-6)	Without proper compensation, it could have a devastating effect		
Probability	Likely (5)	Nature and location of project will most likely result in economic displacement		
Post-mitigation				
Duration	Permanent (7)	As for pre-mitigation		
Extent	Limited (2)	As for pre-mitigation	Consequence: Moderately detrimental (-12)	Significance: Minor - negative (-60)
Intensity x type of impact	Moderate - negative (-3)	Adequate mitigation will significantly reduce adverse effects of displacement		
Probability	Likely (5)	As for pre-mitigation		

11.1.7 Disruption of Movement Patterns

<table>
<tr><th>Criteria</th><th colspan="4">Details / Discussion</th></tr>
<tr><td>Description of impact</td><td colspan="4">Several sites designated for the mine infrastructure are situated on unpopulated, but arable land, often used for agriculture and grazing purposes. This will cause disruptions in the movement of the community in the area.</td></tr>
<tr><td>Mitigation required</td><td colspan="4">Measures to alleviate traffic problems will also serve to maintain and promote; and
Inform communities of planned construction activities that would affect vehicle/ pedestrian traffic.</td></tr>
<tr><td>Dimension</td><td>Rating</td><td colspan="3">Motivation</td></tr>
<tr><td colspan="5">Pre-mitigation</td></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>Will be most pronounced during construction phase</td><td rowspan="3">Consequence: Moderately detrimental (-12)</td><td rowspan="4">Significance: Moderate - negative (-84)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Will affect communities using foot paths as well as those using the N11 and R 518</td></tr>
<tr><td>Intensity x type of impact</td><td>Very high - negative (-6)</td><td>Could affect a large number of people travelling on the N11 and R518 from villages to work in Mokopane</td></tr>
<tr><td>Probability</td><td>Certain (7)</td><td colspan="2">Construction traffic will affect travelling on major roads, and the location of infrastructure will overlap with several walkways that allows access to agricultural and grazing areas</td></tr>
<tr><td colspan="5">Post-mitigation</td></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Slightly detrimental (-7)</td><td rowspan="4">Significance: Negligible - negative (-35)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>Very low - negative (-1)</td><td>Measures are likely to reduce the intensity of this impact</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">Measures would decrease the probability of impacts occurring to the extent predicted</td></tr>
</table>

11.1.8 Construction-Related Health and Safety Impacts

Criteria	**Details / Discussion**
Description of impact	Construction activities are likely to result in an increase in traffic volumes on roads in the vicinity of the local project area. Traffic impacts affect the lives and well-being of people; it therefore also qualifies as a social impact.
Mitigation required	■ Traffic control; ■ Road maintenance; ■ Regulation of traffic at intersection of haul road at N11; ■ Fencing of mine site; ■ Prevention of fires; and ■ Community education.

<table>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><td colspan="5">Pre-mitigation</td></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>Will be limited to construction related activities</td><td rowspan="3">Consequence: Moderately detrimental (-12)</td><td rowspan="4">Significance: Minor - negative (-72)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Will affect neighbouring communities, as well as road users from wider communities</td></tr>
<tr><td>Intensity x type of impact</td><td>Very high - negative (-6)</td><td>Could place the lives of neighbouring community members at risk</td></tr>
<tr><td>Probability</td><td>Highly probable (6)</td><td colspan="2">Increase in traffic levels has been quantitatively assessed in a separate specialist study</td></tr>
<tr><td colspan="5">Post-mitigation</td></tr>
<tr><td>Duration</td><td>Long term (4)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Slightly detrimental (-7)</td><td rowspan="4">Significance: Negligible - negative (-28)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>Very low - negative (-1)</td><td>Appropriate mitigation will reduce the risk of this impact</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">Mitigation measures will reduce the probability of accidents by reducing risk</td></tr>
</table>

11.1.9 Visual/ Acoustic/ Vibration/ Air Quality Impacts

Criteria	**Details / Discussion**
Description of impact	The construction of the Project will represent a significant intrusion into the surrounding physical environment, which could impact on surrounding communities in various ways, this impact will likely continue into the operational phase of the project, but will be most prominent during the construction phase.
Mitigation required	■ Visual, noise, vibration, and air quality mitigation are discussed in separate specialist studies; and ■ For sense of place: rehabilitation after closure & measure to enhance positive impacts.

Dimension	Rating	Motivation		
Pre-mitigation				
Duration	Project Life (5)	Will peak during construction, but continue through the life of the mine	Consequence: Moderately detrimental (-13)	Significance: Moderate - negative (-91)
Extent	Limited (2)	Will affect adjoining communities		
Intensity x type of impact	Very high - negative (-6)	Will affect the quality of life of neighbouring communities		
Probability	Certain (7)	Impacts on the visual environment and air quality have been quantitatively assessed in separate specialist studies		
Mitigation				
■ Visual, noise, vibration, and air quality mitigation are discussed in separate specialist studies; ■ For sense of place: rehabilitation after closure & measure to enhance positive impacts				
Post-mitigation				
Duration	Project Life (5)	As for pre-mitigation	Consequence: Slightly detrimental (-10)	Significance: Minor - negative (-63)
Extent	Limited (2)	As for pre-mitigation		
Intensity x type of impact	Moderate - negative (-3)	Mitigation will reduce impacts to some extent		
Probability	Certain (7)	As for pre-mitigation		

11.1.10 Increase in Spread of Communicable Diseases and Social Pathologies

<table>
<tr><th>Criteria</th><th colspan="4">Details / Discussion</th></tr>
<tr><td>Description of impact</td><td colspan="4">An important contribution of the Project will be the empowerment of previously disenfranchised communities. Platreef intends to transfer a 26% stake in the mine to affected communities (most of which have HDSA status), women and children, and employees.</td></tr>
<tr><td>Mitigation required</td><td colspan="4">■ Develop capacity of local HDSA SMMEs; and
■ Monitor compliance with procurement policy.</td></tr>
<tr><td>Dimension</td><td>Rating</td><td colspan="3">Motivation</td></tr>
<tr><td colspan="5">Pre-mitigation</td></tr>
<tr><td>Duration</td><td>Long term (4)</td><td>Will continue through the life of mine</td><td rowspan="3">Consequence: Slightly beneficial (9)</td><td rowspan="4">Significance: Negligible - positive (27)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Will be beneficial to local business and local communities</td></tr>
<tr><td>Intensity x type of impact</td><td>Low - positive (2)</td><td>Will involve local procurement and local shareholding</td></tr>
<tr><td>Probability</td><td>Unlikely (3)</td><td colspan="2">HDSA service providers might not be available, and those that are available might not have the capacity or skills to provide goods and services</td></tr>
<tr><td colspan="5">Post-mitigation</td></tr>
<tr><td>Duration</td><td>Beyond project life (6)</td><td>Successful empowerment of HDSA will continue after mine closure</td><td rowspan="3">Consequence: Highly beneficial (15)</td><td rowspan="4">Significance: Moderate - positive (75)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>Very high - positive (6)</td><td>Mitigation will likely increase the capacity of HDSA operated SMMEs</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">As for pre-mitigation</td></tr>
</table>

11.1.11 Conflict/ Competition between Newcomers and Incumbent Population

<table>
<tr><th>Criteria</th><th colspan="4">Details / Discussion</th></tr>
<tr><td>Description of impact</td><td colspan="4">A proportion of the construction workforce for the project will be locals, while at least a certain percentage of semi and highly skilled employees will be sourced from elsewhere in South Africa.</td></tr>
<tr><td>Mitigation required</td><td colspan="4">■ Measures to mitigate population influx</td></tr>
<tr><td>Dimension</td><td>Rating</td><td colspan="3">Motivation</td></tr>
<tr><td colspan="5">Pre-mitigation</td></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>Could continue after construction is complete</td><td rowspan="3">Consequence: Moderately detrimental (-11)</td><td rowspan="4">Significance: Minor - negative (-44)</td></tr>
<tr><td>Extent</td><td>Limited (2)</td><td>Will affect surrounding communities</td></tr>
<tr><td>Intensity x type of impact</td><td>Very high - negative (-6)</td><td>High unemployment in the area is likely to engender intense competition for jobs</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">Highly probable that some workers would have to be recruited from elsewhere and that locals will feel overseen</td></tr>
<tr><td colspan="5">Post-mitigation</td></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Slightly detrimental (-7)</td><td rowspan="4">Significance: Negligible - negative (-21)</td></tr>
<tr><td>Extent</td><td>Limited (2)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>Low - negative (-2)</td><td>Stringent enforcement of preferential local employment policy may reduce influx of jobseekers</td></tr>
<tr><td>Probability</td><td>Unlikely (3)</td><td colspan="2">Verification of workers as locals will reduce probability of outsiders fraudulently gaining positions</td></tr>
</table>

11.1.12 Increased Pressure On local Services/ Resources

<table>
<tr><th>Criteria</th><th colspan="4">Details / Discussion</th></tr>
<tr><td>Description of impact</td><td colspan="4">An influx of job-seekers into the area, combined with the presence of an additional workforce, will place considerable pressure on local infrastructure and services.</td></tr>
<tr><td>Mitigation required</td><td colspan="4">■ Liaison with district and local municipalities well in advance to ensure needs are met;
■ Ensure that municipalities take into account expected population influx; and
■ Influx management.</td></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><td colspan="5">Pre-mitigation</td></tr>
<tr><td>Duration</td><td>Long term (4)</td><td>May continue throughout the construction phase</td><td rowspan="3">Consequence: Moderately detrimental (-13)</td><td rowspan="4">Significance: Moderate - negative (-78)</td></tr>
<tr><td>Extent</td><td>District (4)</td><td>May affect resource management at district level</td></tr>
<tr><td>Intensity x type of impact</td><td>High - negative (-5)</td><td>Intensify existing service delivery and resource problems and backlogs</td></tr>
<tr><td>Probability</td><td>Highly probable (6)</td><td colspan="2">Population influx will affect the performance of both the district and local municipalities</td></tr>
<tr><td colspan="5">Post-mitigation</td></tr>
<tr><td>Duration</td><td>Long term (4)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Slightly detrimental (-8)</td><td rowspan="4">Significance: Negligible - negative (-32)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Effective planning can reduce impacts to local municipal level</td></tr>
<tr><td>Intensity x type of impact</td><td>Very low - negative (-1)</td><td>Mitigation measures can assist in reducing backlogs</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">Mitigation will reduce likelihood of impact to the extent predicted</td></tr>
</table>

11.1.13 Establishment and Growth of Informal Settlements

<table>
<tr><th colspan="2">Criteria</th><th colspan="3">Details / Discussion</th></tr>
<tr><td colspan="2">Description of impact</td><td colspan="3">An influx of job-seekers into the area, combined with the presence of an additional workforce, will place considerable pressure on local infrastructure and services.</td></tr>
<tr><td colspan="2">Mitigation required</td><td colspan="3">■ Liaison with district and local municipalities well in advance to ensure needs are met;
■ Ensure that municipalities take into account expected population influx; and
■ Influx management.</td></tr>
<tr><td>Dimension</td><td>Rating</td><td colspan="3">Motivation</td></tr>
<tr><td colspan="5">Pre-mitigation</td></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>Likely to extend into the operational phase</td><td rowspan="3">Consequence: Moderately detrimental (-11)</td><td rowspan="4">Significance: Minor - negative (-55)</td></tr>
<tr><td>Extent</td><td>Limited (2)</td><td>Will affect the site specific area and other nearby communities</td></tr>
<tr><td>Intensity x type of impact</td><td>Very high - negative (-6)</td><td>Will exacerbate existing negative social conditions</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">Informal settlements is already a problem (e.g. Mzombane)</td></tr>
<tr><td colspan="5">Mitigation</td></tr>
<tr><td colspan="5">■ Mitigation measures recommended in Section 6.2.10 to discourage influx.</td></tr>
<tr><td colspan="5">Post-mitigation</td></tr>
<tr><td>Duration</td><td>Medium term (3)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Slightly detrimental (-6)</td><td rowspan="4">Significance: Negligible - negative (-18)</td></tr>
<tr><td>Extent</td><td>Limited (2)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>Very low - negative (-1)</td><td>Mitigation is likely to reduce the number of new squatting residences established</td></tr>
<tr><td>Probability</td><td>Unlikely (3)</td><td colspan="2">Mitigation will reduce the likelihood of this impact occurring to the extent predicted</td></tr>
</table>

11.1.14 Opposition Because of Perceived Negative Impacts

Criteria	**Details / Discussion**
Description of impact	Impact of community attitudes and actions on the project. The impact assessed here pertains to the fact that perceptions regarding potential negative project impacts.
Mitigation required	▪ Communicate commitments regarding LED; ▪ Transparency regarding employment practices; and ▪ Presentation of EIA findings in clear and understandable manner.

<table>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><td colspan="5">Pre-mitigation</td></tr>
<tr><td>Duration</td><td>Project Life (5)</td><td>May continue throughout the life of the operation</td><td rowspan="3">Consequence: Highly detrimental (-14)</td><td rowspan="4">Significance: Moderate - negative (-84)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Will be most prominent in surrounding villages, but might spread through the entire local municipal area</td></tr>
<tr><td>Intensity x type of impact</td><td>Very high - negative (-6)</td><td>Could lead to negative publicity for the company; community mobilisation against the project</td></tr>
<tr><td>Probability</td><td>Highly probable (6)</td><td colspan="2">Stakeholders are sensitive towards many possible impacts that may result from development; also litigation has already occurred</td></tr>
<tr><td colspan="5">Post-mitigation</td></tr>
<tr><td>Duration</td><td>Project Life (5)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Moderately beneficial (11)</td><td rowspan="4">Significance: Minor - positive (44)</td></tr>
<tr><td>Extent</td><td>District (4)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>Low - positive (2)</td><td>Mitigation will enable proponent to capitalise on existing goodwill</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">Widespread awareness of project benefits will increase probability of generating goodwill</td></tr>
</table>

11.2 Operational Phase

This section deals with the social impacts that will be most pronounced or triggered during the operational phase of the Project. Only two of the impacts identified. Additional impacts expected to arise during the operational phase are as follows:

- Two positive impacts, namely job creation and regional economic development; and
- Two negative impacts, namely economic dependency on the Project, and operational-related health and safety impacts.

As with the construction phase impacts, each of the abovementioned impacts is discussed in greater detail below, and appropriate mitigation measures are recommended. Where relevant, the reader is referred to the appropriate specialist studies, in which more comprehensive and quantitatively-orientated information is provided regarding aspects that contribute to the identified social impacts.

11.2.1 Job Creation during Operation

Criteria	**Details / Discussion**			
Description of impact	Impact of community attitudes and actions on the project. The impact assessed here pertains to the fact that perceptions regarding potential negative project impacts.			
Mitigation required	■ As for construction phase; and ■ Intensifying efforts in the SLP to develop scarce skills.			
Dimension	Rating	Motivation		
Pre-mitigation				
Duration	Project Life (5)	Life of mine will be 30 years	Consequence: Moderately beneficial (12)	Significance: Minor - positive (60)
Extent	District (4)	A considerable number of positions will be filled by persons living in the local municipal area; and some from elsewhere in the province		
Intensity x type of impact	Moderate - positive (3)	Approximately 2 100 jobs will be created		
Probability	Likely (5)	Without appropriate mitigation, forecasts of majority local recruitment might not be achieved		
Post-mitigation				
Duration	Project Life (5)	As for pre-mitigation	Consequence: Highly beneficial (15)	Significance: Moderate - positive (105)
Extent	District (4)	As for pre-mitigation		
Intensity x type of impact	Very high - positive (6)	Mitigation will maximise local job creation		
Probability	Certain (7)	Mitigation will maximise probability that local recruitment targets are achieved and local benefits optimised		

11.2.2 Regional Economic Development

<table>
<tr><th>Criteria</th><th colspan="4">Details / Discussion</th></tr>
<tr><td>Description of impact</td><td colspan="4">Impact of community attitudes and actions on the project. The impact assessed here pertains to the fact that perceptions regarding potential negative project impacts.</td></tr>
<tr><td>Mitigation required</td><td colspan="4">■ Measures recommended maximising benefits from local employment, skills and economic development.</td></tr>
<tr><td>Dimension</td><td>Rating</td><td colspan="3">Motivation</td></tr>
<tr><td colspan="5">Pre-mitigation</td></tr>
<tr><td>Duration</td><td>Long term (4)</td><td>Life of mine is 30 years</td><td rowspan="3">Consequence: Moderately beneficial (10)</td><td rowspan="4">Significance: Negligible - positive (30)</td></tr>
<tr><td>Extent</td><td>Province/ Region (5)</td><td>Royalties and taxes will aid regional development; contribution to regional infrastructure projects; culmination of positive economic effects will stimulate regional economic growth</td></tr>
<tr><td>Intensity x type of impact</td><td>Very low - positive (1)</td><td>Effects on regional economy will not be as pronounced</td></tr>
<tr><td>Probability</td><td>Unlikely (3)</td><td colspan="2">Platreef is obliged by law to pay royalties and taxes, and some economic multiplier effects will spill-over into regional economic development</td></tr>
<tr><td colspan="5">Post-mitigation</td></tr>
<tr><td>Duration</td><td>Long term (4)</td><td>As for pre-mitigation</td><td rowspan="3">Consequence: Highly beneficial (15)</td><td rowspan="4">Significance: Moderate - positive (75)</td></tr>
<tr><td>Extent</td><td>Province/ Region (5)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>Very high - positive (6)</td><td>Successful mitigation will create an environment conducive for economic growth</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">Mitigation will increase the chance of the manifestation of this impact</td></tr>
</table>

11.2.3 Dependency on Mine for Sustaining Local Economy

<table>
<tr><th>Criteria</th><th colspan="4">Details / Discussion</th></tr>
<tr><td>Description of impact</td><td colspan="4">Impact of community attitudes and actions on the project. The impact assessed here pertains to the fact that perceptions regarding potential negative project impacts.</td></tr>
<tr><td>Mitigation required</td><td colspan="4">■ Develop turnaround or redeployment strategies;
■ Publicise to mines in the industry that excess skills are available;
■ Implement actions, suggested by the Department of Labour;
■ Equip the affected employees as well as members of the community with portable skills; and
■ Support economic diversification through development of alternative markets.</td></tr>
<tr><td>Dimension</td><td>Rating</td><td>Motivation</td><td></td><td></td></tr>
<tr><td colspan="5">Pre-mitigation</td></tr>
<tr><td>Duration</td><td>Beyond project life (6)</td><td>Effects of retrenchments/ mine closure will be long-lasting</td><td rowspan="3">Consequence: Highly detrimental (-16)</td><td rowspan="4">Significance: Major - negative (-112)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Will mainly affect surrounding communities as a large proportion of the workforce is to be recruited locally</td></tr>
<tr><td>Intensity x type of impact</td><td>Extremely high - negative (-7)</td><td>A large number of HHs will be heavily dependent on the mine</td></tr>
<tr><td>Probability</td><td>Certain (7)</td><td colspan="2">Mining is not a permanent activity</td></tr>
<tr><td colspan="5">Post-mitigation</td></tr>
<tr><td>Duration</td><td>Long term (4)</td><td>Mitigation may decrease period of unemployment</td><td rowspan="3">Consequence: Slightly detrimental (-9)</td><td rowspan="4">Significance: Minor - negative (-36)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>As for pre-mitigation</td></tr>
<tr><td>Intensity x type of impact</td><td>Low - negative (-2)</td><td>Mitigation will reduce retrenchment related impacts</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">Mitigation will somewhat reduce dependency of local economy of mining</td></tr>
</table>

11.2.4 Operation-Related Health and Safety Impacts

Criteria	Details / Discussion
Description of impact	Impact of community attitudes and actions on the project. The impact assessed here pertains to the fact that perceptions regarding potential negative project impacts.
Mitigation required	■ As for construction phase; ■ Plant maintenance; and ■ Rigorous health and safety programmes.

Dimension	Rating	Motivation		
Pre-mitigation				
Duration	Long term (4)	Impacts will continue for the life of the mine	Consequence: Moderately detrimental (-10)	Significance: Minor - negative (-54)
Extent	Limited (2)	May affect plant employees		
Intensity x type of impact	Moderately high - negative (-4)	Accidents/ injuries could have severe negative consequences		
Probability	Highly probable (6)	The large scale of proposed operations will ultimately result in several situation where accidents can occur		
Post-mitigation				
Duration	Long term (4)	As for pre-mitigation	Consequence: Slightly detrimental (-7)	Significance: Negligible - negative (-21)
Extent	Limited (2)	As for pre-mitigation		
Intensity x type of impact	Very low - negative (-1)	Mitigation will reduce incidence of accidents/injuries		
Probability	Unlikely (3)	Mitigation will reduce likelihood of negative consequences		

11.2.5 Decommissioning Phase

The eventual termination of a mine's operating life is common to all extractive operations, and socio-economic consequences are inevitable. It should be noted that predictions concerning the characteristics of the receiving socio-economic environment at the time of decommissioning (30 years in the future) are subject to a large margin of error, thus significantly reducing the accuracy of impact assessment. Several socio-economic impacts could arise when the mining operation is decommissioned and should therefore form part of the scope of study when the ESIA for decommissioning of mine is planned. Socio-economic issues that could be focussed on include:

Impacts on the work force – *psychological issues* (e.g. distraction from normal activities, with a potentially negative impact on performance and safety), and *personal and family income issues* (e.g. concerns about the effect of reduced income on family life);

Impacts on the local community – *economic dependency* (e.g. if new jobs are created, but at remuneration levels are lower than those in the mining industry might impact negatively on the local economy), *demographic changes* (e.g. migration of skilled workforce from the area); and *dependency on CSI initiatives* (e.g. financial support to local amenities may be withdrawn by the power plant); and

Impacts on the wider community - *the national and regional economy* (e.g. impact on the viability of other indigenous industries due to the loss of locally produced outputs), financing of decommissioning (e.g. adequate funds may not have been provided for decommissioning and site rehabilitation); and infrastructure (e.g. mining assistance with road and infrastructure maintenance).

12 CUMULATIVE IMPACTS

Cumulative effects caused by the accumulation and interaction of multiple stresses affecting the parts and the functions of ecosystems. Of particular concern is the knowledge that ecological systems sometimes change abruptly and unexpectedly in response to apparently small incremental stresses. For purposes of this report, cumulative impacts have been defined as “the changes to the environment caused by an activity in combination with other past, present, and reasonably foreseeable human activities”.

12.1 Cumulative impacts on Topography and Visual aspects

The nearest mine is the Mogalakwena Platinum Mine situated approximately 6 km north-west of the Project area. This existing mine has impacts on the topography and visual character of the receiving environment. There a several companies holding prospecting rights in the Mokopane area. These include (but are not limited to) Sylvania Platinum and Bushveld Minerals. The possible development of these mines as well as the development of the proposed Platreef Project and will add to these existing topographic and visual impacts.

12.2 Cumulative Impacts on Biodiversity (flora and fauna)

Cumulative impacts are assessed by considering past, present and anticipated changes to biodiversity. Albeit the vegetation types present are assigned a Least Concern status apart from Makhado Sweet Bushveld (Vulnerable), large portions of these vegetation types are under threat due to expanding anthropogenic activities. The cumulative loss of this vegetation type as well as the SSC found within it should be considered proactively.

The impacts on the ecology of the area will be significant, if highly sensitive areas are disturbed. It is expected that there will be losses of vegetation and flora along with associated faunal habitat. The primary impacts will be fragmentation and edge effects with a reduction in movement of remaining naturally occurring and isolation of pockets of vegetation. Secondary cumulative impacts will include increased accessibility to the site and the resulting increase in development and resource dependence. Ideally, a strategic environmental plan for the area should be developed and adhered to. This should include the conservation of important areas as well as the provision of corridors for faunal movement.

12.3 Cumulative Impacts on Soil

One of the major impacts associated with underground mining is subsidence. This could leave a lasting impact on a large area. This could change drainage lines leading to land capability and land use changes which in turn changes farming land use significantly. This impact must be quantified through expert consultation. Subsidence can be contained by using support structures, and then the mining operation should not leave any significant impacts on the soils, their land capability and resultant land use. The proposed mine will be a deep level hard rock underground mine and it is anticipated that subsidence would be unlikely to occur.

The potential site specific impacts of underground mining activities on land capability are low due to the low impacts on the soil. Fencing of the mining Project site will exclude animals from grazing haphazardly. The condition of vegetation in undisturbed areas inside the mining right area may therefore improve.

The cumulative impact on regional land capability and land use is low because no commercial agriculture is practiced within the Project area and the contribution therefore to regional agriculture is very low.

Land capability and land use can only be rehabilitated after the mine decommissioning phase. Mine infrastructure will be removed making the rehabilitation of soil and land capability possible. Returning to pre-mining land capability depends on the rehabilitation efforts during soil profile reconstruction of building sites and roads.

12.4 Cumulative Impacts on Surface Water the Aquatic Environment and Wetlands

The Project is located in a water scarce area. Current residential and industrial practises such as the release of untreated sewage into the water ways seriously compromises the ecological state of the river systems associated with this study.

Based on the current state of the biological communities associated with the Project area the cumulative impact of the Project will be seen as moderate. This is due to the water stresses and low quality of surface water in the area as well as the potential for secondary impacts such as the increase in need for local water supplies coupled by an increase in waste production by local communities.

12.5 Cumulative Impacts on Surface Water

Chemicals associated with fertilisers used for agricultural activities and erosion caused by grazing has impacted on surface water resources. The proposed mining activities could further add to the surface water quality and quantity impacts on rivers and streams and could lead to cumulative impacts downstream due to other land use activities taking place along the surface water courses.

Cumulative water quantity impacts could be experienced at mine closure if rehabilitation is not done properly and this will affect stream flow downstream in the long-term.

12.6 Cumulative Impacts on Groundwater

The groundwater quality in the proposed mine infrastructure area is already impacted by previous anthropogenic activities such as stock farming and poor local sanitary management resulting in elevated concentrations of nitrates in the shallow aquifer systems as observed even before any mining activity has started. The mine infrastructure activity should contain all water borne constituents that may pose a threat for the quality of the underlying aquifer system. Cumulative impacts on the mine infrastructure area in terms of water quality will therefore not cause long-term deterioration of an already polluted aquifer system. In terms of groundwater quantities, it is the intention of the mine operations not to abstract groundwater from the local, shallow aquifer system – thus no long-term dewatering of the shallow groundwater resource is foreseen.

12.7 Cumulative Impacts on Ambient Air Quality

Current land use activities which include the clearing areas for agricultural activities such as subsistence crop farming has an impact on the current ambient air quality due to barren soil being susceptible to wind erosion. Furthermore, cause the project area are located within a rural area, primitive techniques such as fire (making use of wood or coal) for cooking and heating (especially during winter) could have a further impact on ambient air quality.

Cognisance must be taken of the fact that there are existing mines do exist within close proximity of the Project area which can contribute to the cumulative impact on ambient air quality of the area.

12.8 Cumulative Impacts on Ambient Noise Levels

Cumulative impacts should be considered for the overall improvement of ambient noise levels. The Project is considered a causative source of noise pollution of low significance. Because of the lack of other major sources of noise in the immediate area of the Project as well as the low significance of the impact, the Project in isolation is not considered a significant contributor to the cumulative noise impacts to the area.

The nearest mining operations are 8 km to the north of the Project, near the community of Molekana. The existing noise sources in the immediate area of the Project are limited to agricultural activities, vehicular movement on the N11 as well as the current exploration activities.

Potential future mines starting up in the area will contribute to ambient noise levels in the area and influence the contribution of all mines in the area with regards to the cumulative impact on the ambient noise levels.

After post closure phase of the Project, overall ambient levels will decrease to the pre-mining baseline and the cumulative impacts in the area could improve.

12.8.1 Cumulative Impacts on the Social Environment

The importance of identifying and assessing cumulative impacts stems from the fact that, in social as well as natural systems, the whole is often more than the sum of its parts – implying that the total effect of multiple stressors or change processes acting simultaneously on a system may be greater than the sum of their effects when acting in isolation. Cumulative impacts usually relate to large-scale rather than site-specific impacts and have a tendency to increase the intensity of impacts already predicted for the Project.

The aim of this section is to highlight the nature of the cumulative socio-economic impacts that are expected to occur as result of the combined effect of the Project and other current or planned operations in the area. Three possible cumulative impacts were identified: impacts related to population influx, dependency on mining to sustain the local economy, and impacts on the visual environment and sense of place.

12.8.2 Job Creation and Multiplier Effects on the Local Economy

Approximately 2 100 people will be employed by the mine and its contractors during the operational phase of the Project. Several nearby mines also employ substantial numbers of people; other mines planned for the area such as Lonmin Platinum, will also add to the number of people employed in the mining sector. The contribution of mining to job creation will therefore be enhanced through the Project.

Secondly the Project, together with other existing and planned mining operations will result in several economic benefits for local communities through direct and multiplier effects. These effects are usually stimulated by wage bills, local and regional procurement spend, and investment into LED. The Project will add to the existing positive effect of mining on local economic development by applying best practice in terms of local employment and procurement, as well as LED.

12.8.3 Impacts Related to Population Influx

The area has already experienced a significant influx of people in search of work at nearby mining operations such as Anglo Platinum's, Mogalakwena operation. It is likely that this existing impact will be exacerbated once it becomes known that recruitment for the Platreef Project has started. Population influx is also likely to exacerbate the social pathologies, pressure on existing infrastructure and services, and the growth or establishment of informal settlements.

12.8.4 Dependency on Mining to Sustain the Local Economy

As mentioned earlier in this report, economic activities in the area are dominated by mining and services sectors. Because mining creates a much larger number of jobs than the services sector, and because mine workers tend to earn better salaries than those employed in other sectors, it is fair to deduce that the local economy is heavily dependent on the mines. As emphasised earlier, all mines have a finite lifespan. Inevitably, mining operations in the area will at some point in the future begin to scale down and close. Unless significant investment is made into economic diversification, the area is destined for a considerable economic slump once this process commences.

12.8.5 Impact on the Visual Environment

It was mentioned in the baseline that communities adjacent to Project site have until now maintained a predominantly rural character. The more "alien" elements that are added to a landscape, the more the character of the landscape will be altered. Thus, the effect of the proposed mine on the area's sense of place cannot be considered in isolation from other current and planned activities. For example existing mining activities in the area have left their mark on the landscape (e.g. Mogalakwena Platinum Mine, which is visible from the third TSF option), and future mining activities (e.g. Lonmin is prospecting on properties adjacent to Platreef's prospecting area) will add to the impact on the area's sense of place. Surface infrastructure associated with the Project will therefore represent a new wave in the transformation of the landscape from one dominated by rural communities and fields into one dominated by mine shafts and heavy equipment.

The incremental change in the visual character of the area that will be brought about by the Project can thus be interpreted as a cumulative impact on the sense of place stemming from the combined effect of the Project and mining operations.

13 ENVIRONMENTAL MANAGEMENT PLAN

13.1 EMP Table

Table 13-1 provides a description of the appropriate mitigation and management options for the environmental impacts anticipated during each mining phase (i.e. construction phase, operational and decommissioning and closure phases).

Table 13-1: Environmental Management Plan

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
Construction phase								
1. Site Clearing: Removal of topsoil and vegetation	Topography	■ To minimise topographical change and disruption of surface water flow ■ To minimise soil erosion and topsoil loss	■ Only clear vegetation when and where necessary ■ Only remove topsoil when and where necessary ■ Ensure topsoil is stored away from surface water and drainage lines ■ Ensure topsoil stockpiles are contoured	■ Weekly	■ N/A	■ Air Quality Monitoring Plan ■ Mine Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager
	Visual	■ To minimise the negative visual impact caused by the removal of topsoil and vegetation	■ Topsoil and vegetation should only be removed when and where necessary ■ Topsoil stockpiles should be vegetated and positioned to reduce visual disturbance where possible	■ Weekly	■ N/A	■ Mining Plan ■ Fire Control Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager
	Soil	■ Prevent or minimise soil degradation	■ As far possible try to limit construction activities to the dry season (May – Oct)Prevent hydrocarbon spillages ■ Restrict the extent of disturbance within the Project area and minimise activity within designated	■ Daily	■ MPRDA Regulation 56 (1) to (8); soil pollution and erosion control; CARA Section 4(1) and regulation 6(1)	■ Mine Plan ■ Soil Management Plan.	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			areas of disturbance ■ Stripping operations should only be executed when soil moisture content will minimise the risk of compaction (during dry season) ■ During stockpiling, preferably use the 'end-tipping' method to keep the stockpiled soils loose ■ Ensure stockpiles are placed on a free draining location to limit waterlogging					
	Flora	■ Limit footprint of disturbed areas	■ Highly sensitive areas should be avoided. These include all Ridges, Bushveld and Impacted Ridge Bushveld areas with the exception of the Ridge Bushveld that will be impacted on by the TSF site 2 ■ Areas that are not directly affected by mining activities should be conserved ■ Where SSC are encountered, permits for the removal of these species must be obtained	■ Daily ■ Monthly	■ National Environmental Management Act (Act No. 107 of 1998) ■ National Water Act (Act No. 36 of 1998) ■ Conservation of Agricultural Resources Act (Act No. 43 of 1983 ■ The National Environmental Management: Biodiversity Act (NEMBA) (Act No. 10 of 2004) affords threatened or protected species a legal status and protection	■ Biodiversity Management Plan ■ Alien Invasive Control Management Plan ■ Rehabilitation Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			■ A nursery is recommended which will serve to propagate indigenous species in order that they can restore disturbed areas, immediately after an activity has ceased					
	Fauna	■ Limit footprint of disturbed areas	■ Do not develop near or on the areas of Very High Sensitivity (e.g. wetlands and riparian edges) ■ Where SSC encountered, permits for the removal of these species must be obtained	■ Daily ■ Weekly ■ Monthly	■ National Environmental Management Act (Act No. 107 of 1998) ■ National Water Act (Act No. 36 OF 1998) ■ Conservation of Agricultural Resources Act (Act No. 43 of 1983 ■ The National Environmental Management: Biodiversity Act (NEMBA) (Act No. 10 of 2004) affords threatened or protected species a legal status and protection	■ Biodiversity Management Plan ■ Rehabilitation Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer
	Aquatics	■ Limit footprint of disturbed areas	■ A cut-off trench should be constructed around any waste rock dumps, and stockpiles of overburden and topsoil ■ Only remove vegetation that is within the Project footprint area to ensure	■ According to the Stormwater management plan	■ National Water Act (Act 36 of 1998)	■ Aquatic Biomonitoring Programme ■ Stormwater Management Plan.	■ LoM	■ Environmental Manager ■ Environmental Control Officer

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			that runoff and seepage around the Project area is maintained ■ Ensure effective storm water management to capture dirty water					
	Noise	■ To prevent the noise emanating from the construction machinery having an impact on the sensitive receptors	■ As far as possible keep constructions activities to daylight hours ■ Mining-related machine and vehicles must be serviced on a regular basis to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers ■ Switching off equipment when not in use ■ Fixed noise producing sources such as generators, pump stations to be either housed in enclosures or barriers put up around the noise source	■ Vehicles to be serviced according to service plan ■ Machinery to be switched off when not in use ■ Construction activities must be limited to day time hours	■ National Environmental Management Air Quality Act (Act 39 of 2004) ■ Environmental Conservation Act (Act 73 of 1989)	■ Noise Monitoring Programme ■ Regular vehicle inspections	■ Construction phase	■ Environmental Manager ■ Environmental Control Officer
	Air quality	■ To minimise/ prevent fugitive dust from being released	■ The area of disturbance must be kept to a minimum and no unnecessary clearing of vegetation must occur ■ Topsoil should be re-vegetated	■ Daily ■ Weekly	■ National Environment Management: Air Quality Act (Act No. 39 of 2004)	■ Air Quality Monitoring Plan	■ Construction phase	■ Environmental Manager ■ Environmental Control Office

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			to reduce the exposed areas ■ During the loading of topsoil onto trucks or stockpiles, the dropping heights should be minimised ■ Dust suppression must occur on the mining site and in areas where significant dust may be generated					
2. Construction of surface infrastructure e.g. access roads, pipes, storm water diversion berms, change houses, admin blocks etc.	Topography	■ To minimise topography change and disruption of surface water flow	■ Limit the surface area of infrastructure where possible ■ Store construction materials away from surface water and drainage lines ■ Numerous roads should not be constructed alongside each other	■ Weekly	■ N/A	■ Mine Plan ■ Surface water Monitoring Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager
	Visual	■ To minimise the negative visual impact caused by the construction of surface infrastructure	■ The area of the surface infrastructure should be limited where possible ■ Surface infrastructure should be painted with natural hues so as to blend into the surrounding landscape where possible ■ Down lighting should be	■ Weekly	■ N/A	■ Mine Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			implemented to minimise light pollution at night ■ Pylons and metal structures should be galvanised so as to weather to a matt grey finish rather than be painted silver. If pylons and metal structures are to be painted it is recommended that a neutral matt finish be used ■ Construction of vegetation berms should be implemented close to infrastructure so that vegetation can be established ■ Numerous haul roads should not be created alongside each other ■ Roads should be wetted frequently by means of a water bowser to suppress dust					
	Soil	■ Prevent or minimise soil degradation ■ Minimise soil compaction	■ Refer to the mitigations measures for soil in the Site Clearing activity section above ■ Vehicles need must stay on designated routes and roads	■ Daily	■ MPRDA Regulation 56 (1) to (8); soil pollution and erosion control; CARA Section 4(1) and regulation 6(1)	■ Mine Plan ■ Soil Management Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
	Flora	■ Limit footprint of disturbed areas	■ Refer to the mitigation measures for flora in the Site Clearing activity section above	■ Daily ■ Monthly	■ National Environmental Management Act (Act No. 107 of 1998) ■ National Water Act (Act No. 36 of 1998) ■ Conservation of Agricultural Resources Act (Act No. 43 of 1983 ■ The National Environmental Management: Biodiversity Act (NEMBA) (Act No. 10 of 2004) affords threatened or protected species a legal status and protection	■ Biodiversity Management Plan ■ Weed Control and Alien Invasive Control Plan ■ Rehabilitation Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer
	Fauna	■ Limit footprint of disturbed areas	■ Refer to the mitigation measures for fauna in the Site Clearing activity section above	■ Monthly	■ National Environmental Management Act (Act No. 107 of 1998) ■ National Water Act (Act No. 36 OF 1998) ■ Conservation of Agricultural Resources Act (Act No. 43 of 1983 ■ The National Environmental Management: Biodiversity Act (NEMBA) (Act No. 10 of 2004) affords threatened or protected species a legal status and protection	■ Biodiversity Management Plan ■ Rehabilitation Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer
	Aquatics	■ Prevent contamination of	■ A cut-off trench should be	■ Daily	■ National Water Act (Act 36 of	■ Implementation of an Aquatic	■ LoM	■ Environmental

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
		the aquatic environment	constructed around any stockpiles of overburden and topsoil ■ Limit hydrocarbon spillages and remove those that do occur immediately ■ Vehicles to stay on designated routes and roads ■ Ensure effective storm water management to capture dirty water ■ Ensure quality of discharged water is within a similar state as the current baseline status	■ Weekly	1998)	Biomonitoring Programme ■ Stormwater Management Plan.		Manager ■ Environmental Control Officer
	Noise	■ To prevent the noise emanating from the construction machinery from impacting on the sensitive receptors	■ Refer to the mitigation measures for noise in the Site Clearing activity section above	■ Refer to the frequency for noise in the Site Clearing activity section above	■ National Environmental Management Air Quality Act (Act 39 of 2004) ■ Environmental Conservation Act (Act 73 of 1989)	■ Noise Monitoring Programme ■ Regular vehicle inspections	■ Construction phase	■ Environmental Manager ■ Environmental Control Officer
	Air quality	■ To minimise/prevent fugitive dust from occurring	■ Refer to the mitigation measures for air quality in the construction of surface infrastructure section above	■ Daily ■ Weekly	■ National Environment Management: Air Quality Act (Act No. 39 of 2004)	■ Air Quality Monitoring Plan	■ Construction phase	■ Environmental Manager ■ Environmental Control Office
	Surface water quality	■ To prevent water quality deterioration through siltation	■ Dust suppression measures should be implemented ■ Containment of all stormwater runoff	■ Daily	■ National Water Act (Act 36 of 1998)	■ Surface water Monitoring Plan ■ Stormwater Management Programme	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Engineer

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			according to the stormwater management programme					
	Surface water quantity	■ Increase the water reporting to the catchment	■ The dirty water area isolated from the catchment must be minimized to reduce the volume of runoff prevented from reporting to the catchment	■ Daily ■ Weekly	■ National Water Act (Act 36 of 1998)	■ Stormwater Management Programme	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Engineer
3. Transportation of materials and workers on site.	Topography	■ To minimise topography change and disruption of surface water flow ■ To minimise soil erosion and topsoil loss	■ Numerous roads should not be constructed alongside each other ■ Ensure that drainage off roads does not result in soil erosion	■ Weekly	■ N/A	■ Surface Water Monitoring Plan ■ Soil Management Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager
	Visual	■ To mitigate the negative visual impact caused by the drilling, blasting and development of infrastructure for mining	■ The area of the surface infrastructure should be limited where possible ■ Surface infrastructure should be painted with natural hues so as to blend into the surrounding landscape where possible ■ Down lighting should be implemented to minimise light pollution at night ■ Pylons and metal structures should be galvanised so as to weather to	■ Weekly	■ N/A	■ Mine Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			a matt grey finish rather than be painted silver. If pylons and metal structures are to be painted it is recommended that a neutral matt finish be used ■ Construction of vegetation berms should be implemented close to infrastructure so that vegetation can be established					
	Air quality	■ Minimise the generation of dust and fugitive emissions	■ Speed limits need to be observed and erecting speed humps ■ Application of wetting agents or application of dust suppressant to bind soil surfaces to avoid soil erosion ■ During the loading of topsoil onto trucks or stockpiles, the dropping heights should be minimised ■ Roads must be sealed as for as possible using a bitumen coating	■ Daily ■ Weekly	■ National Environment Management: Air Quality Act (Act No. 39 of 2004)	■ Air Quality Monitoring Plan	■ Construction phase	■ Environmental Manager ■ Environmental Control Office
4. Drilling, blasting and development of infrastructure	Topography	■ To minimise topography change and disruption of surface water	■ Limit the surface areas of infrastructure where possible	■ Weekly	■ N/A	■ Mine Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
for mining.		flow						■ Mine Manger
	Visual	■ To mitigate the negative visual impact caused by the drilling, blasting and development of infrastructure for mining	■ Refer to the mitigation measures for visual in the Transportation of materials and workers on site section above	■ Weekly	■ N/A	■ Mine Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager
	Noise	■ To prevent the noise emanating from blasting / drilling activities from impacting on the sensitive receptors	■ Refer to the mitigation measures for noise in the Site Clearing activity section above	■ Refer to the frequency for noise in the Site Clearing activity section above	■ National Environmental Management Air Quality Act (Act 39 of 2004) ■ Environmental Conservation Act (Act 73 of 1989)	■ Noise Monitoring Programme ■ Regular vehicle inspections ■ Blasting Programme	■ Construction phase	■ Environmental Manager ■ Environmental Control Officer
	Air quality	■ To minimise/prevent fugitive dust from occurring	■ Refer to the mitigations measures for air quality in the construction of surface infrastructure section above	■ Daily ■ Weekly	■ National Environment Management: Air Quality Act (Act No. 39 of 2004)	■ Air Quality Monitoring Plan	■ Construction phase	■ Environmental Manager ■ Environmental Control Office
	Surface water	■ Minimise the introduction of nutrients into surface water bodies	■ Control stormwater run-off according to the management plan ■ Cut-off trenches should be constructed around the explosives area ■ Explosives to be stored in an enclosed area with an impermeable surface	■ Daily ■ Weekly	■ National Water Act (Act 36 of 1998)	■ Stormwater Management Programme	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Engineer
	Groundwater Quality	■ Prevent Seepage from the TSF	■ Monitor water groundwater quality in the potentially affected areas ■ Toe drains should be installed on the downslope sides of the TSF to will	■ Daily ■ Weekly	■ National Water Act (Act 36 of 1998)	■ Groundwater Monitoring Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Engineer

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			capture any shallow seepage within the unsaturated zone					
5. Temporary storage of hazardous chemicals and fuels	Soil	■ Prevent and minimise soil contamination	■ Construction vehicles and equipment should be serviced regularly, in a designated area ■ Service areas must be paved with concrete paving ■ Construction vehicles should remain on designated and prepared compacted gravel roads ■ Areas that are used to store hydrocarbons must be bunded and be able to contain the hydrocarbons in the event of a spillage occurring ■ Drip trays must be used when machinery and/or vehicles are serviced ■ Spill containment and clean up kits should be available onsite and clean-up from any spill must be in place and executed at the time of a spillage with appropriate disposal as	■ Daily ■ Weekly	■ MPRDA Regulation 56 (1) to (8); soil pollution and erosion control	■ Soil Management Plan ■ Equipment Maintenance Plan ■ Incident register and action plan ■ Emergency Response Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager ■ Maintenance workshop manager / supervisor

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			necessary					
	Aquatics	■ Prevent/contain spillages of hazardous material	■ Store hazardous material according to manufacturing specifications ■ Store hazardous material on cemented/concrete floor in a bunded area	■ According to biomonitoring programme	■ National Water Act (Act 36 of 1998)	■ Implementation of an aquatic biomonitoring programme ■ Storm Mater Management Plan	■ LoM	■ Environmental Manager ■ Environmental Control officer
	Surface water quality	■ Prevent/contain spillages of hazardous material	■ Refer to the mitigation measures for aquatics in the Temporary storage of hazardous chemicals and fuels above	■ Continuously	■ National Water Act (Act 36 of 1998)	■ Material Safety Data Sheets ■ Surface water monitoring plan	■ Contraction phase	■ Environmental Manager ■ Environmental Control officer
	Groundwater quality	■ Prevent/contain spillages of hazardous material	■ All spillages of hazardous materials should be cleaned up immediately ■ Clean-up spill kits must be placed at all hazardous material storage areas ■ Store hazardous material according to manufacturing specifications ■ Store hazardous material on cemented/concrete floor in a bunded area	■ Continuously	■ National Water Act (Act 36 of 1998)	■ Material Safety Data Sheets ■ Groundwater monitoring plan	■ Contraction phase	■ Environmental Manager ■ Environmental Control officer
■ **Operational Phase**								
6. Removal of PGM's (underground mining	Topography	■ To minimise subsidence resulting in topography	■ Ensure that sufficient pillars are left to support	■ Weekly	■ N/A	■ Surface Water Monitoring Plan	■ Operational phase	■ Environmental Manager ■ Environmental

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
process)		change and disruption of surface water flow	underground mining areas					Control Officer ■ Mine Manager ■ Mine Engineer
	Visual	■ To reduce the negative visual impact caused by the mine and the associated infrastructure	■ Store waste rock, tailings and stockpiled ore away from surface water and drainage lines ■ Limit the footprint area of the waste rock dumps, TSF and ore stockpile if possible ■ Limit the quantity and time of ore stockpiled on site ■ Ensure ore stockpiles, waste rock dumps and the TSF are contoured ■ Ensure all dirty water is channelled towards pollution control dams ■ Ensure berms are well maintained and contour	■ Weekly	■ N/A	■ Mine Plan	■ Operational phase	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager ■ Mine Engineer
	Air quality	■ To minimise the generation of fugitive dust generation and fugitive emissions	■ Install, filtration systems to remove the pollutants from the air prior to surface release via the vent shaft ■ Use of efficient diesel fuel (low sulphur ppm value) for heavy underground	■ Daily ■ Weekly	■ National Environment Management: Air Quality Act (Act No. 39 of 2004)	■ Air Quality Monitoring Plan	■ Operational phase	■ Environmental Manager ■ Environmental Control Office

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			machinery					
	Groundwater Quantities	■ Minimise the impact on the groundwater table as a result of the underground works	■ Monitor the groundwater levels of the affected areas	■ Daily ■ Weekly	■ National Water Act (Act 36 of 1998)	■ Groundwater Monitoring Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Engineer
7. Operation of surface infrastructure such as the operation of the mining shaft, crusher, pipelines, the TSF and processing plant (includes water use and storage on site, including pollution control dams)	Visual	■ To minimise the negative visual impact caused by the operation of the ore stockpile, waste rock dumps and TSF ■ To minimise the negative visual impact caused by the dust from operation of the crusher	■ The ore stockpile, waste rock dumps and TSF should be positioned to reduce visual disturbance where possible ■ The quantity and time of ore stored on site should be limited where possible ■ The height of the waste rock dumps and TSF should be limited where possible ■ The waste rock dumps and TSF should be top soiled and vegetated where possible ■ Dust suppression should be used during operation of surface crushing	■ Weekly	■ N/A	■ Mine Plan ■ Air Quality Monitoring Plan	■ Operational phase	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager ■ Mine Engineer
	Soil	■ Prevent or minimise soil degradation	■ Re-vegetate cleared areas and stockpiles to avoid water erosion losses ■ Preserve looseness of stockpiled soil by executing fertilisation and seeding	■ Weekly	■ MPRDA Regulation 56 (1) to (8); soil pollution and erosion control	■ Mine Plan ■ Erosion Control Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			operations by hand ■ Soil stockpiles should be monitored for fertility via sampling and testing					
	Flora	■ Limit footprint of disturbed areas	■ Areas of contiguous natural Bushveld must be managed on site and in adjacent sites where mining is proposed, as part of a Biodiversity Action Management Plan ■ Cleared areas should be monitored for colonisation by alien species and a proactive approach should be undertaken to control alien species as soon as they are established ■ Where possible use pesticides or techniques to control pests that will not harm the environment	■ Monthly	■ National Environmental Management Act (Act No. 107 of 1998) ■ National Water Act (Act No. 36 OF 1998) ■ Conservation of Agricultural Resources Act (Act No. 43 of 1983 ■ The National Environmental Management: Biodiversity Act (NEMBA) (Act No. 10 of 2004) affords threatened or protected species a legal status and protection	■ Biodiversity Management Plan ■ Rehabilitation Plan ■ Weed Control and Alien Invasive Control Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer
	Fauna	■ Eliminate impact of pest control activities on the current fauna	■ Pesticides or techniques to control pests that will not harm the environment should be explored and used	■ Daily	■ National Environmental Management Act (Act No. 107 of 1998) ■ National Water Act (Act No. 36 OF 1998) ■ Conservation of Agricultural	■ Weed Control and Alien Invasive Control Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
					Resources Act (Act No. 43 of 1983 ■ The National Environmental Management: Biodiversity Act (NEMBA) (Act No. 10 of 2004) affords threatened or protected species a legal status and protection			
	Aquatics	■ Limit the impact of infrastructure on the aquatic environment	■ Only dirty water should be managed in the storm water management plan ■ Runoff should be managed in such a manner that channel straightening and erosion does not result in habitat loss	■ According to biomonitoring programme	■ National Water Act (Act 36 of 1998)	■ Implementation of an aquatic biomonitoring programme ■ Stormwater Management Plan	■ LoM	■ Environmental Manager ■ Environmental Control officer
	Noise	■ To prevent the noise emanating from the operation of machinery and equipment from impacting on the sensitive receptors	■ Mining-related machine and vehicles must be serviced on a regular basis to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers ■ Switching off equipment when not in use ■ Fixed noise producing sources such as generators, pump stations to be either housed in enclosures or barriers put up	■ Vehicles to be service according to service plan ■ Machinery to be switched off when not in us ■ Construction activities must be limited to day time hours	■ National Environmental Management Air Quality Act (Act 39 of 2004) ■ Environmental Conservation Act (Act 73 of 1989)	■ Noise monitoring programme ■ Regular vehicle inspections	■ Operational phase	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager ■ Maintenance Workshop Manager / Supervisor

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			around the noise source					
	Air quality	■ To minimise the generation of fugitive dust generation and fugitive emissions	■ Install water sprays around the crushing area ■ Ensure the crusher is enclosed ■ The TSF should undergo routine maintenance throughout the lifespan of the mine – with on-going re-vegetation to avoid exposed surface amenable to wind erosion	■ Daily ■ Weekly	■ National Environment Management: Air Quality Act (Act No. 39 of 2004)	■ Air quality monitoring plan	■ Operational phase	■ Environmental Manager ■ Environmental Control Office
	Surface water quality	■ Minimise surface water run-off	■ Only dirty water should be managed in the storm water management plan ■ No clean water should be stored ■ Runoff should be managed in such a manner that channel straightening and erosion does not result in habitat loss	■ Daily ■ Weekly	■ National Water Act (Act 36 of 1998)	■ Stormwater Management Program	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Engineer
	Groundwater quality	■ Prevent seepage from the TSF	■ Please refer to the mitigation measures for Groundwater quality in the drilling, blasting and development of infrastructure for mining section above	■ Daily ■ Weekly	■ National Water Act (Act 36 of 1998)	■ Groundwater Monitoring Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Engineer
8. Storage, handling and	Soil	■ Prevent or minimise soil	■ Refer to the mitigation	■ Weekly	■ MPRDA Regulation 56 (1)	■ Mine Plan ■ Soil Management	■ LoM	■ Environmental Manager

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
treatment of hazardous products (fuel, explosives, and oil) and waste activities (waste, sewage, discards, PCD)		contamination	measures for soil in the temporary storage of hazardous chemicals and fuels above		to (8); soil pollution and erosion control	Plan		■ Environmental Control Officer ■ Mine Manager
	Surface water quality	■ Prevent/contain spillages of hazardous material.	■ Refer to the mitigation measures for aquatics in the temporary storage of hazardous chemicals and fuels above	■ Continuously	■ National Water Act (Act 36 of 1998)	■ Material Safety Data Sheet ■ Surface Water Monitoring Plan	■ Operational phase	■ Environmental Manager ■ Environmental Control Officer
	Groundwater quality	■ Prevent/contain spillages of hazardous material	■ Refer to the mitigation measures for aquatics in the temporary storage of hazardous chemicals and fuels above	■ Continuously	■ National Water Act (Act 36 of 1998)	■ Material Safety Data Sheets ■ Groundwater Monitoring Plan	■ Operational phase	■ Environmental Manager ■ Environmental Control officer
■ **Decommissioning Phase**								
9. Demolition and removal of all infrastructure (including transportation off site)	Topography	■ To rehabilitate the topography	■ Ensure, as far possible, that all infrastructure is removed	■ Weekly	■ N/A	■ Rehabilitation Plan	■ Decommissioning phase	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager
	Visual	■ To increase the positive visual impact caused by the removal of all infrastructure.	■ Ensure all unnecessary infrastructure is removed ■ Ensure all concrete foundations are removed	■ Weekly	■ N/A	■ Rehabilitation Plan	■ Decommissioning phase	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager
	Soil	■ To prevent or minimise soil degradation.	■ Re-vegetate cleared areas and stockpiles to avoid water erosion losses ■ Monitoring of the condition of all unpaved roads is necessary due to the high	■ Weekly	■ MPRDA Regulation 56 (1) to (8); soil pollution and erosion control; CARA Section 4(1) and regulation 6(1)	■ Mine Plan ■ Soil Management Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			rainfall and potential water runoff and erosion of the soils present in the Platreef Project site					
	Flora	■ Prevent the spread of alien species	■ Cleared areas should be monitored for colonisation by alien species and a proactive approach should be undertaken to control alien species as soon as they are established ■ Re-vegetate areas where infrastructure has been demolished	■ Monthly	■ National Environmental Management Act (Act No. 107 of 1998) ■ National Water Act (Act No. 36 OF 1998) ■ Conservation of Agricultural Resources Act (Act No. 43 of 1983 ■ The National Environmental Management: Biodiversity Act (NEMBA) (Act No. 10 of 2004) affords threatened or protected species a legal status and protection	■ Biodiversity Management Plan ■ Rehabilitation Plan ■ Weed Control and Alien Invasive Control Plan	■ Decommissioning phase	■ Environmental Manager ■ Environmental Control Officer
	Aquatics (water quantity)	■ Minimise surface water run-off	■ Only dirty water should be managed in the storm water management plan	■ Daily ■ Weekly	■ National Water Act (Act 36 of 1998)	■ Stormwater Management Program	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Engineer
	Noise	■ To prevent the noise emanating from the demolition activities from impacting on the sensitive receptors	■ As far as possible keep operational activities to daylight hours ■ Mining-related machine and vehicles must be serviced on a regular basis to ensure noise suppression mechanisms are effective	■ Vehicles to be service according to service plan ■ Machinery to be switched off when not in us ■ Construction activities must be limited to day time hours	■ National Environmental Management Air Quality Act (Act 39 of 2004) ■ Environmental Conservation Act (Act 73 of 1989)	■ Noise monitoring programme ■ Regular vehicle inspections	■ Decommissioning phase	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager ■ Maintenance Workshop Manager / Supervisor

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			e.g. installed exhaust mufflers ■ Switching off equipment when not in use ■ Fixed noise producing sources such as generators, pump stations to be either housed in enclosures or barriers put up around the noise source					
	Air quality	■ To minimise/prevent fugitive dust from occurring	■ The area of disturbance must be kept to a minimum ■ Dust suppression must be applied to areas where possible dust could generate from	■ Daily ■ Weekly	■ National Environment Management: Air Quality Act (Act No. 39 of 2004)	■ Air Quality Monitoring Plan	■ Decommissioning phase	■ Environmental Manager ■ Environmental Control Office
	Groundwater quality	■ Prevent/contain possible hydrocarbon spillages	■ Maintain vehicles on a regular basis ■ Make use of oil pans in/under vehicles	■ Continuously	■ National Water Act (Act 36 of 1998)	■ Implement vehicle maintenance schedule	■ Decommissioning phase	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manage
10. Rehabilitation (spreading of soil, re-vegetation and profiling/contouring) (ventilation shaft entrances)	Topography	■ To rehabilitate the topography ■ To recreate natural drainage lines and surface water flow; and ■ To minimise soil erosion	■ Shaft voids must be plugged and closed ■ Ensure that the rehabilitated area is re-contoured and profiled to a topography similar to the pre-development topography ■ Spread soil over the rehabilitated	■ Weekly	■ N/A	■ Rehabilitation Plan ■ Surface Water Monitoring Plan ■ Erosion Control Plan	■ Decommissioning phase	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manage

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			area ■ Ensure that surface water and drainage lines are rehabilitated to pre-development condition ■ Re-vegetate rehabilitated areas					
	Soil	■ To prevent or minimise soil degradation	■ Re-vegetate cleared areas and stockpiles to avoid water erosion losses ■ Preserve looseness of stockpiled soil by executing fertilisation and seeding operations by hand ■ Soil stockpiles should be monitored for fertility via sampling and testing	■ Weekly	■ MPRDA Regulation 56 (1) to (8); soil pollution and erosion control; CARA Section 4(1) and regulation 6(1)	■ Mine plan ■ Soil management plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager
	Flora	■ Prevent the spread of alien species	■ Cleared areas should be monitored for colonisation by alien species and a proactive approach should be undertaken to control alien species as soon as they are established	■ Monthly	■ National Environmental Management Act (Act No. 107 of 1998) ■ National Water Act (Act No. 36 OF 1998) ■ Conservation of Agricultural Resources Act (Act No. 43 of 1983 ■ The National Environmental Management: Biodiversity Act (NEMBA) (Act No. 10 of 2004) affords threatened or	■ Biodiversity management plan ■ Rehabilitation plan	■ Decommissioning phase	■ Environmental Manager ■ Environmental Control Officer

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
					protected species a legal status and protection			
11. Storage, handling and treatment of hazardous products (fuel, explosives, oil) and waste activities (waste, sewage)	Soil	■ Prevent and minimise soil contamination	■ Refer to the mitigation measures for soil in the temporary storage of hazardous chemicals and fuels above	■ Daily	■ MPRDA Regulation 56 (1) to (8); soil pollution and erosion control	■ Soil Management Plan ■ Mine Maintenance Plan ■ Incident register and action plan ■ Emergency Response Plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager ■ Maintenance workshop manager / supervisor
	Aquatics	■ Prevent/contain spillages of hazardous material	■ Refer to the mitigation measures for aquatics in the temporary storage of hazardous chemicals and fuels above	■ Continuously	■ National Water Act (Act 36 of 1998)	■ Material Safety Data Sheets ■ Groundwater Monitoring Plan	■ Decommissioning phase	■ Environmental Manager ■ Environmental Control officer
	Surface water quality	■ Prevent/contain spillages of hazardous material	■ Refer to the mitigation measures for aquatics in the temporary storage of hazardous chemicals and fuels above	■ Continuously	■ National Water Act (Act 36 of 1998)	■ Material Safety Data Sheets ■ Groundwater Monitoring Plan	■ Decommissioning phase	■ Environmental Manager ■ Environmental Control officer
	Groundwater quality	■ Prevent/contain spillages of hazardous material	■ Refer to the mitigation measures for aquatics in the temporary storage of hazardous chemicals and fuels above	■ Continuously	■ National Water Act (Act 36 of 1998)	■ Material Safety Data Sheets ■ Groundwater Monitoring Plan	■ Decommissioning phase	■ Environmental Manager ■ Environmental Control officer
■ **Post-closure Phase**								
■ Post-closure monitoring and rehabilitation	Topography	■ To rehabilitate the topography ■ To minimise soil erosion	■ Ensure that the post-development topography is as close as possible to the pre-development topography by	■ Weekly	■ N/A	■ Rehabilitation plan ■ Erosion Control Plan	■ Post-closure phase	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manage

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			re-contouring and profiling the study area ■ Ensure that surface water and drainage lines are rehabilitated to pre-development condition ■ Carefully monitor rehabilitated areas to ensure that soil erosion is prevented					
	Visual	■ To increase the neutral visual impacts of post-closure rehabilitation	■ Ensure that all disturbed areas are rehabilitated to a state as close as possible to the pre-development state	■ Weekly	■ N/A	■ Rehabilitation Plan	■ Post-closure phase	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manage
	Soil	■ Monitor the sustainability of the current soil rehabilitation.	■ Post mine soil survey to be conducted (annually) ■ Soil fertility testing to be conducted annually	■ Weekly ■ Month ■ Annually	■ MPRDA Regulation 56 (1) to (8); soil pollution and erosion control	■ Soil management plan ■ Mine Maintenance plan ■ Incident register and action plan ■ Emergency response plan	■ LoM	■ Environmental Manager ■ Environmental Control Officer ■ Mine Manager ■ Maintenance workshop manager / supervisor
	Flora	■ Prevent the spread of alien species ■ Successful re-vegetation of areas	■ Cleared areas should be monitored for colonisation by alien species and a proactive approach should be undertaken to control alien species as soon as they are established ■ Re-vegetate cleared areas of the	■ Monthly	■ National Environmental Management Act (Act No. 107 of 1998) ■ National Water Act (Act No. 36 OF 1998) ■ Conservation of Agricultural Resources Act (Act No. 43 of 1983 ■ The National Environmental Management:	■ Biodiversity management plan ■ Rehabilitation plan	■ Post-closure phase	■ Environmental Manager ■ Environmental Control Officer

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			infrastructure footprint		Biodiversity Act (NEMBA) (Act No. 10 of 2004) affords threatened or protected species a legal status and protection			
	Air quality	■ To minimise/prevent fugitive dust from occurring	■ Demolition should not be performed during windy periods (August, September and October) ■ The area of disturbance must be kept to a minimum	■ Daily ■ Weekly	■ National Environment Management: Air Quality Act (Act No. 39 of 2004)	■ Air quality monitoring plan	■ Post-closure phase	■ Environmental Manager ■ Environmental Control Office
■	Aquatics	■ To monitor the state of the aquatic ecosystem through the measurement of physical and biological properties	■ Bi-annual aquatic biomonitoring	■ Bi-annually	■ National Water Act (Act 36 of 1998)	■ Material Safety Data Sheets ■ Groundwater monitoring plan	■ Decommissioning phase	■ Environmental Manager ■ Environmental Control officer

13.2 Social Management Plan

The description of the appropriate management options for the socio-economic impacts anticipated during the construction phase, operational and closure/decommissioning phase is described in Table 13-2 below.

Table13-2: Summary of the Appropriate Management Options for the Socio-economic Impacts Anticipated during the LoM

Receiving Environment	Receiving potential Impact description	Mitigation and management requirements
Construction phase	Job creation during construction	■ Recruitment to be coordinated through the Department of Labour; ■ Update and optimal use of the skills database; Promotion of female and youth employment; ■ Effective implementation of training and skills development initiatives; ■ Monitoring subcontractors in terms of local employment targets; and ■ Labour-intensive construction and mining methods should be promoted.
	Multiplier effects on the local economy	■ Give preference first to capable subcontractors located in the local municipal area; ■ Establish linkages with other mining proponents in the area involved in skills and SMME development; ■ Align skills development to build capacity of SMMEs; ■ Utilise electronic business database to identify local SMMEs; and ■ Utilise the accommodation database to identify local accommodation option.
	Economic empowerment of previously disenfranchised communities	■ Develop capacity of local HDSA SMMEs; and ■ Monitor compliance with procurement policy.
	Skills transfer and development	■ Early involvement of

Receiving Environment	Receiving potential Impact description	Mitigation and management requirements
		Project beneficiaries; ■ Collaboration with other existing/planned skills development programmes; ■ Skills development programmes should where possible focus on scarce skills; and ■ Guidelines encapsulated in Platreef's HRD and LED policies will optimise skills development.
	Community development induced by LED and CSI	■ Assuring stakeholder buy-in and participation; and ■ Aligning LED and CSI initiatives with those of other development role-players.
	Economic displacement	■ Determine party responsible for relocation; ■ RAP development; ■ Surface lease agreements; and ■ For non-vulnerable households and individuals, negotiate favourable outcome on a case-by-case basis.
	Disruption of movement patterns	■ Measures to alleviate traffic problems will also serve to maintain and promote access (see Section 6.3.2.1 and Impofu Engineering Services, 2013); and ■ Inform communities of planned construction activities that would affect vehicle/ pedestrian traffic.
	Construction-related health and safety impacts	■ Traffic control; ■ Road maintenance; ■ Regulation of traffic at intersection of haul road at N11; and ■ Fencing of mine site. ■ Prevention of fires ■ Community education

Receiving Environment	Receiving potential Impact description	Mitigation and management requirements
	Visual/acoustic/vibration and air quality impacts	■ Visual, noise, vibration, and air quality impacts are discussed in separate specialist studies; and ■ For sense of place: rehabilitation after closure & measure to enhance positive impacts.
	Increase in spread of communicable diseases and social pathologies Conflict/competition between newcomers and incumbent population	■ Extensive HIV/ AIDS awareness and general health campaign; ■ Cease construction activities before nightfall; ■ Clear identification of workers; prevention of loitering; ■ Liaison with police, community policing forum; and ■ Influx management.
	Increased pressure on local services/ resources	■ Liaison with district and local municipalities well in advance to ensure needs are met; ■ Ensure that municipalities take into account expected population influx; and ■ Influx management.
	Establishment and growth of informal settlements	■ Extensive HIV/ AIDS awareness and general health campaign; ■ Cease construction activities before nightfall; ■ Clear identification of workers; prevention of loitering; ■ Liaison with police, community policing forum; and ■ Influx management.
	Opposition because of perceived negative impacts	■ Communicate commitments regarding LED; ■ Transparency regarding employment practices; and ■ Presentation of EIA

Receiving Environment	Receiving potential Impact description	Mitigation and management requirements
		findings in clear and understandable manner
Operational phase	Job creation during operation	■ Intensifying efforts in the SLP to develop scarce skills.
	Regional economic development	■ Measures recommended maximising benefits from local employment, skills and economic development.
	Dependency on mine for sustaining local economy	■ Develop turnaround or redeployment strategies; ■ Publicise to mines in the industry that excess skills are available; ■ Implement actions, suggested by the Department of Labour; ■ Equip the affected employees as well as members of the community with portable skills; and ■ Support economic diversification through development of alternative markets
	Operation-related health and safety impacts	■ As for construction phase; ■ Plant maintenance; and ■ Rigorous health and safety programmes.
Decommissioning phase	Impacts on the work force	■ No mitigation measures
	Impacts on the local community	■ No mitigation measures
	Impacts on the wider community	■ No mitigation measures
	Job creation	■ No mitigation measures

13.3 Heritage Mitigation Measures

The ultimate goal of heritage resources management is to ‘promote good management of the national estate, and to enable and encourage communities to nurture and conserve their legacy so that it may be bequeathed to future generations’, stipulated in the Preamble to the NHRA.

Proposed mitigation and management measures must therefore comply with the General Principles contained in Section 5 of the NHRA. Proposals need to take into account all relevant cultural values and indigenous knowledge systems, material or cultural heritage value and involve the least possible alteration or loss of it. In addition, recommendations need to promote the use and enjoyment of, and access to, heritage resources, in a way consistent with their cultural significance and conservation needs and contribute to social and economic development. Mitigation measures must also safeguard the options of present and future generations with regards to heritage resources: requiring comprehensive research, documentation and recording.

In order to comply with these General Principles, mitigation measures are divided into two categories: Project-related mitigation and mitigation of sites/heritage resources. Depending on the value of a resource (field rating/grading) certain prescribed site mitigation measures must then be implemented.

Project-related mitigation aims to ensure conservation of heritage resources by avoiding or reducing impacts. Project-related mitigation may include:

- Implementation of feasible mitigation measures related to the Project design and planning to avoid negative changes to resources; or
- Site preservation that is essentially a no-development recommendation.

Mitigation of heritage resources may be necessary where Project-related mitigation will not conserve or preserve heritage resources, thus resulting in partial or complete changes (including destruction) to a resource. Such resources need to be mitigated to ensure that they are fully recorded, documented and researched before any negative change occurs. This may require mitigation such as:

- Intensive detailed recording of sites through various non-intrusive techniques to create a documentary record of the site;
- Intrusive recording and sampling such as Shovel Test Pits (STPs) and excavations, relocation (usually burial grounds and graves, but sites may be relocated), restoration and alteration. Any form of intrusive mitigation is a regulated permitted activity for which permits need to be issued by the relevant heritage authorities. Such mitigation may result in a reassessment of the value of a resource that could require conservation measures to be implemented. Alternatively, an application for a destruction permit may be made if the resource has been sufficiently sampled; and
- Where resources have negligible significance the specialist may recommend that no further mitigation is required and the site may be destroyed.

The description of the appropriate management options for the anticipated impacts on heritage and cultural resources during the construction phase, operational and closure/decommissioning phase is described in Table 13-3 below.

Table 13-3: Summary of the Appropriate Management Options for the Historical and Cultural Impacts Anticipated during the construction phase

Receiving Environment	Potential Impact Description	Mitigation and Monitoring
Burial Ground / single graves	Immediate threats or risks include ground and vegetation clearance for the construction of infrastructure in the Operational Area. Potential sources of threats and risk include vandalism by workers on site, accidental destruction or alteration of burial site by construction workers on site.	As such, it is recommended that the burial grounds be avoided where possible or relocated to avoid negative impacts. If grave relocation is to take place, a Grave Relocation Plan (GRP) must be drafted and implemented in accordance with Section 36 of the NHRA and NHRA Regulations.
Isolated occurrences (Refer to Table 10-1)	The construction of the proposed mine infrastructure will destroy these sites. In addition, any removal of vegetation and ground clearing may expose more extensive deposit potentially existing subsurface.	It is recommended that isolated sites with heritage significance undergo archaeological mitigation by a qualified archaeologist to adequately record the site if Project mitigation cannot be implemented. The mitigation measures include intensive mapping of the site and features, and sample excavations throughout the site.

13.4 Emergency Response Plan

The environmental management programme and associated management options are intended to minimise environmental risk as far as possible. Should, however, circumstances lead to unacceptable risks, emergency systems and procedures have been designed and will be implemented in the case of an emergency to prevent or minimise the consequential environmental damage. The environmental emergency contingency plan addresses any reasonably anticipated failure (most probable risk) for the entire mining area and focuses on incidents that could cause environmental emergencies.

The most crucial aspect of the emergency system is the identification and communication of the emergency to the appropriate persons. Consequently, the names of the appropriate contact person together with their contact numbers would be prominently displayed around the facility. The contact details will be updated on a regular basis. First-party employees (such as security, safety superintendents, mine overseers, environmental officers) will be trained to respond to the responsible personnel in the event of an emergency.

The Risk Assessment covers the following risks:

- Fall of Ground;
- Explosions;
- Fires;
- Inundation of workings (including gas, water and mud);

- Transport (surface busses);
- Ventilation fan;
- Labour Unrest; and
- Code of Practice.

14 MONITORING PROGRAMME

Table 14-1 below depicts a monitoring programme for the monitoring of various environmental aspects associated with the Project.

Table 14-1: Monitoring programme

Environment aspect requiring monitoring	**Method**	**Monitoring locations**	**Frequency**	**Target**	**Reporting**
Aquatics	The following parameters should be monitored by qualified specialists: ■ *In situ* and ex situ water quality constituents; ■ Sediment and water column metal analysis; ■ Toxicity testing; ■ Habitat integrity; ■ Aquatic macroinvertebrates; ■ Fish assemblages; and ■ Riparian vegetation.	The monitoring programme should include sites/locations where biological monitoring has occurred previously. The sites included plan 13 (Appendix A) will be sufficient to include in future monitoring applications during the high flow season.	Biomonitoring activities should occur bi-annually during the months in which the high flow assessment should preferably be conducted in middle to late February with the low flow assessment in May.	If modifications to the system occur, a reduced biological diversity will be observed. Proliferation of pollution tolerant species may also be an indication of a deterioration of ecological integrity. If there is further reduction in species diversity further studies should be undertaken which should include water quality analysis as well as the accumulation of pollutants in the sediments.	A biomonitoring report should be provided annually on completion of the two surveys or where required monthly.
Air quality	Dust fallout sampling will be conducted according to the SANS 1137:2012 standard, with buckets exposed over a 30 day period. The dust fallout buckets will be collected and the dust will	The proposed positions for the dust monitoring are shown in Plan 22(Appendix A).	Dust samples from the buckets should be collected monthly and analysed.	Dust deposition rates will be expressed in the units of mg/m2/day over a 30-day average. Standards	A monthly report should be compiled.

Environment aspect requiring monitoring	Method	Monitoring locations	Frequency	Target	Reporting
	be filtered through a sub-micronic pre-weighed filter using a vacuum filter bench. Once the wet filtrate is desiccated by means of evaporation to remove any retained moisture, the filter is reweighed to ascertain the collected mass (insoluble particulate). The soluble particulate is assessed by evaporating the catch media and weighing the resulting solids. The results are then illustrated by means of graphs.			South Africa (SANS 1929:2011) has published two important standards in terms of air quality underlying limits for dust fallout rates. In terms of dust deposition standards.	
Noise	Sampled in accordance with the SANS 10103:2008; Noise measurement should be taken for a period not less than 10 min at each location	The noise measurements should be taken at the measurement locations depicted in Table 7-20 as per the baseline study.	■ To be conducted on a quarterly basis throughout the construction phase; ■ Once it is established that the mitigation measures have decreased the specific noise levels from the mining activities, the noise monitoring should be carried out on	Noise levels from the proposed mining activities should not measure above the measured baseline level at each mentioned community.	A report must be compiled quarterly/ bi-annual, depending on the intervals of the monitoring programme then submitted to management to ascertain compliance with the required standards

Environment aspect requiring monitoring	Method	Monitoring locations	Frequency	Target	Reporting
			a bi-annual basis thereafter throughout the life of mine		
Surface water	Surface monitoring should initially be performed for a period on 12 months to be able to determine and establish the prevailing water quality trends. Sampling should be carried out at the recommended monitoring sites shown in Plan 18(Appendix A). Where possible the stream flows and channels geometry will be monitored especially in extreme flood events to determine any impact of the mining on river channels and water quantity in general, in the catchment.	The sampling location points are depicted on Plan 18 (Appendix A).	Water monitoring to be conducted on weekly bases. Monitoring should be implemented throughout the LoM. The impacts on water quality will be determined by benchmarking the monitoring data against the SANS 241: 2011 drinking water standards as well as the baseline water quality or as specified in the WUL.	A monitoring program is used as an early detection tool for surface water quality and is used to determine when mitigation must be implemented.	Reporting should be done once monitoring has been conducted (as per the frequency column).
Groundwater	Groundwater monitoring and sampling should be performed for a period on 12 months to be able to determine and establish the prevailing water quantity and quality trends.	A LoM groundwater monitoring programme has been operational over 2 hydrological cycles and represents the reference baseline groundwater conditions of the Site Area, the surrounding communal area and the Rietfontein	■ Water monitoring to be conducted on weekly bases. Monitoring should be implemented throughout the LoM. The impacts on water quality	A monitoring program is used as an early detection tool for surface water quality and is used to determine when mitigation must be	Reporting should be done once monitoring has been conducted (as per the frequency column).

Environment aspect requiring monitoring	Method	Monitoring locations	Frequency	Target	Reporting
		2KS TSF site in space and time. Expansion of the existing groundwater monitoring network is progressing with boreholes focussed on individual mine infrastructure including the Bultongfontein TSF site area.	will be determined by benchmarking the monitoring data against the SANS 241: 2011 drinking water standards as well as the baseline water quality or as specified in the WUL.	implemented	

15 CLOSURE FRAMEWORK AND COSTING

15.1 Closure Objectives

Internationally and in the South African context, the broad rehabilitation objectives include three schools of thought, explained below:

- Restoration of previous land use capability;
- No net loss of biodiversity; and
- What the affected community wants, the affected community gets.

Rehabilitation objectives need to be tailored to the Project at hand and be aligned with the EMP and Mine Closure Plan. And thus, the overall rehabilitation objectives for the Project are as follows:

- Provide for a sustainable post-mining land use and re-establishment of the pre-mining land use/capability;
- Maintain and minimise impacts to the functioning wetlands and water bodies within the area;
- Implement progressive rehabilitation measures where possible (i.e. contractors camps and areas used during the construction phase)
- Prevent soil, surface water and groundwater contamination;
- Comply with the relevant local and national regulatory requirements; and
- Maintain and monitor the rehabilitated areas.

The conceptual Rehabilitation Plan provides a description of the management and rehabilitation of the area to be affected by the proposed mining activities (attached as Appendix S). The conceptual Rehabilitation Plan focuses on the following:

- Land Preparation;
- Soil Management Plan and Amelioration;
- Infrastructure (demolition and future use);
- Vegetation and Fertiliser Management Plan;
- Weed Control and Alien Invasive Control Plan;
- Monitoring and Maintenance of receiving environment; and
- Wetland Rehabilitation.

15.2 Financial Provision

Digby Well was appointed by Platreef to calculate the environmental closure liability for Platreef's MWP in support of the Mining Right Application. The cost required for the first 10 years of mining according to the DMR methodology is R 39 298 028.74. A breakdown of the closure cost calculations (as per the DMR method) is set out in Table 15-1 below.

Table 15-1: Closure Liability Cost Breakdown

CALCULATION OF THE QUANTUM			
Mine:	Platreef - Closure Costs Assessment	**Location:**	Limpopo
Evaluators:	Digby Wells Environmental	**Date:**	26-Sep-13
No.:	**Description:**	**Unit:**	**Amount**
	Class C (Low Risk)		**(Rand)**
1	Dismantling of processing plant & related structures (incl. overland conveyors & Power lines)	m^3	R 3 437 978
2 (A)	Demolition of steel buildings & Structures	m^2	R 4 855 135
2 (B)	Demolition of reinforced concrete buildings & structures	m^2	R 8 547 441
3	Rehabilitation of access roads	m^2	R 567 932
4 (A)	Demolition & rehabilitation of electrified railway lines	m	R 0
4 (B)	Demolition & rehabilitation of non-electrified railway lines	m	R 0
5	Demolition of housing &/or administration facilities	m^2	R 1 775 141
6	Opencast rehabilitation including final voids & ramps	ha	R 0
7	Sealing of shafts, adits & inclines	m^3	R 29 841
8 (A)	Rehabilitation of overburden & spoils	ha	R 54 704
8 (B)	Rehabilitation of processing waste deposits & evaporation ponds (basic, salt producing waste)	ha	R 2 450 805
8 (C)	Rehabilitation of processing waste deposits & evaporation ponds (acidic, metal-rich waste)	ha	R 0
9	Rehabilitation of subsidised areas	ha	R 0
10	General surface rehabilitation	ha	R 4 802 120
11	River diversions	ha	R 0
12	Fencing	m	R 0
13	Water management	ha	R 1 095 541
14	2 to 3 years of maintenance & aftercare	ha	R 639 065
15 (A)	Specialist study	SUM	R 0
15 (B)	Specialist study	SUM	R 0
(Sum of items 1 to 15 Above)			**R 28 255 700.84**

<table>
<tr><th colspan="4">CALCULATION OF THE QUANTUM</th></tr>
<tr><td>Mine:</td><td>Platreef - Closure Costs Assessment</td><td>Location:</td><td>Limpopo</td></tr>
<tr><td>Evaluators:</td><td>Digby Wells Environmental</td><td>Date:</td><td>26-Sep-13</td></tr>
<tr><td>No.:</td><td>Description:</td><td>Unit:</td><td>Amount</td></tr>
<tr><td></td><td>Class C (Low Risk)</td><td></td><td>(Rand)</td></tr>
<tr><td></td><td colspan="2">Weighting factor 2 (step 4.4)</td><td>R 28 255 700.84</td></tr>
<tr><td rowspan="2">1</td><td>Preliminary and General</td><td>12% of Subtotal 1</td><td>R 3 390 684</td></tr>
<tr><td>Contingency</td><td>10% of Subtotal 1</td><td>R 2 825 570</td></tr>
<tr><td></td><td></td><td></td><td rowspan="2">R 34 471 955.03</td></tr>
<tr><td></td><td></td><td>(Subtotal 1 plus sum of management & administrative items, 1 to 6 above)</td></tr>
<tr><td>7</td><td>Contingency</td><td></td><td>R 4 826 073.70</td></tr>
<tr><td colspan="3">Grand Total (Subtotal 2 plus VAT)</td><td><u>R 39 298 028.74</u></td></tr>
</table>

16 UNDERTAKING

UNDERTAKING BY APPLICANT TO COMPLY WITH THE PROVISIONS OF THE ACT AND THE REGULATIONS THERETO AND THE COMMITMENTS WITHIN THE EMP

I, ……………………………………………………………………………………………………..,
the undersigned and duly authorised thereto by…………………………………………………
have studied and understand the contents of this document in its entirety and hereby duly undertake to adhere to the conditions as set out therein.

Signed at………………………on this………………………day of………………………………

17 REFERENCES

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Appendix A: List of Plans

Plan 1: Local Setting of the Mine

Plan 2: Regional Setting

Plan 3: Conceptual Infrastructure plan of the proposed mine

Plan 4: Geology map

Plan 5: Topography map

Plan 6: Slope model

Plan 7: Aspect model

Plan 8: Theoretical Viewshed Model

Plan 9: Regional Vegetation

Plan 10: Vegetation communities

Plan 11: Vegetation sensitivity and planned infrastructure for the Platreef Project area

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Plan 15: The Platreef Project site is located within dominating land types Ae, Ah and Ib

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Plan 18: Map showing locations of DWA water quality and flow sampling sites and water quality and flow sampling sites setup by Golder

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Plan 20: Groundwater Piezometric Map – August 2013

Plan 21: Groundwater level trends (March 2012 – August 2013)

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Plan 23: Map indicating the locations of site notices announcing the project to the public

Appendix B: Geotechnical Report

Appendix C: Waste Impact Assessment Report

Appendix D: Public Participation Process Documents and Information

Appendix E: Specialist Declaration Froms

Appendix F: Topography and Visual Aspects Impact assessment Report

Appendix G: Flora and Fauna Impact Assessment Report

Appendix H: Aquatic Impact Assessment Report

Appendix I: Wetlands Impact Assessment Report

Appendix J: Air Quality Impact Assessment Report

Appendix K: Noise Impact Assessment Report

Appendix L: Soil Impact Assessment Report

Appendix M: Hydrology Impact Assesement Report

Appendix N: Hydrogeology Imact Assessment Report

Appendix O: Heritage Impact Assessment Report

Appendix P: Social Impact Assessment Report

Appendix Q: Health Impact Assessment Report

Appendix R: Traffic Impact Assessment Report

Appendix S: Conceptual Rehabilitation Plan