Petra Diamonds Finsch Diamond Mine

Environmental Management Programme

Locality: Northern Cape

Departmental Ref No: NC 30/5/1/2/2/102 MR

SHANGONI
Management Services (Pty) Ltd

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ENVIRONMENTAL MANAGEMENT PROGRAMME

Petra Diamonds Finsch Diamond Mine

Environmental Management Programme

Locality: Northern Cape

Departmental Ref No: NC 30/5/1/2/2/102 MR

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Shangoni Management Services (Pty) Ltd

ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PROGRAMME

SUBMITTED

IN TERMS OF SECTION 39

OF THE MINERAL

AND PETROLEUM RESOURCES DEVELOPMENT

ACT, 2002,

(ACT NO. 28 OF 2002) (the Act)

mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

SHANGONI
Management Services (Pty) Ltd

STANDARD DIRECTIVE

All applicants for mining rights are herewith, in terms of the provisions of Section 29 (a) and in terms of section 39 (5) of the MPRDA, directed to submit an environmental Impact Assessment, and an Environmental Management Programme strictly in accordance with the subject headings herein, and to compile the content according to all the sub items to the said subject headings referred to in the guideline published on the Departments website, within 30 days of notification by the Regional Manager of the acceptance of such application.

PROJECT DETAILS

Department of Mineral Resources (DMR)

Reference No.: NC 30/5/1/2/2/102 MR

Project Title: **Petra Diamonds Finsch Diamond Mine Environmental Management Programme**

Project Number: **PET/fin/08-09-11**

Compiled by: **Salome Beeslaar**

Date: **April 2012**

Location: **Northern Cape**

Technical Reviewer: Brian Hayes

RB Hayes (Pr.Eng.)

Management Services (Pty) Ltd

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DEFINITIONS

Criteria pollutants

Criteria air contaminants (CAC), or criteria pollutants, are a set of air pollutants that cause smog, acid rain, and other health hazards. CACs are typically emitted from many sources in industry, mining, transportation, electricity generation and agriculture. In most cases they are the products of the combustion of fossil fuels or industrial processes.

Environment:

The surroundings (biophysical, social and economic) within which humans exist and that are made up of:

- The land, water and atmosphere of the earth;
- Micro organisms, plant and animal life;
- Any part or combination of (i) and (ii) and the interrelationships among and between them; and
- The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and wellbeing.

Environmental aspects:

Environmental aspects are elements of an organization's activities, products or services that can interact with the environment.

Environmental degradation:

Refers to pollution, disturbance, resource depletion, loss of biodiversity, and other kinds of environmental damage; usually refers to damage occurring accidentally or intentionally as a result of human activities.

Environmental impacts:

Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products or services.

Environmental impact assessment:

An EIA is a study of the environmental consequences of a proposed course of action.

Environmental impact report:

A report assessing the potential significant impacts as identified during the environmental impact assessment.

Environmental impact:

An environmental change caused by some human act.

Karst system

Karst system is a geological formation shaped by the dissolution of a layer or layers of soluble bedrock, usually carbonate rock such as limestone or dolomite, but has also been documented for weathering resistant rocks, such as quartzite, given the right conditions.

Land use:

Land use is the various ways in which land may be employed or occupied. Planners compile, classify, study and analyse land use data for many purposes, including the identification of trends, the forecasting of space and infrastructure requirements, the provision of adequate land area for necessary types of land use, and the development or revision of comprehensive plans and land use regulations.

L_{AEQ}: Energy averaging

This is the energy average noise level considered as a notional steady level that contains the same amount of noise as the actual fluctuating noise level during a specified period of time (based on equal energy principal)expressed as L_{Aeq} sometimes referred to as the $_{Leq}$.

L_{AF}: Sound pressure level

This is the instantaneous sound level with a specified frequency weighting and time weighting that shows the current level of the sound being measured it is written as L_{AF} sometimes referred to as the SPL.

L_{AFMX}: Maximum noise level

This is the highest instantaneous sound pressure level in decibels with a specified frequency weighting and time weighting, expressed as L_{Afmx} and sometimes referred to as the L_{max}.

L_{CPK}: Peak noise level

This is the absolute highest sound pressure in Pascals or the absolute highest noise level in dB over a given period of time with no frequency weighting (or the C or A frequency weighting) and no time weighting expressed as L_{Cpk} and is sometimes written as Peak or L_{peak}.

Nitrogen dioxide (NO_2)

NO_2 is formed through the oxidation of nitric oxide which is formed at high combustion temperatures and emitted by vehicles.

Ozone

Ozone is formed from the reaction of NOx and reactive hydrocarbons (HCs) in the presence of sunlight.

Particulate Matter (PM)

Also particle pollution is the term for a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small; they can only be detected using an electron microscope. Particle pollution includes "inhalable coarse particles," with diameters larger than 2.5 micrometers and smaller than 10 micrometers and "fine particles," with diameters that are 2.5 micrometers and smaller.

Pollution prevention:

This is any activity that reduces or eliminates pollutants prior to recycling, treatment, control or disposal.

Public participation process:

A process of involving the public in order to identify needs, address concerns, in order to contribute to more informed decision making relating to a proposed project, programme or development.

Soil catena

A soil catena is a sequence of different soil profiles that occur.

Stomatal opening

In botany, a stoma is a pore, found in the leaf and stem epidermis that is used for gaseous exchange.

Topography:

Topography is a term in geography, referring to the "lay of the land" or the physio-geographic characteristics of land in terms of elevation, slope and orientation.

Vegetation:

Vegetation is all of the plants growing in and characterizing a specific area or region; the combination of different plant communities found there.

Volatile organic compounds (VOC)

Constitute a wide-ranging category of products found in gaseous state and are easily evaporated under normal temperature and pressure conditions (20°C and 105 Pa), these compound include pollutants such as benzene, acetone, perchloroethylene etc. some of them are considered human carcinogens.

Waste:

Waste is unwanted or undesired material left over after the completion of a process. "Waste" is a human concept: in natural processes there is no waste, only inert end products.

ABBREVIATIONS

AMD:	Acid mine drainage
ARD:	Acid rock drainage
CBD:	Chronic Beryllium Disease
CAC:	Criteria air contaminants
CGL:	Current ground level
CR:	Critically endangered
CRD:	Coarse residue deposit
DENC:	Department of Environment and Nature Conservation
DMR:	Department of Mineral Resources
DMS:	Dense media separation
DRDLR:	Department: Rural Development and Land Reform
DWA:	Department of Water Affairs
EIA:	Environmental Impact Assessment
EMP:	Environmental Management Programme/Plan
EMS:	Environmental Management System
EN:	Endangered
FEPA:	Freshwater Ecosystem Priority Areas
FRD:	Fine residue deposit
HAP:	Hazardous air pollutants
HCW:	Health care waste
HID:	High Intensity Discharge
HOD:	Head of department
HWSA:	Hazardous waste storage area
I&APs:	Interested and affected parties
KLM:	Kgatelopele Local Municipality
LDV:	Light delivery vehicle
LED:	Local Economic Development
LEDP:	Local Economic Development Plan
LHD:	Load Haul Dumper
Mamsl:	Meters above mean sea level
MPRDA:	Mineral and Petroleum Resources Development Act (Act 28 of 2002)
MRD:	Mine residue deposit
MSDS:	Material safety data sheet
NEMA:	National Environmental Management Act, (Act 107of 1998)
NEMBA:	National Environmental Management: Biodiversity Act (Act 10 of 2004)
NWA:	National Water Act, 1956 (Act 54 of 1956)
OEM:	Original Equipment Manufacturer

OMS:	Automated Management System
PAH:	Polynuclear aromatic hydrocarbons
PCB:	Polychlorinated Biphenyl
PCB:	Printed circuit boards
PPE:	Personal protective equipment
SDM:	Siyanda District Municipality
SHE:	Safety, Health and Environmental
SLP:	Social and labour plan
SVOCs:	Semi-volatile organic compounds
TCE:	Trichloroethylene
TDS:	Total dissolved solids
VG:	Vaal-Gamagara
VOC:	Volatile organic compound
VU:	Vulnerable
WAMY:	Waste management yard
WRD:	Waste rock dump

EXECUTIVE SUMMARY

Background

Finsch Mine is a diamond mine and is a source of large, high-quality Type II industrial and gem diamonds. The mine is located on the Remaining Extent of Portion 26 (Brits) and Portion 24 of farm Carter Block 458in Kgatelopele Local Municipality (KLM) in the Siyanda District Municipality (SDM)of Northern Cape Province, 3km north east of Lime Acres. The approximate co-ordinates of the mine are 28°23'5.82"S and 23°26'35.59"E.

Diamonds were first discovered on Brits in 1930 by HS Richter. In 1956 Danie de Bruin obtained a licence to prospect for base minerals. His rights were transferred to Thorny Fincham, although it was only in 1959 that the claims were worked by Willie Schwabel. After a year Schwabel's option on the claims lapsed, but he and Fincham then formed the *Finsch Base Minerals* Company.

It was still not possible to prospect for diamonds on the property due to it being state owned land. The law was changed to allow for the prospecting for precious stones on state land. Brahm Papendorf became the third partner in the company, and the company was called *Finsch Diamonds*. The Finsch kimberlite pipe was discovered in 1960.

In 1962 De Beers obtained an option to prospect on the land. In 1964 waste stripping commenced and a treatment and recovery plant was erected adjacent to the pipe. Full production commenced in 1967. De Beers eventually bought the mine from the South African Government by Certificate of Consolidated title no. 20288/1929 in 1967 (Deed of Transfer T1033/1967), and the mine was officially opened that year. Additional areas, such as the Single-quarter and Five Mission were bought in 1970 (Deed of Transfer T 24/1970).The adjoining Bonza Farm (Portion 27 of Carter Block 458) was bought by De Beers from Andries Fritz Coetzee on 5 February 1969 (Deed of Transfer T55/1969).

The original plant was built in 1964. The first upgrade was completed in 1980, whereby underground operations commenced in 1990. Sinking of the main shaft to access the mine from underground started in 1978. Two vertical shaft complexes, tunnels and ground handling infrastructure were prepared for the continuing exploitation of the pipe with the use of highly mechanised mining methods. The open pit mining ended in 1992 and was succeeded by the commencement of underground operations in 1992.The pre-1979 coarse residue deposit (CRD) retreatment was introduced in 2003. The treatment plant upgrade took place between March 2003 and August 2008. In 2008 the treatment plant was upgraded. On 14 September 2011 Petra purchased the mine as a fully-staffed, operating mine from De Beers.

Current state

The mine currently operates under a new order mining right, which was issued in terms of item 7 of Schedule II of the Mineral and Petroleum Resources Development Act (MPRDA), 28 of 2002 promulgated ion 1 May 2004.

This Environmental Management Plan (EMP) amendment was done to include all new activities on Finsch and to change the EMP details form De Beers to Petra Diamonds.

The mine has an approved integrated Safety, Health and Environmental (SHE) Policy. The environmental considerations of the policy have been implemented through establishing and maintaining an Environmental Management System (EMS) based on the ISO 14001:2004 standards The EMS caters for clearly defined structures and responsibilities for environmental management and control

The mine has a water use license (WUL) No: 10/C92C/ABCEGIJ/414 with reference number 16/2/7/C92C/107/1. According to the conditions of this licence, the Integrated Water and Waste Management Plan (IWWMP) of the mine will be updated annually. The WUL include the following water uses:

- Section 21(a): Taking water from a resource for dewatering of underground workings;
- Section 21(b): Storing water subject to the conditions set out in Appendices 1 and 11; the potable water storage tanks and reservoirs in the villages, the Flask, Norfin and 5 Mission Tanks, Finville tank, the Game Farm tanks, Mine potable water dam (Bottom dam);
- Section 21 (c): Impeding or diverting the flow of water in a watercourse; the construction and now operation of the Brits FRD;
- Section 21 (i): Altering the bed, banks, course or characteristics of a watercourse; the construction and now operation of the Brits FRD;
- Section 21 (e): Engaging in a controlled activity, subject to conditions set out in Appendices I and V; irrigation of the golf course with water containing waste;
- Section 21(g): Disposing of waste in a manner which may detrimentally impact on a water resource; this includes the following: Streichers Dam, Five-Mission Dam, Five Mission Overflow/Overspill Dam, Mud Dam Earth Dam, Bonza quarry Top Dams, Bottom Dam, Thickeners, Clarifier, Underground water storage dams, Golf Course Dam, and Old FRD 1,2 and 3 and the Infill dam Disposal Facilities, Brits FRD Disposal facility, Brits return water dam, storm water sumps, waste rock dumps, pre-79 Coarse residue deposits (CRD), current CRD, conservancy tanks;
- Section 21(j) Removing discharging or disposing of water found underground.

The WULA was submitted in October 2006. The French drains operate under a general authorisation but will be included in the WUL amendment which is currently being undertaken by Finsch Mine at the same time that all water uses are being re-registered under Petra Diamonds. The current water uses for Finsch Mine are registered under DBCM.

VG water is also piped by the mine to Lime Acres for domestic use with permit No. 8/111/99 issued under Section 56(3) of the National Water Act, 1956 (Act 54 of 1956) (NWA) entitles the mine to withdraw 2,837,000m³ treated potable water per annum from the VG Pipeline. Sedibeng Water Board is the Water Service provider and holds the IWUL they provide Finsch with the potable water from the VG pipeline. The quantities are reviewed annually.

The following Certificates of Registration have been issued for the incinerators on 14 August 2000 in terms of Section 12 of the Atmospheric Pollution Prevention Act No. 45 of 1965:

- Certificate No. 2416 to operate the incinerator at the Sewage Plant, and
- Certificate No. 2416/1 to operate the incinerator situated in the Recovery Plant. This has been de commissioned and is no longer in use

An application for an Atmospheric Emissions License for the Incinerator at the Wastewater Treatment Plant be prepared and submitted to the authorities.

Permit 920 B issued under Section 21(5) of the NWA entitled the mine to reuse 1 079 m³ per day of purified sewage effluent. This care works operates under a license. This has been replaced by the IWUL section 21(e).

Finsch has a Waste Tyre Abatement Plan registration No WTSREG008NC, DEAT was informed of the change of name from DBCM to Petra Diamonds.

The bioremediation site has an authorisation and is run according to a documented procedure.

Layout of this document

This document comprises of an Environmental Impact Assessment (EIA) section and an EMP section. Section 1 (EIA) is divided into sixteen paragraphs in accordance with Regulation 50(a) to Regulation 50(1) of the MPRDA. Section 2 (EMP) is divided into 14 paragraphs in accordance with Regulation 51(a), Regulation 51(b) and Section 39 of the MPRDA.

Paragraph 1 of section 1 (EIA) is a description of the present environmental background, that differs from a baseline study due to already existing mining impacts. Paragraph 2 is a description of all proposed mining operations. Paragraph 3 is a list of all potential impacts including cumulative impacts. These three paragraphs are in accordance with Regulation 50(a) of the MPRDA. Paragraph 4 considers all alternative land uses or developments that may be affected and paragraph 5 lists all potential impacts in the case of alternative land use or developments taking place. This paragraph also includes the cumulative impacts of such land use or development. These two paragraphs are in accordance with Regulation 50(b) of the MPRDA.

Paragraph 6 is an identification of potential social and cultural impacts. This paragraph includes the quantification of the impacts on the socio-economic conditions. Paragraph 7 is a combination of paragraph 3 and 6 with the significance rating included. This paragraph also gives the method for significance rating as well as the impact phases associated with the mine. These two paragraphs are in accordance with Regulation 50(c) of the MPRDA. Paragraph 8 is an identification of alternative land uses which will be impacted upon and paragraph 9 indicates any results from a specialist on comparative land use assessment. These two paragraphs are in accordance with Regulation 50(d) of the MPRDA. Paragraph 10 is a list of all significant impacts identified in paragraph 7. This paragraph is in accordance with Regulation 50(e) of the MPRDA.

Paragraph 11, 12 and 13 is a detailed discussion of public participation that has taken place. These three paragraphs are in accordance with Regulation 50(f). Paragraph 14 is a description of the appropriateness of the assessment. This includes the adequacy of the predictive methods, underlying assumptions and any uncertainties in the information. This paragraph is in accordance with Regulation 50(g) of the MPRDA. Paragraph 15 is a detailed description of monitoring and in accordance with Regulation 50(h). Paragraph 16 is a list of additional information relevant to section 1 (EIA) attached to this document.

Paragraphs 1 to 4 of section 2 (EMP) are descriptions of environmental objectives and specific goals for mine closure, management of identified impacts, socio-economic conditions and historical and cultural aspect. These four paragraphs are in accordance with Regulation 51(a) of the MPRDA. Paragraph 5 is a complete description of the mitigation and management measures, paragraph 6 lists all action plans to achieve the objectives and specific goals, paragraph 7 lists all emergency procedures, paragraph 8 is a description of monitoring and environmental performance assessment, and paragraph 9 gives detail on the financial provision related to the impacts and mitigations assessment. These five paragraphs are in accordance with Regulation 51(b).

Paragraph 10 is a description of the environmental awareness plan, and paragraph 12 is the capacity of the mine to manage and rehabilitate. These two paragraphs are in accordance with section 39 of the MPRDA. Paragraph 11 is a list of additional information relevant to section 2 (EMP) attached to this document, paragraph 13 is the undertaking and paragraph 14 is an identification of the report.

Applicant

Name of Applicant	Petra Diamonds – Finsch Diamond Mine
Postal Address	PO Box 7 Lime Acres 8410
Telephone No.	(053) 385 9911
Fax No.	(053) 385 9382
Farm name and portion on which the activities take place	Portion 26 (Brits) and portion 24, a portion of the RE of the farm Carter Block 458
Co-ordinates of operation	28°23'5.82"S and 23°26'35.59"E

Appointed Environmental Assessment Practitioner

Name of firm	Shangoni Management Services	
Postal address	PO Box 74726 Lynnwood Ridge 0040	
Telephone No.	(012) 807 7036	
Fax	(012) 807 1014	
E-mail	info@shangoni.co.za	
Team of Environmental Assessment Practitioners on project		
Name	Qualifications	Responsibility
Salome Beeslaar	BSc Honours Geography	Report compilation
Jan Nel	MSc Environmental Management	Technical reviewer
Brian Hayes	B Eng (Chemical), MSc Environmental Engineering,	Quality reviewer

Section 1: Environmental impact assessment

Regulation 50 (a)

1 Description of the baseline environment

1.1 Concise description of the environment on site relative to the environment in the surrounding area

Please note the environmental description as provided in paragraph 1.1 is the description of the environment at present with the included mining activities.

1.1.1 Regional background

The locality of the mine is indicated in Figure 1 below.

1.1.1.1 Land tenure and use of immediately adjacent land

The land tenure and land use of immediately adjacent land is given in Table 1 below.

Table 1: Land tenure and use of immediately adjacent land

NAME	FARM	POST ADDRESS	USE
Mr. J.J. Lambrechts	Farms Strathmore & Wildspan	P.O. Box 273 Postmasburg 8420	Agriculture
Mr. R. Lombaard	Farm Rocky Flats	P.O. Box 1398 Kuruman 8460	Agriculture
Mr. R.J. Lombaard	Farm Bergplaas	P.O. Box 165 Lime Acres 8410	Agriculture
Mr C Schoombie	PPC Lime Acres	Private Bag Lime Acres 8410	Mining

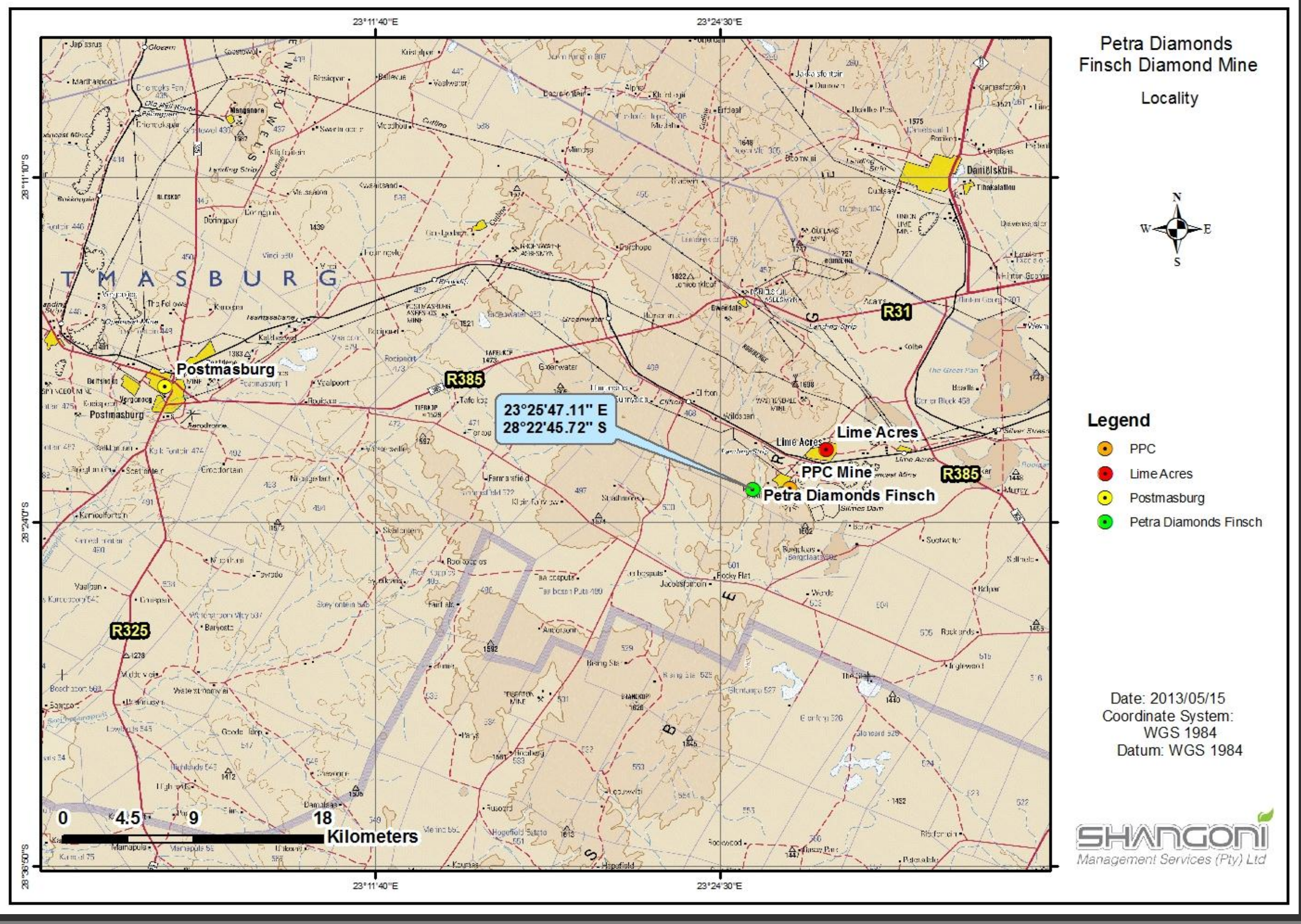

Figure 1: Locality map of the mine

Client: Petra Diamonds, Finsch Mine	SHANGONI Management Services (Pty) Ltd
Project: EMP Amendment	
Date: May 2012	

1.1.1.2 Distance to nearest towns

There is good road infrastructure around the mine, with tar road links to the towns of Lime Acres, Postmasburg, Danielskuil and Kuruman, Barkly West and Kimberley. There is also a network of dirt roads, mostly in good condition, to adjacent towns in the vicinity of the mine. The main public road in the area that passes by the mine is the Provincial R31.

The Kimberley-Sishen railway line is located about 1.5km to the north of the mine, with a link to the PPC Lime operation. This railway line serves both goods and passenger traffic. Table 2 below gives an indication of the distance and directions to the nearest towns.

Table 2: Direction and distance to nearest towns

TOWN	DISTANCE (km)	DIRECTION
Lime Acres	3	Northeast
Danielskuil	30	North-northeast
Postmasburg	52	Northwest
Papkuil	31	Southeast

1.1.1.3 Name of the catchment in which the mine is situated

The mine is located on a watershed which forms part of the Asbesberge. To the east the water drains to the Vaal River and to the west the area drains to the Orange River (*Geo-hydrology Report, KLM Consulting Services, November 2001*). To the east the mine falls in the catchment area of the Klein Riet River, located to the southeast of the mine. The Klein Riet River drains out of three seasonal shallow water bodies or pans (The Great Pan, Rooi Pan and one unnamed pan) located to the north east and east of the mine from where the river runs in a south easterly direction and drains into the Vaal River some 60km away. To the west the area drains into a pan at Taaibosch Puts, which drains towards the Orange River.

1.1.2 Geology

1.1.2.1 Regional geology

The main point of interest is the 17.9ha kimberlite pipe. The kimberlite pipe is impacted by and located in two distinct geological features. Firstly there is the Lime Acres Dolomite Member of the Gaap Plateau Dolomite Formation of the Campbell Group and then secondly, the Kuruman Member of the Asbestos Hills Banded Ironstone Formation of the Griekwatown group.

The Lime Acres Dolomite Member consists of dolomite limestone and is characterised by stromatolites and stylolites with occasional lenses of carbonaceous shales.

A transitional sedimentary sequence known as the “Passage beds” occurs between the Dolomite formation and the Banded Ironstone formation. This sequence is made up of interbedded shales, mudstones, chert, magnetic bands and shaly dolomite. The passage beds are underlayed by dolomite limestone of the Lime Acres Dolomite Member estimated to be between 900m to 1800m thick.

The Asbestos Hills Banded Ironstone Member consist of stilpnomelane and hematite with occasional bands of amphibolite and crocidolite asbestos (Preece 1998).

Peerce (1998) also commented that to describe the correlation between the major geological types around the kimberlite pipe is not feasible because of the complexity of the dolomitic sequence. The complexity is due to "localised discontinuities, lensoid-shaped bodies, stromatilitic algal domes, styolites and the occurrence of secondary and "drusy" dolomites controlled by water bearing, mainly vertically orientated joints".

1.1.2.2 Site specific geology

1.1.2.2.1 Mine pit and immediate surroundings

The pipe was covered by ironstone rubble, red sand and extremely altered clayey kimberlite (so called yellow ground). The zone of yellow ground extended down to a maximum of 30m below surface. Below the yellow ground extends a zone of partially to heavily altered kimberlite down to about 100m below surface. Unaltered kimberlite is encountered from some 70m below surface. The kimberlite is contaminated with minor amounts of dolomite, mudstones, Clarence formation sandstone, Karoo shales and a block of Drakensberg Lava present as internal waste bodies.

The Finsch Kimberlite Pipe is an 118Ma old Group 2 kimberlite with a surface area of 17.9ha. It consists of eight main kimberlite types, some but not all, representing individual eruptive events. These have been designated F1 to F8 in the order in which they were recognised. The volumetrically significant units are labelled F1, F5/F6 and F8, and are distinguished from the minor types F2, F3, F4 and F7. These distinctions are based on megascopic contact relationships, percentage dilution, density, petrology and diamond grade.

The salient features of each rock type are summarised in Table 3 below. The kimberlite types were emplaced in the following order:

- Emplacement of several kimberlite dykes along a north-east-striking lineament which already contained highly brecciated dolomite with a kimberlitic inter-clast matrix in places.
- Intrusion of the south-west and north-east precursor bulges (F3, F5 and F6 varieties) which truncated the earlier kimberlite dykes. The intrusion sequence of these precursors is unknown since contact relationships were destroyed by emplacement of the main pipe. The presence of common Karoo sedimentary clasts within these structures suggest that they extended well into the Karoo Supergroup and it could be speculated that they reached the land surface at the time of emplacement. No evidence now remains, since the upper parts were truncated by the main pipe emplacement process.

- Emplacement of the main pipe (F1, F7 and F8) and truncation of the south-west and north-east precursor bulges. During this stage of emplacement crater blocks and large quantities of Karoo basalt and sediments were incorporated into the pipe. The gradational contact between the F1 and F8 kimberlite, and the complex geometry of F8, suggests that they might be the same kimberlite, and that the differences are the result of crustal contamination.
- The final phase of activity was the intrusion of late-stage magmatic dykes (F4 and F2) which truncated the earlier kimberlites. These dykes are contained within the pipe and do not extend into the country rock. They are characterised by irregular geometries that could be attributed to the internal heterogeneous nature of the host rock.

Table 3: General features of each kimberlite type

UNIT NAME	GENERAL FEATURES
F1	A kimberlite breccia located along the outer periphery of the kimberlite, containing on average 30% crustal dilution. Exhibits variations in colour with associated high levels of dilution in places, due to localized sidewall failure. Visibly fragmental with a clast-supported texture and well-rounded magmaclasts. Average density 2.55t/m³. Mineralogically classified as a phlogopite kimberlite containing extensive ash to dust-sized material in the matrix resulting in a relatively friable rock mass.
F8	The unit is characterised by a decrease in the abundance of Karoo Supergroup xenoliths, but an increased abundance in Precambrian dolomite and chert compared to F1. Visibly fragmental with a high (50 %+) volume of well-rounded, often large magmaclasts. Structure is massive to diffusely layered. Variable, gradational contact with F1. Average density equals 2.63t/m³. Mineralogically classified as a phlogopite kimberlite, but with notably less ash to dust-sized material in the matrix.
F7	Intermediate in texture between a hypabyssal (magmatic) and magmaclastic rock. Exhibits areas that are uniformly hypabyssal as well as areas with poorly/incompletely developed magmaclasts. Crustal dilution may be as low as 5% in the hypabyssal areas and may reach 20% in more magmaclastic textures. The crustal material is largely comprised of dolerite and dolomite, with lesser sedimentary fragments. Average density equals 2.71t/m³. The unit may be classified mineralogically as a melilite-rich phlogopite kimberlite with the modal abundance of melilite decreasing with increasing hypabyssal character.
F2	Occupies a central plug-like geometry in the pipe, which varies with depth and consists of hypabyssal kimberlite. Dark brown in colour and contains abundant dolomite xenoliths with lesser dolerite, representing a total crustal dilution of 30%. The crustal xenoliths are highly altered. Very competent with an average density of 2.80t/m3. One of the last phases of magmatic activity within the kimberlite. Mineralogically classified as a clinopyroxene-phlogopite kimberlite.

UNIT NAME	GENERAL FEATURES
F3	Hypabyssal in nature and can be subdivided into F3a breccia and F3b. F3a is brownish in colour with prominent white calcite segregations. Typically contains up to 20% crustal dilution, representing virtually the entire country rock stratigraphy. F3b is dyke-like in geometry, more uniform in texture and contains less than 5% crustal xenoliths, compared to F3a. Contacts between the two range from sharp to gradational. Average density equals 2.70t/m³. Both can mineralogically be classified as phlogopite kimberlite, but with different textures.
F4	Occurs as a system of internal dykes and sills within the main pipe and represents the final phase of magmatic activity. Represented by several variants. Crustal dilution is low (<10%) and the xenoliths consist of variably altered dolomite and chert. Average density equals 2.81t/m³. Mineralogically classified as clinopyroxene-phlogopite kimberlites containing coarse-grained perovskite.
F5/F6	Together forming the south-west Precursor, truncated by the main pipe along a sharp contact. Similar in appearance to F3, also with regards to the segregationary texture and contains on average 20% crustal material, i.e. a kimberlite breccia. Average density equals 2.80t/m³. Classified as phlogopite kimberlite.

1.1.2.2.2 Dykes, sills and faults

An analysis of aerial photographs and satellite images showed that there are several dolomite and kimberlite dykes that cross the area. The two major dykes identified are the Danielskuil dyke to the west of the mine (1km) and the Groot Pan dyke to the east of the mine (7.5km). The aforementioned dykes have a major impact on the groundwater regime of the area. Of lesser impact are the Botha dyke to the northwest of the Lime Acres Village, the Bowden dyke which basically runs in a straight line through the open pit of the mine in north-easterly direction to the PPC workings and the Smuts dyke which crosses the Bowden dyke just northeast of the golf course and runs in a north-north-easterly direction south of the Lime Acres village. A fourth “lesser” dyke, the Bonza dyke, traverses the Bonza farm also in a north-easterly direction.

According to the “Finsch Diamond Mine Preliminary Closure Plan” compiled by Redco in 2009, sinkholes occur on the old “Paddocks”, which overlay dolomites. Numerous cracks are also observable on the surface, lining up with the sinkholes, displaying a distinct linear zone of subsidence this zone has a SSE-NNW trend and is termed the “Slimes Paddock Fault” and has a down-throw on the western side.

There are two sub-vertical dykes traversing the area. SW – NE trending sub-vertical dyke swarm (“Golf Course dyke swarm”) which crosses the Lime Acres Golf Course and trends directly into PPC quarry No. 5. This dyke swarm is thought to be some 300 m wide and comprises numerous fractures in-filled with Kimberlite and dolerite dykes and a SW – NE trending sub-vertical dyke swarm “quarry

No. 4 dyke swarm") which extends from the Old fine residue deposit (FRD) paddocks into PPC quarry No. 4.

1.1.3 Climate

1.1.3.1 Brief description of the climate

The region in which the mine is located experiences a temperate Highveld climate with warm to hot summers and mild, cool winters. The climate around Kimberley is essentially a continental one - the weather provides hot wet summers (December to February) and mild dry winters (June to August). The infrequent summer rains tend to take the form of occasional severe thunderstorms rather than prolonged soft showers. It is not unusual for winter night-time temperatures to drop below freezing point.

1.1.3.2 Mean monthly and annual rainfall

Rainfall figures at the mine are depicted in Table 4 below. The highest rainfall months are October to April.

Table 4: Average rainfall at the mine for the period 2005 to 2012

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2005	92.0	111.0	57.0	62.5	9.0	3.0	0.0	0.0	0.0	44.0	31.0	14.0
2006	130.5	208.0	61.0	83.0	41.0	20.0	0.0	17.0	0.0	25.0	25.0	0.0
2007	69.0	18.0	78.0	70.0	0.0	8.0	0.0	33.0	33.0	110.0	57.5	186.0
2008	104.0	64.0	30.0	18.0	133.0	50.0	30.0	0.0	0.0	40.0	49.0	28.0
2009	51.0	129.5	65.0	0.0	4.0	6.0	14.5	0.0	0.0	59.0	8.0	54.5
2010	196.0	95.5	54.8	51.4	2.7	0.0	0.0	0.0	0.0	0.0	29.4	33.8
2011	352.6	192.0	84.7	90.1	67.2	46.6	5.7	3.0	5.6	0.0	19.3	72.5
2012	37.1	97.0	94.8	61.1	0.0	37.4	8.2	5.3	1.4			

1.1.3.3 Mean monthly maximum and minimum temperatures

Since the mine has a very distinctive micro climate it is inappropriate to use the weather data for nearby towns as supplied by the South African Weather Bureau. The mine installed a metrological station at the Lime Acres Air Field during 1998. Data from this station is however not continuous since installation due to technical difficulties and a lightning strike. Refer to Table 5 for these temperature data for the period 1998 to 2001.

Table 5: Average temperature for the period 1998 to 2001 at Lime Acres Air Field (°C)

MONTH	MEAN MAX	MEAN MIN	MEAN	HI	LOW
January	29.4	17.4	25.0	40.0	9.8

MONTH	MEAN MAX	MEAN MIN	MEAN	HI	LOW
February	28.4	22.2	25.5	40.4	13.7
March	28.1	16.7	23.7	40.5	3.4
April	23.4	15.0	19.8	32.8	8.2
May	18.8	7.4	13.5	28.6	1.0
June	16.0	5.6	11.4	24.6	-2.8
July	15.6	4.2	11.0	24.3	-4.5
August	18.2	5.6	12.6	27.2	-1.7
September	21.7	7.8	15.4	31.1	0.2
October	26.6	14.2	20.9	35.8	5.6
November	27.9	15.7	23.4	38.3	7.9
December	28.0	19.2	24.1	38.8	10.8

1.1.3.4 Mean monthly evaporation

Evaporation figures for this area due to its arid climate fluctuate between a minimum of 81.1mm in June and a maximum of 322.2mm per year in December. The average total evaporation per year is 2,350mm per year. Refer to Table 6 for the S-pan evaporation figures for 1967 to 2011.

Table 6: S-pan evaporation in mm for the period 1967 to 2011

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
S-pan	319.6	245.6	212.0	148.1	106.7	81.1	93.8	127.8	177.0	236.6	279.7	322.2

1.1.3.5 Extreme weather conditions

Due to lack of data kept for the mine it is difficult to give precise data on the occurrence of extreme weather events in the close vicinity of the mine. The data basis of the Kuruman weather is used to give a general idea of occurrence rates of thunderstorms, hail, snow and mist.

Thunderstorms happen normally on 27 days per year, with hail a rare occurrence at 1 day a year. Cloud cover is associated with the mid afternoon convectional activity and the resultant thunderstorms. Snow has a frequency of less than 1 day per year and mist is also rare at 1 day per year

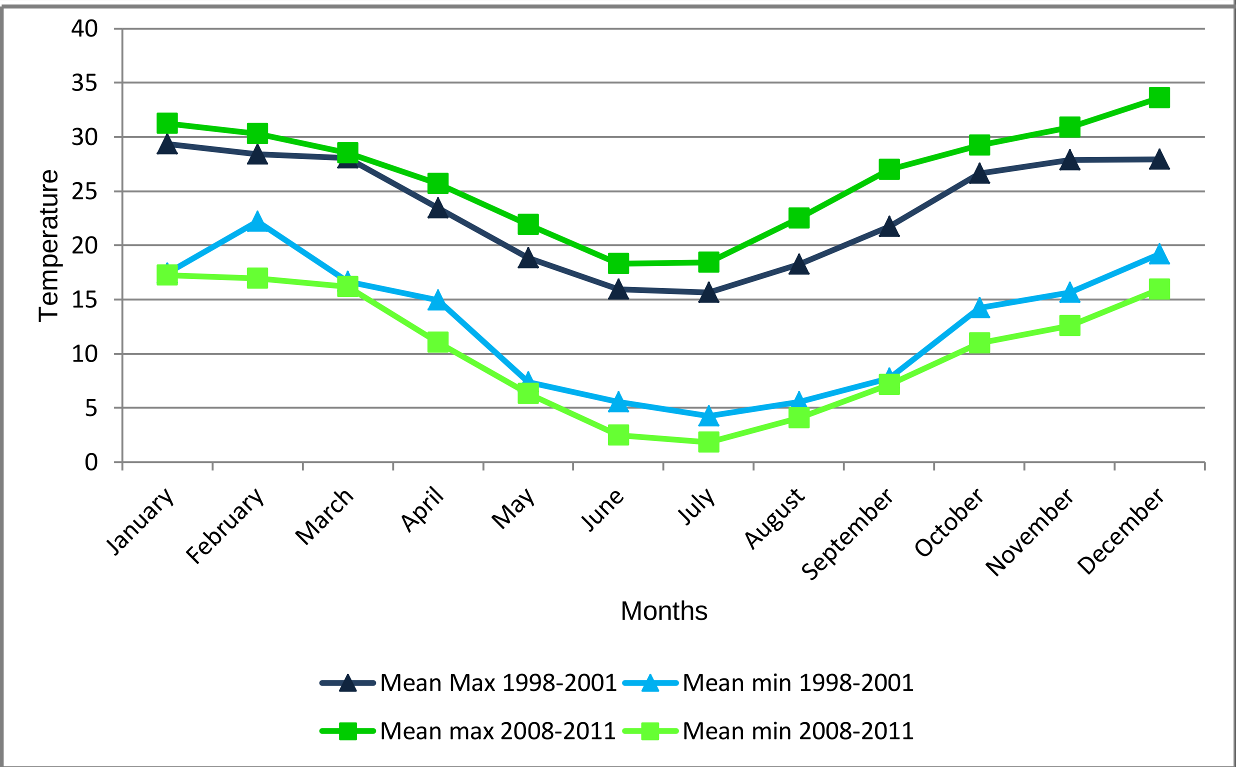

Figure 2: Comparison of average temperature between 1998-2001 and 2008-2011

Client: Petra Diamonds, Finsch Mine

Project: EMP Amendment

Date: May 2012

SHANGONI Management Services (Pty) Ltd

1.1.3.6 Mean monthly wind direction and speed

The mine has a distinctive micro climate. The weather data from nearby towns as supplied by the South African Weather Bureau is used in addition to the data generated by the on-site metrological station. The mine installed a metrological station at the Lime Acres Air Field during 1998. Data from this station is however not continuous since installation due to technical difficulties and a lightning strike. Refer to Table 7for these temperature data for the period 1998 to 1999.

Table 7: Average wind speeds and direction for the period 1998 to 1999at Lime Acres Air Field (knots)

MONTH:	AVERAGE:	HI:	DOM. DIR.:
January	7.2	44.8	NNW
February	6.1	35.7	NNW
March	6.2	35.6	NNW
April	4.0	32.2	NNW
May	6.4	35.9	NW

MONTH:	AVERAGE:	HI:	DOM. DIR.:
June	6.2	31.9	NW
July	7.6	38.6	N
August	7.6	43.5	N
September	7.5	41.7	NNW
October	6.9	45.5	NNW
November	7.5	40.3	NNW
December	8.7	45.7	NNW

The average wind gust speed (m/s) data for Postmasburg Weather Station has also been obtained for the periods June 2008 to November 2011. Refer to Table 8 for these figures.

Table 8: Average wind gust speed (m/s) at Postmasburg weather station for the period June 2008 to November 2011

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2008						8.3	9.0	10.3	10.7	9.9	9.7	9.5
2009	9.7	8.3	8.1*	9.8	9.2	10.1	9.0	9.8	11.3	12.6	12.3	13.2
2010	10.5	9.6	9.7	8.8	8.4	9.0	8.9	10.4	10.4	19.9*	12.7*	12.4
2011	10.9	10.4	9.1	9.6	9.9	8.1	9.7	10.7	12.2	10.8	12.4	

* Average is unreliable due to missing daily values
--- Data is unavailable

1.1.4 Topography

1.1.4.1 Regional Description

The topography may best be described as an undulating plateau with low hills. The Ghaap plateau is bounded to the east by the Harts River and to the west by the Kuruman hills which form part of the Asbesberge.

1.1.4.2 Site Description

The mine is located approximately 1 500m above mean sea level on an undulating Plateau with low hills. The Kimberlite pipe is located on the eastern edge of the Kuruman Hills, which form part of the Asbesberge, stretching from Griquatown in the south to Kuruman in the north. The hills are of banded ironstone with, in most cases, a shallow covering of soil. The soils are deeper in the valleys on the Brits property. At least three pan areas occur on the Bonza property, all along the southern side.

The ridges are in some places quite steep, with bands of rock outcrops. The section of the Brits farm which skirts the southern edge of the mining area and Brits FRD is steep, with small valleys, and in some places small cliffs. Small overhangs occur in a few places.

Apart from the south-western corner of the property, the Bonza Farm area is relatively flat. Vegetation is sparser and is dominated by grass species.

1.1.5 Soil

A detailed soil survey was done by Dr. T.L. Morgenthal from Viridus Technologies (Pty) Ltd. trading as EKO REHAB. Most of the soils are derived from the banded ironstone formation. The natural soils of the area are predominantly shallow and rocky. The approximate depth the soils can be excavated varies between 30-50cm.

1.1.5.1 Soil profiles

There are two types of soil profiles as well as the banded ironstone outcrops. The two types of soil profile forms are described in Table 9 below.

Table 9: Soil forms and families identified at the mine

SOIL FORM		SOIL FAMILY	DIAGNOSTIC HORIZONS	SOIL DEPTH (CM)
Ms	Mispah	Myhill	Ortic A	20
			Hard rock	>20
Hu	Hutton	Hayfield	Ortic A	20
			Red Apedal B	50

1.1.5.2.1 Mispah

Soil of the Mispah form is the predominant soil form on the mining area and occurs on the middle slopes of terrain. The A-horizon has a sandy loam texture with a high gravel/stone content of 48.7%. The soil structure can be described as structureless and single grained. Soils of the Mispah soil form can further be classified as belonging to the Myhill soil family due to non leached and non calcareous A horizon. The depth of the A horizon is on average 200 mm.

Areas on which this soil type occurs is the most affected by mining activities and large areas on which this soil type has occurred is now covered by FRDs and CRDs.

1.1.5.2.2. Hutton

Soils of the Hutton type are mostly shallow, the A-horizon being 20cm and the B horizon is mostly between 20 and 30cm deep. This soil type occurs on the valley pediments and has probably developed from finer material which has accumulated on the low-lying areas. The A and B horizon has predominantly a sandy loam texture and the gravel content varies from between 10% and less in the low lying areas to 40% and more on the lower middle slopes. The structure remained structureless and single grained throughout.

The Hutton soils found during the survey was mesotrophic and non luvic soils. According to the South African classification system the Hutton soil belong to the Hayfield soil family. The total depth of this soil on the mine property rarely exceed 500mm with the A horizon normally being 200mm and the B horizon depth varying between 200mm and 300mm.

All the soils have probably derived from banded Ironstone the predominant rock formation on the mine. Mining activities which is impacting on this soil type is the FRDs and in lesser extent the CRDs.

1.1.5.2.3. Banded ironstone outcrops

The hills consist of banded ironstone with, in most cases, a shallow covering of soil.

1.1.5.3 Soil erodibility

Refer to Table 10 below for the soil erodibility of the two types of soil form.

Table 10: Derived soil properties, land capability and pre-mining land use

SOIL FORM	NATURAL FERTILITY	ERODIBILITY	CROP PRODUCTION (DRY LAND)	CROP PRODUCTION (IRRIGATION)	LAND CAPABILITY	PRE MINING LAND USE
Hu	Low	Low	-	-	Grazing	Grazing
Ms	Low	Low	-	-	Grazing	Grazing

1.1.5.4 Soil chemistry and nutrient status

Soil chemical analyses were conducted on 5 soil samples from the undisturbed veld and one sample from the compost that is being used as organic ameliorant during rehabilitation by Eko Rehab in 2001. Results of the soil chemical analyses are given below.

1.1.5.4.1 Coarse and fine residue

- The chemistry of the coarse and fine residue is similar regarding most characteristics.
- Both areas are alkaline according to the soil pH, which exacerbate the micro-element deficiencies.
- The low EC indicate a low nutrient status.
- The percentage sodium in relation to the saturation value is too high. This is also true for the Calcium ratio. The percentage Potassium and Magnesium are, however, to low.
- The phosphate in the samples was too low.
- The base saturation exceeds 100%; therefore there is a need to increase the cation exchange capacity of the soil. This can be corrected by the addition of organic material.

1.1.5.4.2 Natural soils (Ortic A, Red Apedal B, Ortic A Glenrosa)

- The pH is slightly alkaline but the electrical conductive (EC) of the soils are within acceptable range.
- It is however preferred that the base saturation must be below 100% which is not the situation in this case. The base saturation corroborates with the alkaline pH. A further explanation for the high base saturation of the soil is the low cation exchange capacity (CEC).
- The macro element ratios do not conform to the ideal macro nutrient ratio and needs to be corrected with potassium and magnesium containing fertilisers.
- Overall Ca ratio is too high and the Mg and K ratios to low.
- A low Na ratio is preferred, which is true for the natural soil samples at Finsch. The calculated sodium adsorption ration (SAR) was also within the acceptable norm value of < 1.

The natural soil is suitable for topsoil especially with correct fertilisation and kraal manure or compost is added.

1.1.5.4.3Compost

- The pH of the compost is within acceptable norm values but the elevated electrical conductivity indicates high concentration of salts.
- The high levels of nitrate, ammonium and phosphate indicate that the compost will be a good supplement for phosphate and nitrogen.
- Of more concern is the high Na content influencing the osmotic potential of the compost solution. This is atypical of organic material and the reason for the high Na is due to the use of reeds that were grown on the FRD and were cut down and used as a bulking agent in the making of the compost.
- The high sodium concentration will also influence the physical stability of the medium through dispersion and deflocculation.
- The Boron and manganese concentrations are also over the excepted norm values.
- The compost is used in rehabilitation trials for the stabilisation of FRD sidewalls.

1.1.6 Land capability

1.1.6.1 General

Land use in the Province is predominated by stock farming, with an increasing game farming component (96%), while only 2% of the land is used for crop farming, and 1% is reserved for conservation. Mines and quarries constitute only 0.1% of the total land area. Grazing capacity of the natural veld surrounding the mine ranges between 10 and 12ha / LSU and most of the former land use in the Lime Acres area was grazing. Except for the surrounding old asbestos mines, soil pollution is limited. Like most land in the province, there is a local potential susceptibility to desertification and management should be directed towards its prevention.

1.1.6.2 Site specific

The mine area was first occupied in the 1870's and has been used for domestic livestock production for more than 100 years. It is probable that landowners have utilised the land for hunting purposes. The pre-mining land capability is thus classified as extensive grazing land. Soil depth, however, limits most of the area's potential and when combined with the erratic and unpredictable rainfall, the land is considered most suited to conservation/wilderness land. With the acquisition of the mine and surrounding properties in 1962, De Beers initiated a wildlife conservation policy, which resulted in sections of properties being enclosed by a game fence and the areas being managed as game farms (Golder, 2006).

Extensive grazing land, with soil depth limiting most of the area's potential. The land is considered most suited to conservation/wilderness use due to limited soil depth in combination with the erratic and unpredictable rainfall. Refer to Table 11 below for the classification of the land capability.

Table 11: Soil types, land use and land capability

SOIL TYPE	EFFECTIVE DEPTH (MM)	SURFACE AREA (HA)	LAND USE	LAND CAPABILITY
Hutton	1 800	12	Natural veld	Arable
Mispah	150	225	Natural veld	Wilderness

1.1.7 Vegetation

1.1.7.1 General

The mine is situated in the Savannah Biome. Low and Rebelo (1996) described the general vegetation type present on the site as Kalahari Mountain Bushveld which is dominated by camphor bush *Tarchonanthus camphoratus.* Kunibush *Rhus burchelii* and *Rhus tridactyla* become the principal shrubs in certain areas in the southern portions of the site. The tree layer is poorly developed and individuals of wild olive *Olea europaea* subsp. *africana* and black thorn *Acacia mellifera* subsp. *detinens* are widely scattered. The common grasses include copperwire grass *Aristida diffusa,* Lehmann's lovegrass *Eragrostis lehmanniana,* thimblegrass *Fingerhuthia africana* and *Digitaria eriantha*.

Mucina and Rutherford (2006) identify the Mine as being within the Savannah Biome (9), where the following vegetation types can be expected: Ghaap Plateau Vaalbosveld (SVk 7), Southern Kalahari Salt Pans (AZi 4), Olifantshoek Plains Thornveld (SVk 13) - adjacent and to the north and west of the mine, and Kuruman Mountain Bushveld (SVk 10), which is endemic to the Griqualand West Centre of plant endemism and is therefore a priority for conservation (Anderson, 2006:2). Generally occurring trees include *Olea europaea* subsp. *africana* (Wild olive), *Acacia tortilis* subsp. *heteracantha* (Umbrella thorn), *Ziziphus mucronata* (Buffalo thorn) and *Acacia karroo* (Sweet thorn). At the mine typical Kuruman Mountain Bushveld shrubs such as *Rhus burchelii* are present, while grasses include Lehmann's love grass (*Eragrostis lehmanniana*), thimble grass (*Fingerhuthia africana*) and *Digitaria eriantha.* Regional vegetation types in the surrounding area of the mine are given in Table 12 below.

Table 12: Regional vegetation types in the surrounding area of Finch Diamond mine

Kalahari Plateau Bushveld (van Rooyen & Bredenkamp, 1998a)	Kalahari Mountain Bushveld (van Rooyen & Bredenkamp, 1998b)	Kalahari Thornveld: Vryburg Shrub (Mixed *Tarchonanthus* veld) (Acocks,1988)
Tarchonanthus camphoratus	*Tarchonanthus camphoratus*	*Tarchonanthus camphoratus*
Rhigozum trichotomum	Rhus undulata	Olea europaea subsp africana
Ehretia rigida	*Rhus dregeana*	*Rhus ciliata*
Grewia flava	*Olea europaea subsp. africana*	*Rhus dregeana*
Maytenus heterophylla	Acacia mellifera subsp. detinens	*Lebeckia macrantha*
Olea europaea subsp. africana	*Diheteropogon amplectens*	*Euclea crispa subsp. ovata*
Acacia tortilis subsp.	*Andropogon schirensis*	Rhigozum obovatum
Boscia albitrunca	*Brachiaria serrata*	*Maytenus heterophylla*
Themeda triandra	*Aristida diffusa*	*Putterlickia pyracantha*
Aristida diffusa	*Eragrostis lehmanniana*	*Rhus burchellii*
Stipagrostis uniplumis	*Fingerhuthia africana*	*Euclea undulata*
Rhus ciliata	*Digitaria eriantha*	*Rhigozum trichotomum*
Acacia melifera subsp. detinens		*Grewia flava*
		Schizachyrium sanguineum
		Diheteropogon amplectens
		Andropogon schirensis
		Andropogon chinensis
		Brachiaria serrata

1.1.7.2 Site specific

The following data was obtained from the plant and soil survey conducted by EkoRehab in 2001.

1.1.7.2.1 Rocky hilltops

The vegetation on the rocky hills consists mainly of trees/large shrubs including *Tarchonanthus camphoratus* and *Rhus* spp (*R cilliata*, *R. tridactyla* and *R. burchelii*) and common shrubs including *Lebeckia macrantha* and *Euryops* sp. cf *subcarnosus* subsp. *vulgaris*. The grasses *Heteropogon contortus*, *Eragrostis lehmanniana* and *Fingerhuthia africana* were the most common on the rocky hilltops. This plant community seemed to be in a good veld condition due to its species composition ground cover and grass biomass. The rocky hilltops also had the highest grass cover In comparison to the other natural vegetation situated in the security fence.

1.1.7.2.2 Lower middle slopes

The vegetation on the lower middle slopes at the toes of the CRD has been encroached by *Acacia mellifera* subsp *detinens* (Swarthaak). Other shrubs and trees, which have a common occurrence, include *Tarchonanthus camphoratus*, *Rhus tridactyla, Ehretia rigida* and *Rhus burchelii*. The herbaceous layer is sparse and mostly consists of the grasses *Enneapogon desvauxii*, *Eragrostis lehmanniana* and *Digitaria eriantha* and the forbs *Chrysocoma cilliata* and *Geigeria ornativa.*

1.1.7.2.3 Valley bottoms/pediments

The vegetation of the valley bottoms can be considered an open shrubland consisting of small to medium bush clumps of *Tarchonanthus camphoratus* (dominant), *Rhus cilliata* (sub-dominant), *Grewia flava, Lycium* sp. and *Cadaba aphylla*. The herbaceous layer consists predominantly of the grasses *Stipagrostis* sp., *Eragrostis lehmanniana, Digitaria eriantha* and *Cymbopogon plurinodis* and the forbs *Geigeria ornativa*, *Chrysocoma cilliata* and *Felicia muricata.*

The vegetation on the plains to the east that borders the FRDs area (Bonza wildlife camp) are totally encroached by *Acacia mellifera* subsp *detinens* forming a low thicket which are impregnable, indicating past mismanagement of the veld. Other trees/large shrubs also occurring in this area include *Tarchonanthus camphoratus*, *Grewia flava* and *Rhus tridactyla*. The herbaceous layer consists predominantly of the grasses *Stipagrostis* sp, *Enneapogon desvauxii* and *Eragrostis lehmanniana* and the forbs *Eriocephalus ericoides*, *Felicia muricata*, *Asparagus* spp and *Hermannia vestita.*

A different vegetation community occurs on the pediments to the northern side of Finsch Mine near the airstrip because no encroachment of *Acacia mellifera* subsp. *detinens* was evident. The ground cover was sparse and mostly consisted of forbs. Species that were only found at this areas included *Aloe grandidentata*, *Gnidia polychepala*, *Pteronia mucronata*, *Rhuscia* sp., *Osteospermum muricata*, *Aptosimum* sp., *Ursinia nana*, *Diospyros astro-africana* and *Olea europaea* subsp. *africana*.

1.1.7.2.4 Rehabilitated vegetation

The rehabilitated Waste Shaft Rock Dump and Red Dumps were sampled in October 2001 to determine which species were the most successful to be established. The Red dumps are the topsoil from the pit and are said to contain diamonds thus a future resource. This dump contains a magnitude of high-density residue such as dolomite, banded ironstone etc., which make it difficult to treat in the current plant. *Eragrostis lehmanniana* and *Eragrostis echinochloidea* were at both dumps the dominant grass species. Other prominent species includes *Salsola kali, Chrysocoma cilliata*, *Blumea gariepina* and *Argemone ochroleuca*. The cover at both areas was estimated at over 80%. Other grass species that was also found on the rehabilitated sites were *Cenchrus ciliaris, Chloris virgata*, *Digitaria eriantha, Enneapogon cenchroides*, *Heteropogon contortus* and *Panicum maximum* (in the contours).

1.1.7.2.5 Unrehabilitated coarse residue deposit

The vegetation on the top of both CRDs (Pre-1979 and Post-1979) was also investigated in October 2001 and an overall low vegetation cover characterises both areas. *Stipagrostis namaquensis* and *Stipagrostis obtusa* are the dominant grasses on the CRDs. Other grasses, also occurring on the unrehabilitated CRDs includes *Eragrostis echinochloidea*, *Hyparrhenia hirta* (only Pre-1979CRD) and *Pennisetum setaceum*. The only prominent forb on the CRDs was *Sutherlandia microphylla*, which particularly occur on the top of the Post 1979CRDs.

1.1.7.2.6 Unrehabilitated fine residue deposits

The vegetation on the unrehabilitated FRDs is dominated by *Salsola kali*. Other frequent occurring species are *Senecio consanguineus*, *Nidorella resedifolia* subsp. r*esedifolia, Blumea gariepina, Phragmites* sp. and *Argemone ochroleuca.* On the toe wall of the dam a number of tree species were found of which some were possibly planted. Species that were probably planted include *Rhus lancea*, *Rhus pendulina*, *Rhus pyroides* and *Ziziphus mucronata*.

1.1.7.3 Rare or endangered species

Red data species present include Devil's Claw (*Harpagophytum procumbens*), while the following protected species occur on the mine's property: Camel thorn (*Acacia erioloba*), Grey camel thorn (*Acacia haematoxylon*), Shepherd's tree (*Boscia albitrunca*), as well as *Aloe hereroensis, Ammocharis coranica, Boophane disticha, Hereroa* cf. *wilmaniae, Orbeopsis lutea, Pachypodium succulentum*, and *Ruscia* cf. *sedimentata*. The following endemic species occur on the site*: Lebeckia macrantha* and *Rhus tridactyla*, while the near-endemic *Tarchonanthus* cf. *obovatus* is also present (Anderson, 2006:3,4).

The pans in the ephemeral drainage line of the valley are considered to be sensitive habitats, with a number of protected species associated with their slopes.

1.1.7.4 Invader species

Prosopis glandulosa (Honey mesquite), *Nicotiana glauca* (Wild tobacco), *Opuntia ficus-indica* (Sweet prickly pear) as well as another eleven alien invasive plant species were found within the mining lease area of the mine in 2001 (Eko-Rehab, 2001). Another Category 1 invader found on site in 2006 is *Datura ferox* (Anderson, 2006). Species with the highest frequency of occurrence are *Schinus molle* (Pepper tree), *Nicotiana glauca* (Wild tobacco), *Pennisetum setaceum* (Fountain grass) and to a lesser extent *Prosopis glandulosa* (Honey mesquite). Other invaders include *Barleria rigida*, *Pentzia* spp, *Plinthus karooirus*, *Rosenia humilis* and *Stigpagrostis obtusa* (Eko-Rehab, 2001), while the presence of *Salsola kali* (Tumbleweed) is also likely (Anderson, 2006). See Table 13 below for a complete list of invader species.

Table 13: List of all exotic species considered invaders or weeds according to the proposed amendments of the Conservation of Agricultural Resources Act 43 of 1983

SCIENTIFIC SPECIES	AFRIKAANS NAME	ENGLISH NAME	CATEGORY
Argemone ochroleuca	Mexikaanse papawer	Mexican poppy	1
Cirsium vulgare	Skotse dissel	Spear thistle	1
Conyza spp	Skraalhans	Fleabane	-
Cortaderia jubata	Pampasgras	Pampas grass	1
Lepidium bonariense	Peperbossie	Pepperweed	-
Melia azedarach	Seringboom	Syringa	3
Nicotiana glauca	Tabakboom	Wild tobacco	1
Pennisetum setaceum	Pronkgras	Fountain grass	1
Salsola kali	Russiese rolbossie	Russian tumbleweed	-
Schinus molle	Pepperboom	Pepper tree	-
Sonchus oleraceus	Sydissel	Milkthistle	-
Sonchus spp	Dissel	Thristle	-
Tagetes minuta	Kakiebos	Tall khaki weed	-
Xanthium spinosum	Boetebos	Spiny cocklebur	1

1.1.8 Animal life

1.1.8.1 Site specific

Due to the three security fences that encircles the mining area and the constant movement of machinery there is very little possibility that any terrestrial game will access the area. The only animals that one can expect to see inside the fences are avifauna, rodents, small predators and baboons. On the mine property outside the security fence one can expect to see various small game species that moves through the area and these will probable move to and from the surrounding game farms. One can expect to see duiker, steenbok, jackal, scrub hare and porcupine to name a few (Morris, D. (ed), 1995).

1.1.8.1.1 Mammals

The following rare animals could possibly access the mining area outside of the security fence; Honey Badger, African wild cat, Ant bear, South African Hedgehog, Aardwolf, Brown hyena and Leopard. In most instances these animals will only be foraging for food or moving through the area.

1.1.8.1.2 Bird habitat assessment

Typical grassland bird species which were recorded during Tania Anderson's January 2006 botanical survey and ECOSUN's faunal assessment of November 2006 included: *Mirafra fasciolata (*Eastern Clapper Lark*)*, *Mirafra africanoides (*Fawncoloured Lark*), Cisticola juncidis* (Zitting Cisticola), *and*

Myrmecocichla formicivora (Anteating Chat). Bushveld specialists observed included: *Telophorus zeylonus* (Bokmakierie), *Tricholaema leucomelas* (Acacia Pied Barbet), *Oena capensis* (Namaqua Dove), *Pycnonotus nigricans* (Red-eyed Bulbul), and *Otus leucotis* (Southern White-faced Scops-Owl). All the ephemeral pans and streams in the area were dry and therefore none of the water dependant birds were present in the study area. Although a number of Red Data species were expected in the area, none were recorded. No endemic species were recorded at the site. There is a number of vulnerable bird species listed for the area, including the Kori Bustard (*Ardeotis kori)*, the African Marsh Harrier (*Circus ranivorus*), the Lesser Ketrel (*Falco naumanni*), the African Whitebacked Vulture (*Gyps africanus*), Martial Eagle (*Polemaetus bellicosus*), Bataleur (*Terathopius ecaudatus*) and Lappetfaced Vulture (*Torgos tracheliotos*).

1.1.8.1.3 Amphibians

Only one common amphibian species was recorded within the study area namely *Afrana angolenis* (Common river frog), which is not listed as a Red Data species.

1.1.8.2 Red data species, endemism and biodiversity

Of the avifauna only the raptor species enjoy protected status and since mining has moved underground there are no disturbances impacting on the breeding birds in the pit. In terms of mammals, the Springbok (*Antidorcas marsupialis*), Klipspringer (*Oreotragus oreotragus*) and Gemsbok (*Oryx gazelle*) are all Conservation Dependent, while Sclater's golden mole (*Chlorotalpa sclateri*), Round or short-eared elephant-shrew (*Macroscelides proboscideus*) and spring hare (*Pedetes capensis*) are listed as Vulnerable.

1.1.9 Surface water

Surface water management facilities are described in detail in paragraph 2.3.2.2 of section 1 (EIA).

The mine falls within the greater Lower Vaal catchment area and is located on a ridge that forms part of the catchment divide between quaternary catchments C92C and D71B. This watershed forms part of the Asbesberge. The area in the east drains towards the Vaal River whilst the area in the west drains towards the Orange River. To the east, the mine falls within the catchment area of the Klein Riet River which is located to the southeast of the mine. The Klein Riet River drains out of three seasonal pans (Great Pan, Rooi Pan and one unnamed pan) located to the northeast and the east of the mine, from where the river runs in a south easterly direction till it drains into the Vaal River some 60km away. To the west the area drains into a pan at Taaibosch Puts, which drains towards the Orange River.

Mean annual rainfall of 320mm and the endoreic nature of the catchment imply that no real rivers are present in the immediate area: the closest river is the Groenwater Spruit near Postmasburg. There is no measurable surface water, except for the altered surface hydrology caused by coarse residue depositions: this result in erosion, altered groundwater flow and groundwater quality as consequential impacts. Pans that form on the Ghaap Plateau east from the mine are saline in nature and display natural vegetation typical of this landform.

1.1.9.1 Water management area

The mine falls within the greater Lower Vaal catchment area and is located on a ridge that forms part of the catchment divide between quaternary catchments C92C and D71B. There is no perennial surface water systems located or traversing the mine property, with pre-mining surface runoff from rainfall flowing to the pan at Bergplaas in the eastern catchment area and to the pan at Taaibosch Puts in the western catchment. There are, however, two distinct topographically low lying areas or drainage basins that will carry a concentrated amount of water through the mine property in the event of a 1 in 50 year storm.

The first low lying area (part of the D71B quaternary catchment) is located to the west of the mine and drains towards to the south on a north – south axis ending up in the Orange River system (West sub-catchment). The second low lying area (part of the C92C quaternary catchment) is located to the north of the mine, draining towards the southeast on an east – west axis that swings to a northwest – southeast axis running between the Norfin Village and the existing FRD 1,2 & 3 complex towards Bonza Dam. This water drains towards the Vaal River system (North sub-catchment).

There are a few streams indicated on the 1:50,000 map and most of these are non –persistent drainage channels which feed the groundwater in the dolomites of the Ghaap Plateau or flow into seasonal pans. The whole region is considered to be endorheic, which means that precipitation does not reach river systems, but is either evaporated or reports to groundwater.

In the past, the Vaal Gamagara State Water Scheme (now known as the Sedibeng Water Board Management Scheme) managed this area but is now managed by the Department of Water Affairs (DWA), Kimberley and the Tshiping Water Users Association.

1.1.9.2 Surface water quantity

1.1.9.2.1 Drainage density

In order to calculate drainage densities of the mine the area was divided into four sub catchments by KLM Consulting Services:

- Sub-Catchment A: Constitutes the north-western and western sections of the mine, including the Waste rock dump (WRD) and Brits FRD
- Sub-Catchment B: Constitutes the eastern sections of the mine, including the new CRD, FRDs and Bonza Quarry and Dump.

- Sub-Catchment C: Includes the eastern section of the Plant, a portion of the Old CRD and the Stores area.
- Sub-Catchment D: Includes the western section of the Plant, Capitol Dump and the single-quarter complex.

The drainage densities of the four sub-catchments are calculated at:

- Sub-Catchment A: $4.09 \times 10^{-4}\ m^{-1}$
- Sub-Catchment B: $3.53 \times 10^{-4}\ m^{-1}$
- Sub-Catchment C: $17.0 \times 10^{-4}\ m^{-1}$
- Sub-Catchment D: $17.0 \times 10^{-4}\ m^{-1}$

1.1.9.2.2 Mean annual runoff

The mean annual runoff for the sub-catchments is as follows:

- Sub-Catchment A: $0.077 \times 10^{6}\ m^{3}$
- Sub-Catchment B: $0.078 \times 10^{6} m^{3}$
- Sub-Catchment C: $0.0052 \times 10^{6} m^{3}$
- Sub-Catchment D: $0.0052 \times 10^{6} m^{3}$

1.1.9.2.3 Dry weather flow

There is no flow in the drainage channels but sub-surface flow within the drainage channels is sustained by ground water.

1.1.9.2.4 Flood peaks and flows

The flood peak flow rates for the four sub-catchments are shown in Table 14, and the flood volume rates for the four sub-catchments are shown in Table 15 below.

Table 14: Flood peak

1:X YEARS	1:2	1:5	1:10	1:20	1:50	1:100	1:200
A m^3/s	7	11	14	18	26	36	48
B m^3/s	14	21	28	36	53	72	97
C m^3/s	5	8	9	14	17	24	27
D m^3/s	3	5	6	9	11	15	17

Table 15: Flood volume

1:X YEARS	1:2	1:5	1:10	1:20	1:50	1:100	1:200
A x $1000m^3$	89.54	191.59	281.57	375.61	519.59	634.06	761.89
B x $1000m^3$	122.1	261.3	384.0	509.5	708.5	864.6	1038.9
C x$1000m^3$	8.14	17.42	25.60	33.96	47.24	57.64	69.26

1:X YEARS	1:2	1:5	1:10	1:20	1:50	1:100	1:200
D x1000m^3	8.14	17.42	25.60	33.96	47.24	57.64	69.26

1.1.9.2.5 Stormwater runoff

Stormwater runoff has been estimated for this catchment area. The catchment area is in this regard reduced by excluding the surface area of all dams (the volume of water falling directly on the dams having already been accounted for), FRDs (accounted for under FRDs runoff) as well as the open pit. An effective area of 8.38km^2 contributing to surface runoff has been measured in this manner. It should be noted that in discussions with Mine personnel, it has been indicated that even during relatively major rainfall events, little of no surface runoff is seen to emanate from the surrounding veld, with the only major contributions to runoff being from the developed areas (predominantly from paved areas and roads, as infiltration rates in grassed areas remain high). The following parameters where applied in estimating the stormwater runoff:

Catchment area:	8,38km^2
Mean Annual Precipitation:	393mm
Runoff co-efficient:	2.6%

The runoff for each period has been based on the measured rainfall for that period and has been applied over the entire catchment area.

1.1.9.3 Surface water quality

The surface water chemical qualities for the mine is available for periods ranging from April 2010 to November 2011, however, not all surface water monitoring localities have been measured at each of the different dates. Refer to Table 16 to Table 19 below for the surface water chemical qualities for process water facilities, potable water, seepage and sewage on the mine. Also refer to Table 20 for the hydrocarbons result for the oil separators.

Table 16: Surface water chemical qualities for process water facilities

SITE NAME	DATE	pH	EC mS/m	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	MALK mg/L	Cl mg/L	SO_4 mg/L	NO_3 mg/L	Al mg/L	Fe mg/L	Mn mg/L	F mg/L	TDS mg/L	S Solids	Turbidity NTU	Ba mg/L	Cd mg/L	Hg mg/L	Pb mg/L	Se mg/L	Zn mg/L
General limits	-	5.5.-9.5	150	--	--	--	--	--	0.25	--	15	--	0.3	0.1	1	--	25	--	--	0.005	0.005	0.01	0.02	0.1
5-Mission Dam	2011/11/23	7.75	222.0	79.0	18.3	352.8	66.636	52.5	109.71	887.00	2.85	0.015	0.017	0.034	<0.10	1578	2022	686.00	0.045	<0.001	<0.0001	<0.010	0.022	0.021
5-Mission Dam	2012/06/13	7.52	189	78	33	291	39	74	113	696	4.51	0.009	0.020	0.034	0.10	1343	61	44	0.040	<0.001	<0.0001	<0.010	0.011	0.012
5-Mission Dam	2012/11/28	8.1	172	63.94	26.23	257.84	52.39	73.9	125.65	570.00	7.46	0.021	0.028	0.019	0.19	1202	2024.5	630.00	0.028	<0.001	-0.0001	<0.010	0.011	0.011
BRITZ-ED	2010/11/10	7.67	191	110.8	23.0	543.4	87.57	37.1	165.40	1480	4.10	0.014	0.047	0.022	0.19	2466	32.9	2.10	0.036	-0.001	-0.0001	-0.006	0.021	0.014

SITE NAME	DATE	pH	EC mS/m	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	MALK mg/L	Cl mg/L	SO_4 mg/L	NO_3 mg/L	Al mg/L	Fe mg/L	Mn mg/L	F mg/L	TDS mg/L	S Solids	Turbidity NTU	Ba mg/L	Cd mg/L	Hg mg/L	Pb mg/L	Se mg/L	Zn mg/L
BRITZ-ED	2011/07/11	7.33	174	53.05	16.37	289.35	53.595	44.6	71.84	665.00	2.36	0.015	0.048	0.028	0.00	1204	16.4	4.18	0.025	<0.001	-0.0001	0.009	0.018	0.035
BRITZ-ED	2011/11/23	7.49	308	139.8	45.3	463.7	84.105	116.0	177.90	1306.00	-0.50	<0.004	0.029	0.288	0.10	2332	5982	95.10	0.042	<0.001	-0.0001	<0.010	<0.006	0.011
BRITZ-ED	2012/06/13	7.19	249	115	40	360	62	64	123	1044	2.90	0.014	0.025	0.177	<0.1	1821	557	203	0.047	<0.001	<0.0001	<0.010	0.017	0.017
BRITZ-ED	2012/11/28	7.88	268	139.49	51.32	360.96	71.21	43.7	211.43	1092.00	9.11	0.010	0.017	0.008	-0.10	2010	158.3	64.40	0.029	<0.001	-0.0001	<0.010	0.011	0.010
ED (Earth Dam)	2010/11/10	7.73	314	103.2	25.2	486.1	79.78	50.2	177.25	1241	4.09	0.012	1.481	0.029	0.21	2182	36.8	63.3	0.040	<0.001	<0.0001	<0.006	0.019	0.018
ED (Earth Dam)	2011/07/11	7.51	125	69.46	32.39	122.40	18.027	260.0	136.15	166.77	0.81	0.009	0.060	0.348	0.11	823	21181	>870	0.051	<0.001	<0.0001	0.004	0.006	0.020
ED (Earth Dam)	2012/06/13	7.52	162	80	38	197	28	95	128	485	12.83	0.024	0.034	0.035	0.14	1107	207	81	0.056	<0.001	<0.0001	<0.010	0.008	0.023

SITE NAME	DATE	pH	EC mS/m	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	MALK mg/L	Cl mg/L	SO_4 mg/L	NO_3 mg/L	Al mg/L	Fe mg/L	Mn mg/L	F mg/L	TDS mg/L	S Solids	Turbidity NTU	Ba mg/L	Cd mg/L	Hg mg/L	Pb mg/L	Se mg/L	Zn mg/L
ED (Earth Dam)	2012/11/28	8.79	130	68.92	39.70	135.01	20.63	14.91	147	157.51	256.93	9.07	0.012	0.018	0.007	865	72.6	49.70	0.022	<0.001	-0.0001	<0.010	<0.006	0.009
Plant	2011/07/11	7.56	71.0	40.66	22.54	71.50	20.200	137	69.00	111.00	0.60	0.054	0.103	0.030	0.19	475	2551	72.4	0.053	<0.001	<0.0001	0.006	0.007	0.051

Table 17: Surface water chemical qualities for potable water

SITE NAME	DATE	pH	EC mS/m	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	MALK mg/L	Cl mg/L	SO_4 mg/L	NO_3 mg/L	Al mg/L	Fe mg/L	Mn mg/L	F mg/L	TDS mg/L	S Solids	Turbidity NTU	Ba mg/L	Cd mg/L	Hg mg/L	Pb mg/L	Se mg/L	Zn mg/L
SANS 241:2011	-	5-9.7	≤170	--	--	≤200	--	--	≤5	≤500	≤0.9	≤0.3	≤0.3	≤0.5	≤1.5	≤1,200	--	≤1	--	≤0.003	≤0.006	≤0.01	≤0.01	≤5
PW (Potable water)	2010/11/1	7.97	78.8	44.6	32.3	59.6	7.35	146	91.00	133.00	0.05	0.033	0.092	0.024	0.34	514	0.96	62.4	0.094	<0.001	<0.0001	<0.006	<0.006	0.116
PW (Potable water)	2011/07/11	7.88	65.6	41.41	30.70	55.89	6.472	134	79.00	82.00	0.53	0.029	0.058	0.012	0.20	432	2613	1.31	0.058	<0.001	<0.0001	0.006	0.003	0.139
PW (Potable water)	2011/11/23	8.23	83.1	49.7	36.4	71.0	7.472	161	99.00	127.50	0.12	0.012	0.044	0.021	0.28	553	4.1	4.10	0.070	<0.001	<0.0001	<0.010	<0.006	0.102

SITE NAME	DATE	pH	EC mS/m	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	MALK mg/L	Cl mg/L	SO_4 mg/L	NO_3 mg/L	Al mg/L	Fe mg/L	Mn mg/L	F mg/L	TDS mg/L	S Solids	Turbidity NTU	Ba mg/L	Cd mg/L	Hg mg/L	Pb mg/L	Se mg/L	Zn mg/L
PW (Potable water)	2012/06/13	7.52	84	47	36	79	8	150	107	139	0.16	0.016	0.036	0.007	0.28	566	1	1	0.066	<0.001	<0.0001	<0.010	<0.006	0.067
PW (Potable water)	2012/11/28	8.13	93.8	41.29	38.07	85.77	10.15	151	109.00	169.00	-0.05	0.054	0.026	0.025	0.32	605	3.25	1.36	0.081	<0.001	-0.0001	<0.010	<0.006	0.120

Table 18: Surface water chemical qualities for seepage water

SITE NAME	DATE	pH	EC mS/m	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	MALK mg/L	Cl mg/L	SO4 mg/L	N NO3 mg/L	Al mg/L	Fe mg/L	Mn mg/L	F mg/L	TDS mg/L	S Solids	Turbidity NTU	Ba mg/L	Cd mg/L	Hg mg/L	Pb mg/L	Se mg/L	Zn mg/L
General limits	-	5.5.-9.5	150	---	--	--	--	--	0.25	--	15	--	0.3	0.1	1	--	25	--	--	0.005	0.005	0.01	0.02	0.1
Seepage North	2011/11/23	8.51	223.0	86.6	37.4	360.3	21.506	73	104.45	953.00	1.12	0.180	0.127	0.023	<0.10	1641	14.4	13.38	0.030	<0.001	<0.0001	<0.010	<0.006	0.024
Seepage South	2011/11/23	8.28	289.0	185.5	105.4	358.4	17.515	83	189.57	1327.00	<0.50	<0.004	0.014	0.013	<0.10	2263	5.7	1.77	0.036	<0.001	<0.0001	<0.010	0.007	0.019
Seepage North	2012/06/13	7.52	232	102	42	363	19	38	127	983	<0.5	0.043	0.040	0.007	0.18	1671	4	2	0.052	<0.001	<0.0001	<0.010	<0.006	0.005

SITE NAME	DATE	pH	EC mS/m	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	MALK mg/L	Cl mg/L	SO4 mg/L	N NO3 mg/L	Al mg/L	Fe mg/L	Mn mg/L	F mg/L	TDS mg/L	S Solids	Turbidity NTU	Ba mg/L	Cd mg/L	Hg mg/L	Pb mg/L	Se mg/L	Zn mg/L
Seepage North-D	2012/06/13	7.52	186	101	33	278	15	37	101	780	<0.5	0.018	0.024	0.008	0.38	1341	35	29	0.063	<0.001	<0.0001	<0.010	<0.006	0.008
Seepage North	2012/11/28	8.7	355	154.32	60.57	598.99	32.44	21.2	218.94	1701.00	-0.50	0.026	0.027	0.017	0.08	2785	15.5	1.87	0.042	<0.001	-0.0001	<0.010	<0.006	0.009

Table 19: Surface water chemical qualities for sewage water

SITE NAME	DATE	pH	EC mS/m	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	MALK mg/L	Cl mg/L	SO4 mg/L	N NO3 mg/L	Al mg/L	Fe mg/L	Mn mg/L	F mg/L	TDS mg/L	S Solids	Turbidity NTU	Ba mg/L	Cd mg/L	Hg mg/L	Pb mg/L	Se mg/L	Zn mg/L
General limits	-	5.5.-9.5	150	---	--	--	--	--	0.25	--	15	--	0.3	0.1	1	--	25	--	--	0.005	0.005	0.01	0.02	0.1
Sewage Water	2010/11/10	7.83	123	70.2	35.5	107.7	16.82	138	140.00	201.68	14.64	0.015	0.047	0.026	0.24	799	18.2	2.60	0.025	<0.001	<0.0001	<0.006	<0.006	0.044
Sewage Water	2011/07/11	7.64	125	80.46	34.34	112.61	15.907	213	127.68	194.32	4.06	0.012	0.047	0.038	0.03	801	2601	10.8	0.016	<0.001	<0.0001	0.005	0.006	0.023
Sewage Water	2011/11/23	7.54	122.0	80.1	43.0	124.0	14.306	195	128.74	225.595	2.98	0.006	0.024	0.044	0.10	823	9.7	5.25	0.042	<0.001	<0.0001	<0.010	<0.006	0.019

SITE NAME	DATE	pH	EC mS/m	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	MALK mg/L	Cl mg/L	SO4 mg/L	N NO3 mg/L	Al mg/L	Fe mg/L	Mn mg/L	F mg/L	TDS mg/L	S Solids	Turbidity NTU	Ba mg/L	Cd mg/L	Hg mg/L	Pb mg/L	Se mg/L	Zn mg/L
Sewage Water	2012/06/13	7.52	124	74	42	133	16	106	143	212	25.29	0.008	0.020	0.006	0.25	837	17	8	0.031	<0.001	<0.0001	<0.010	<0.006	0.030
Sewage Water	2012/11/28	7.89	130	70.28	41.03	127.48	17.69	140	156.98	239.09	13.71	0.017	0.022	0.010	-0.10	856	7.32	1.10	0.028	<0.001	0.0001	<0.010	<0.006	0.031

Table 20: Surface hydrocarbon qualities for oil separators

SITE NAME	DATE	Oil & grease mg/l	Diesel mg/l	VOC µg/l	SVOC µg/l
General limits	-	2.5	2.5	--	--
Oil Separator (UG)	2010/04/08	--	--	--	--
Oil Separator 1 (WAMY)	2010/04/08	--	--	--	--
Oil Separator 1 (WAMY)	2010/11/10	84	<0.01	--	--
Oil Separator 1 (WAMY)	2011/07/11	596	20	249	7
Oil Separator 1 (WAMY)	2011/11/23	6			
Oil Separator 1 (WAMY)	2012/06/13	---	3	1	4
Oil Separator 2 (Plant)	2010/04/08	--	--	--	--
Oil Separator 2 (Plant)	2010/11/10	9	<0.01	--	--
Oil Separator 2 (Plant)	2011/11/23	3	--	--	--
Oil Separator 2 (Plant)	2012/06/13		2	1	12
Oil Separator 3 (Benleg)	2010/04/08	--	--	--	--
Oil Separator 3 (Benleg)	2010/11/10	8	<0.01	--	--
Oil Separator 3 (Benleg)	2011/07/11	8	--	--	--
Oil Separator 3 (Benleg)	2011/11/23	33	--	--	--
Oil Separator 3 (Benleg)	2012/06/13		0	1	1

In general, Cl and suspended solid levels for the process water facilities were higher than the general limits. In general Cl and turbidity levels were above the SANS 241:2011 limits for potable water. Cl and EC levels from seepage water were higher than general limits. Cl levels were also higher than general limits in the sewage water. Oil and grease levels in t most of the oil separators were higher than general limits.

Bacteriological monitoring is also done on the potable water from the VG pipeline. The results for the monitoring results for January, February and March 2012 is given in Table 17 below. No water sapling was done at VG inflow of pipeline, final effluent service water of single quarter kitchen faucet for March 2012. Water sampling of water inflows and outflows into the main potable water reservoirs takes place monthly for bacteriological analysis. This is to determine whether there is a quality issue with water supply coming into the tank or whether it occurs after the storage facility. If there is a parameter that exceeds the limit the Services Engineer is notified. As a result of the monitoring the reservoirs are flushed every 6 months to remove any sediment build up on the floor of the reservoir.

Table 21: Surface water bacteriological qualities of the mine

	BOTTOM DAM									VG INFLOW OF PIPELINE								
	01/12	02/12	03/12	05/12	08/12	09/12	10/12	11/12	12/12	01/12	02/12	03/12	05/12	08/12	09/12	10/12	11/12	12/12
Standard agar plate count (cfu/ml)	120	Innumerable	Innumerable	180	Innumerable	---	Innumerable	---	260	Innumerable	Innumerable	---	80	Innumerable	Innumerable	Innumerable	---	Innumerable

	LIME ACRES VILLAGE RESERVOIR									HEADER TANK SERVICE WATER								
	01/12	02/12	03/12	05/12	08/12	09/12	10/12	11/12	12/12	01/12	02/12	03/12	05/12	08/12	09/12	10/12	11/12	12/12
Standard agar plate count (cfu/ml)	280	Innumerable	1	180	3	---	Innumerable	320	Innumerable	Innumerable	60	1	160	0	---	1	---	58

	BOTTOM DAM								
	01/12	**02/12**	**03/12**	**05/12**	**08/12**	**09/12**	**10/12**	**11/12**	**12/12**
Total coliform count (cfu/100ml)	1	8	0	0	0	---	21	---	3
Escherichia coli type 1 (cfu/100ml)	0	0	0	0	0	---	0	---	0

	VG INFLOW OF PIPELINE								
	01/12	**02/12**	**03/12**	**05/12**	**08/12**	**09/12**	**10/12**	**11/12**	**12/12**
Total coliform count (cfu/100ml)	5	1	---	1	3	1	1	---	1
Escherichia coli type 1 (cfu/100ml)	0	0	---	0	0	0	0	---	0

	LIME ACRES VILLAGE RESERVOIR								
	01/12	**02/12**	**03/12**	**05/12**	**08/12**	**09/12**	**10/12**	**11/12**	**12/12**
Total coliform count (cfu/100ml)	2	2	---	0	2	---	89	0	2
Escherichia coli type 1 (cfu/100ml)	0	0	---	0	0	---	0	0	0

	HEADER TANK SERVICE WATER								
	01/12	**02/12**	**03/12**	**05/12**	**08/12**	**09/12**	**10/12**	**11/12**	**12/12**
Total coliform count (cfu/100ml)	>201	0	0	0	0	---	0	---	0
Escherichia coli type 1 (cfu/100ml)	4	0	0	0	0	---	0	---	0

	FIVE MISSION VILLAGE RESERVOIR								
	01/12	**02/12**	**03/12**	**05/12**	**08/12**	**09/12**	**10/12**	**11/12**	**12/12**
Standard agar plate count (cfu/ml)	240	140	Innumerable	180	Innumerable	---	Innumerable	240	---

	FINAL EFFLUENT SERVICE WATER								
	01/12	**02/12**	**03/12**	**05/12**	**08/12**	**09/12**	**10/12**	**11/12**	**12/12**
Standard agar plate count (cfu/ml)	Innumerable	120	---	80	20	Innumerable	5	Innumerable	---

	EARTH DAM SERVICE WATER								
	01/12	**02/12**	**03/12**	**05/12**	**08/12**	**09/12**	**10/12**	**11/12**	**12/12**
Standard agar plate count (cfu/ml)	Innumerable	Innumerable	Innumerable	Innumerable	Innumerable	Innumerable	---	Innumerable	---

	SINGLE-QUARTER KITCHEN FAUCET								
	01/12	**02/12**	**03/12**	**05/12**	**08/12**	**09/12**	**10/12**	**11/12**	**12/12**
Standard agar plate count (cfu/ml)	4	40	---	40	30	61	---	140	---

	FIVE MISSION VILLAGE RESERVOIR									FINAL EFFLUENT SERVICE WATER									EARTH DAM SERVICE WATER									SINGLE-QUARTER KITCHEN FAUCET								
	01/12	02/12	03/12	05/12	08/12	09/12	10/12	11/12	12/12	01/12	02/12	03/12	05/12	08/12	09/12	10/12	11/12	12/12	01/12	02/12	03/12	05/12	08/12	09/12	10/12	11/12	12/12	01/12	02/12	03/12	05/12	08/12	09/12	10/12	11/12	12/12
Total coliform count (cfu/100ml)	3	1	0	1	0	---	3	3	---	>201	2	---	4	18	>201	201	145	---	>201	>201	50	>201	127	>201	---	45	---	0	0	---	0	0	0	---	0	---
Escherichia coli type 1 (cfu/100ml)	0	0	0	0	0	---	0	0	---	>201	0	---	0	0	4	0	18	---	>201	5	2	4	8	43	---	0	---	0	0	---	0	0	0	---	0	---

Standard agar plate count recommended limit: <100cfu/ml

Escherichia coli type 1 maximum allowed: 0cfu/100ml

--- Data unavailable

Bacteriological levels above the Standard agar plate count recommended limit and Escherichia coli type 1 maximum allowed occurred in header tank, final effluent service water and earth dam service water.

1.1.9.4 Surface water use

There are no perennial streams and no permanent surface water sources in the area. During the heavy rainfall years of 1988 a nearby large surface pan filled with water and became a recreational area for a few years. Some freshwater pans which only fill with water during exceptionally wet years are used to water livestock. Generally the pan water is saline.

1.1.9.5 Wetlands and pans

There are no wetlands located on the mining area. The 1:50,000 2823AD Lime Acres topographical map shows that there are three pans in close proximity to the site for the FRD. Two small pans are located close to the northern and southern ends of the existing rock deposit. Another pan is located towards the watershed of the catchment to the north of the FRD (Rietpan). Runoff generally drains in a southerly direction to a pan about 6km south of the mine and towards the pan located adjacent to the northern end of the existing rock deposit. All water courses and pans are non-perennial. Runoff is generally low, with the average runoff from the quaternary being 1.4 percent of the mean annual precipitation. There is therefore generally no dry season flow in the area. Surface runoff will occur only after large or high intensity rainfall events, or during prolonged periods of rainfall (Golder 2006: 30).

The Groot Pan and Danielskuil Pan (located to the east and the northeast of the study area) were sampled in 1980 / 81 and represent background surface water quality for the natural pans in the area. The pans in the vicinity of the mine exhibit characteristically higher concentrations of salts due to high evaporation rates, as indicated in Table 18.

Table 22: Background surface water quality for the natural pans in the area

	EC µS/c	TDS mg/l	pH	Mg	Na	Ca	F	Cl	NO_3	SO_4	K	HCO_3	NH_4	PO_4
Groot Pan(May 1980)	315	2 047	8.2	216	235	2.7	0.2	497	2.7	163	76	560	1.00	0.004
Groot Pan (Sep 1980)	424	2 756	8.5	433	357	4.1	0.4	740	0.9	194	131	1 423	0.5	0.019
0.019Groot Pan (May 1981)	271	1 763	8.9	256	197	2.7	0.3	427	0.1	141	65	930	0.2	0.006
Danielskuil (May 1980)	82	533	7.4	50	30	61.7	0.2	62	0.4	155	16	171	0.1	0.003

	EC µS/c	TDS mg/l	pH	Mg	Na	Ca	F	Cl	NO_3	SO_4	K	HCO_3	NH_4	PO_4
Danielskuil (May 1981)	81	528	7.6	48	25	6.1	0.2	60	0.2	149	16	173	0.06	0.006

1.1.9.6 Disturbance of watercourses

One non-perennial drainage line flows in a north- easterly direction towards a non-perennial pan in the west sub-catchment to the west of the Brits FRD. This drainage line is in close proximity to the Brits FRD. No other significant drainage lines are present in the catchment.

1.1.10 Groundwater

1.1.10.1 Depth of water tables

In 1963 the water level elevation in a borehole on the northern boundary of the Brits farm was measured at 1,475 meters above mean sea level (mamsl) (KLM, 2002).. In 1982 the water elevation in a borehole close to the open pit (SH7) was measured at 1,335 mamsl. This indicates probable dewatering effects close to the open pit of about 140m (EMP, 2002). The water levels measured from 2007 to 2012 indicates a decreases level at the pit with a drop of 17m (Vermeulen & Lourens, 2011).

The areas with artificial recharge, i.e. the FRD dams as well as at the golf course have shallower water levels than the rest of the boreholes. The water levels of the boreholes at the main WRD on the western side of the mine are deep (50 -115m) and those to the south of the Post-1979 CRD deeper than 125m.

According to KLM (2002), in 1963 mapped water levels indicated a regional groundwater flow from west to east. Present groundwater flow north of the mine is generally from west to east towards the existing FRD complex. East of the FRD complex, groundwater flow is from north to south. The PPC quarries and the old FRD paddock area were considered to have generally similar water level elevations while the golf course area had higher elevations, suggesting a different groundwater compartment (IWWMP, 2010).

According to the KLM (2002), water levels on the farms adjacent to the mine lease area are similar to the pre-mining water levels. This indicates that the dewatering cone of depression is of limited extent and restricted to the mine lease area. Regional water levels have been affected by groundwater abstraction from the quarries at PPC.

Refer to Figure 3 for the regional water level of the area and Figure 4 for the regional water level elevations of the area.

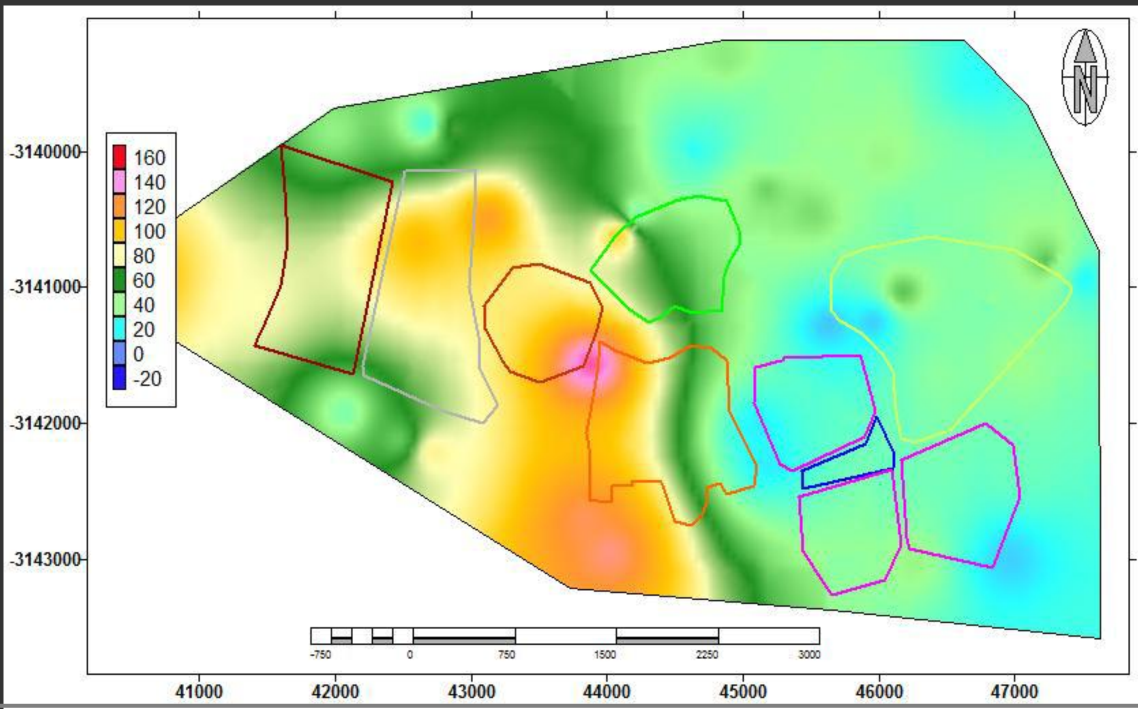

Figure 3: Regional water level of the area

Client: Petra Diamonds, Finsch Mine

Project: EMP Amendment

Date: May 2012

SHANGONI Management Services (Pty) Ltd

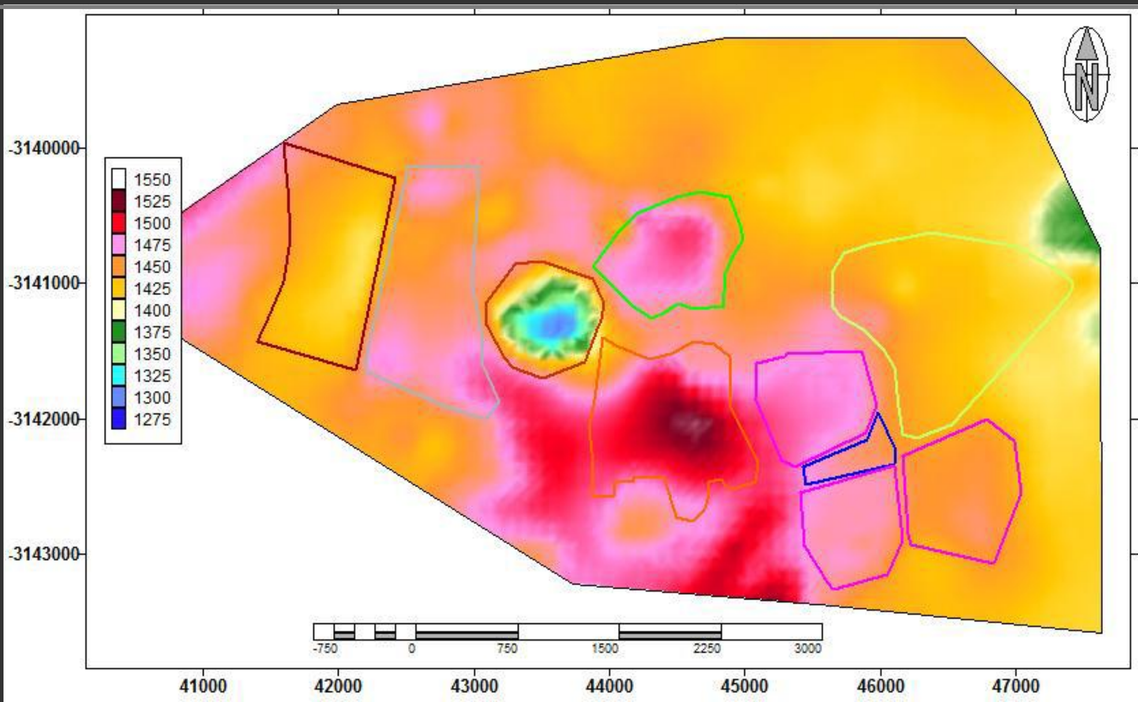

Figure 4: Regional water level elevations of the area

Client: Petra Diamonds, Finsch Mine

Project: EMP Amendment

Date: May 2012

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1.1.10.2 Groundwater zones

According to the IWWMP (2010), the groundwater system is characterised by two aquifers. The first aquifer is a shallow aquifer developed in weathered dolomite which extends from the ground surface to a depth determined by the extent of dolomite weathering but is generally less than 40m. The second aquifer is a deeper aquifer along fault zones, joints, fractures, dyke margins and Karst solution features developed in relatively un-weathered dolomite. Key features of the regional hydrogeology are:

- Karst dolomite underlies the Golf Course, PPC quarry and Bonza Game Farm
- areas,
- The dolomite aquifer is divided into compartments by the Daniëlskuil and Groot
- Pan dykes,
- Faults in the area can act as barriers or conduits to groundwater flow,
- The groundwater level is between 6m and 39m below surface,
- Regional groundwater flow is from west to east, and
- Hydraulic conductivities in the dolomite vary from 0.0002m/day to 2m/day.

Flow along permeable features can be rapid and extend for long distances. Seepage from the existing FRD1, 2& 3 complex will tend to move to the northeast, based on historical evidence during the mining of PPC quarries 4 & 5, as well as the Bonza quarry.

When PPC developed quarry 5 the boreholes on the Golf Course to the southwest dried up. In late 1999 PPC extended quarry 5 to the west and intersected a water-bearing fissure. Groundwater levels in boreholes on the Golf Course and Bonza Game Farm fell to such an extent that the holes were unusable. Over the following 6 months the water level on Bonza recovered but chemical analysis of the water indicated that it was not fit for drinking purposes due to high levels of salts (TDS). By late 2001 water conditions had stabilised and the water was again fit for drinking.

During the initial development of the PPC quarry 4, water flowed out of the south-western face. Water-bearing fissure was intersected on the south side of quarry 4 which was inferred to extend beneath the FRD paddocks. The water flow from this fissure reportedly dried up when monitoring borehole E2 was drilled.

Seepage was observed on the northern (PPC) side of the pit when the Bonza quarry was being mined (Bonza dam). The dominance of the southwest – northeast trending structural pattern, combined with the anecdotal evidence, indicates that there is a strong anisotropy in the dolomite with preferential groundwater flow in the southwest – northeast direction. The implication is that seepage from the existing FRD complex will tend to move to the northeast.

The dolomite aquifer consists of a series of solution cavities within solid dolomite. The solution cavities could be developed on structural features and may or may not be interconnected. A cavity was intersected during drilling of KLM2. The observation of sinkholes in the excavation of the paddock walls confirms the indication from the geophysical data that solution features exist beneath the Old FRD paddocks. The dolomite aquifer further consists of permeable horizons within the dolomite including the near-surface weathered zone. The aquifer is heterogeneous and anisotropic, i.e. hydraulic properties vary over short distances in all directions.

1.1.10.3 Groundwater use

Surface water resources, especially in the Lower Vaal Catchment area, are virtually fully utilised and therefore the exploitation of groundwater resources constitutes more than 50% of total water demand in the region. Virtually all farms are dependent on groundwater for both domestic and stock use.

The groundwater pumped out of the mine (from sumps located at 680m below surface) as part of the dewatering of the underground workings is pumped to the Bottom dams. From here it is pumped to the Treatment Plant for use in the processing of the diamond ore. The water then forms part of the closed water reticulation system of the mine. Currently the mine extracts approximately 120 000m³ water per month from its underground operations (IWWMP, 2010). Prior to 2007 an average of approximately 206 300m³ of water was pumped monthly from the Bonza quarry. This operation has been suspended.

Groundwater is used by PPC to supply their employees in Lime Acres with potable water. The water is pumped from quarries which receive water from submerged springs. The mine uses imported water from the Vaal - Gamagara pipeline for potable water.

The use of borehole water on the surrounding farms is mainly for stock and game watering. Ground water is utilised for a number of different purposes in this region. Table 19: below summarises these purposes.

Table 23: Summary of groundwater use (IWWMP, 2010)

N=155	DOMESTIC WATER USE	ABANDONED,BLOCKED OR NOT IN USE	IRRIGATION USE	STOCK AND/OR GAME WATERING	MONITORING BOREHOLES
Number of uses	23	34	19	53	26
Percentage	14.8%	22%	12.3%	34.1%	16.8%

All the monitoring holes have been drilled by the two mines (Finsch and PPC Lime) in the region. If these are removed from the water use statistics, together with the boreholes that have been abandoned, then it can be concluded that about 20 % of all actively pumping boreholes are used for irrigation purposes. Table 20 indicates the pumping details of the boreholes utilised in the region.

Table 24: Pumping details for boreholes in the Finsch Mine region (IWWMP, 2010)

N=137	WIND-MILL PUMP	SUBMER-SIBLE PUMP	MONO PUMP	SOLAR PUMP	BROKEN PUMP	NOT EQUIPPED
Number of uses	58	12	10	1	9	47
Percentage	42.6%	8.8%	7.4%	0.7%	6.6%	34.6%

Most of the boreholes in this region are equipped with windmills. 34 % of holes are not equipped.

1.1.10.4 Groundwater quality

Groundwater chemical analysis is ongoing on the mine. The most recent chemical analysis available is for November 2011, June 2012 and November 2012. These results are presented in Table 25 to Table 27 below. Refer to Figure 5 for the location of the boreholes.

Table 25: Chemical analysis for groundwater for November 2011

SITE NAME	PH	EC	Ca	Mg	Na	K	PALK	MALK	Cl	SO4	N NO3	Al	Fe	Mn	F	TDS	SUSP. SOLIDS	TURB	Ba	Cd	Hg	Pb	Se	Zn
		mS/m	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	mg /L	Mg/L	NTU	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L
BA2	7.31	183.0	206.6	62.2	124.4	5.633	0	446	167.29	308.899	0.70	<0.004	0.021	0.723	0.20	1355	29.7	91.80	0.073	<0.001	-0.0001	<0.010	0.007	0.043
E2	7.62	78.9	98.1	46.8	20.7	3.832	0	299	48.37	78.90	0.46	0.009	0.014	0.020	0.74	599	28.4	11.39	0.037	<0.001	-0.0001	<0.010	<0.006	0.017
E3	7.59	74.3	93.2	37.1	16.1	3.163	0	294	34.62	78.25	0.15	0.009	0.015	0.123	1.20	559	19.4	13.09	0.044	<0.001	-0.0001	<0.010	<0.006	0.017
E4	7.23	131.0	144.0	78.2	42.3	5.334	0	454	58.70	193.71	1.50	0.006	0.014	0.021	-0.10	983	53.0	25.70	0.024	<0.001	-0.0001	<0.010	<0.006	0.021
E7	7.58	97.7	118.0	34.8	43.6	3.758	0	201	132.00	113.20	4.15	0.002	0.016	0.283	0.07	666	97.04	401.00	0.016	<0.001	-0.0001	<0.010	<0.006	0.014
E15	6.54	15.3	8.7	3.2	11.8	1.825	0	31.7	9.42	11.12	2.73	0.027	0.049	0.015	0.05	90	26	21.60	0.015	<0.001	-0.0001	<0.010	<0.006	0.028
E17	7.59	61.4	68.3	40.5	9.8	2.983	0	239	42.94	34.38	-0.05	0.016	0.013	0.100	0.29	438	148	113.00	0.048	<0.001	-0.0001	<0.010	<0.006	0.017
E20	7.44	106	98.6	100.6	12.5	6.703	0	565	18.41	46.92	-0.50	0.006	0.015	0.160	-0.10	847	198	290.00	0.028	<0.001	-0.0001	<0.010	<0.006	0.015
E21	8.19	154	129.0	122.1	50.7	16.661	0	735	18.01	146.906	-0.50	0.008	0.016	0.066	0.19	1215	848	389.00	0.109	<0.001	-0.0001	<0.010	<0.006	0.023
E23	7.65	41.4	36.1	23.6	10.6	2.851	0	193	13.94	9.80	0.48	0.008	0.023	0.018	0.16	292	156	337.00	0.017	<0.001	-0.0001	<0.010	<0.006	0.019
E24	7.9	297	226.1	204.6	226.4	4.791	0	289	294.01	1096.00	6.90	<0.004	0.024	0.144	0.10	2373	40.3	232.00	0.020	<0.001	-0.0001	<0.010	<0.006	0.019
E25	7.50	178	213.4	55.8	148.7	6.095	0	331	92.71	529.00	4.27	<0.004	0.017	1 136	0.14	1397	36.9	154.00	0.034	<0.001	-0.0001	<0.010	0.009	0.028
E26	7.52	193	231.9	66.1	142.8	3.470	0	239.0	123.72	658.00	8.25	0.005	0.017	0.208	-0.10	1500	21	101.00	0.033	<0.001	-0.0001	<0.010	0.015	0.023
E27	7.71	171	151.8	95.6	119.2	6.747	0	369	83.00	498.28	1.06	0.014	0.016	0.030	1.03	1329	19.0	6.01	0.046	<0.001	-0.0001	<0.010	0.010	0.021
E28	7.25	167	213.2	61.	99.6	8.317	0	274	169.34	373.81	5.07	<0.004	0.013	0.021	-0.10	1227	55.8	78.50	0.022	<0.001	-0.0001	<0.010	<0.006	0.021
E29	7.62	61.5	28.7	31.9	48.2	4.377	0	135.0	91.02	50.91	-0.05	0.007	0.015	0.183	0.02	391	48	232.00	0.033	<0.001	-0.0001	<0.010	<0.006	0.016
E30	7.78	99.1	110.5	38.2	43.9	4.000	0	207	136.04	111.00	5.10	0.007	0.016	0.025	0.04	674	24.6	10.62	0.019	<0.001	-0.0001	<0.010	<0.006	0.019
E31	6.70	29.1	17.9	8.0	20.8	2.846	0	41.8	21.42	18.95	12.29	0.005	0.015	0.013	0.05	186	17.0	17.36	0.018	<0.001	-0.0001	<0.010	<0.006	0.024
F4	7.61	171.0	153.5	69.4	173.1	3.162	0	338.0	92.88	475.94	5.87	0.005	0.015	0.052	0.13	1332	80.6	54.10	0.020	<0.001	-0.0001	<0.010	0.007	0.018
F5	7.87	64.5	36.9	46.9	46.3	2.323	0	305.0	6.56	47 49	0.43	0.013	0.016	0.014	1.67	495	6.2	5.92	0.015	<0.001	-0.0001	<0.010	<0.006	0.014
F6	7.51	134.0	175.9	47.6	60.5	3.216	0	320	106.21	215.25	5.66	0.007	0.024	0.026	-0.10	955	2.1	1.92	0.019	<0.001	-0.0001	<0.010	<0.006	0.881
F8	7.55	164	144.4	71.7	141.9	3.073	0	373.0	88.88	407.16	5.03	0.008	0.016	0.048	-0.10	1251	17.2	13.24	0.026	<0.001	-0.0001	<0.010	0.010	0.030
G3	7.14	47.3	38.0	19.7	20.3	3.057	0	65.3	32.67	77.80	11.20	0.013	0.021	0.086	0.03	307	99	207.00	0.026	<0.001	-0.0001	<0.010	<0.006	0.020
G4	7.77	40.2	36.1	24.1	11.7	2.628	0	190	14.97	5.35	-0.05	0.007	0.014	0.117	0.07	285	34.8	81.70	0.017	<0.001	-0.0001	<0.010	<0.006	0.019
G8	8.12	54.4	39.8	43.8	16.3	5.520	0	252	20.26	11.81	2.92	0.000	0.013	0.013	0.03	403	20	10.67	0.019	<0.001	-0.0001	<0.010	0.009	0.013
G12	7.62	59.1	69.3	34.7	15.3	3.526	0	294	15.58	11.85	-0.05	<0.004	0.013	0.255	0.28	445	27	48.50	0.031	<0.001	-0.0001	<0.010	<0.006	0.016
GA01A	7.85	97.9	102.8	68.4	30.6	4.104	0	348	77.80	91.80	1.61	<0.004	0.013	0.015	0.11	732	3.00	3.61	0.015	<0.001	-0.0001	<0.010	0.009	0.012
GA02A	7.69	97.8	98.1	63.5	29.9	3.723	0	282	96.30	73.70	11.68	<0.004	0.012	0.018	0.18	700	3.0	0.78	0.015	<0.001	-0.0001	<0.010	0.006	0.015
GA03	7.64	132	130.7	87.6	41.3	4.569	0	406	130.39	139.908	0.91	0.001	0.012	0.018	0.28	945	7.20	2.12	0.026	<0.001	-0.0001	<0.010	<0.006	0.015
GA04A	8.08	119	86.2	71.4	73.2	2.551	0	176	100.42	305.34	-0.50	<0.004	0.013	0.015	0.20	812	22.37	14.95	0.036	<0.001	-0.0001	<0.010	<0.006	0.013
GA04B	8.21	161	126.0	88.1	141.0	1.576	0	178	112.94	581.24	0.69	<0.004	0.014	0.348	0.06	1231	64.7	358.00	0.025	<0.001	-0.0001	<0.010	<0.006	0.022
GA05	7.73	122.0	141.0	46.2	64.6	3.334	0	297	107.17	189.45	0.99	0.006	0.013	0.046	-0.10	852	10.8	2.79	0.029	<0.001	-0.0001	<0.010	<0.006	0.021
KLM4	7.73	69.2	77.6	42.9	15.5	2.610	0	262.0	42.62	51.95	2.11	0.011	0.018	0.116	0.32	505	10.1	3.40	0.025	<0.001	-0.0001	<0.010	<0.006	0.016
KLM5	7.74	241	190.6	113.6	229.9	17.121	0	321	142.85	885.00	2.09	0.007	0.018	0.478	0.03	1909	38.9	25.30	0.028	<0.001	-0.0001	<0.010	<0.006	0.019

SITE NAME	PH	EC	Ca	Mg	Na	K	PALK	MALK	Cl	SO4	N NO3	Al	Fe	Mn	F	TDS	SUSP. SOLIDS	TURB	Ba	Cd	Hg	Pb	Se	Zn
		mS/m	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	mg /L	Mg/L	NTU	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L	Mg/L
KLM6	7.61	164	156.8	68.5	168.9	6.837	0	486	31.81	446.01	-0.50	0.005	0.014	0.028	0.04	1361	160.8	30.50	0.024	<0.001	-0.0001	<0.010	0.007	0.016
M1	7.61	121	122.3	52.8	58.7	4.344	0	164	133.32	212.725	9.60	<0.004	0.015	0.028	0.03	789	28.3	14.65	0.019	<0.001	-0.0001	<0.010	0.006	0.019
M4	7.44	127	191.1	59.4	19.4	4.297	0	369	63.80	254.802	-0.50	<0.004	0.013	0.499	0.38	960	9.7	0.76	0.037	<0.001	-0.0001	<0.010	<0.006	0.017
M6	7.72	97.8	113.7	49.7	36.4	4.527	0	227	99.30	144.00	7.71	0.005	0.014	0.021	0.18	709	41.9	33.10	0.023	<0.001	-0.0001	<0.010	<0.006	0.013
M8	7.78	64.9	101.2	26.5	10.8	2.665	0	218	25.41	117.70	0.05	0.007	0.016	0.385	0.40	503	24.0	16.09	0.036	<0.001	-0.0001	<0.010	<0.006	0.021
M9	7.75	80.2	94.1	40.2	20.3	4.513	0	202	82.10	69.80	10.68	0.010	0.017	0.017	0.03	561	16.1	7.20	0.017	<0.001	-0.0001	<0.010	<0.006	0.019

Table 26: Chemical analysis for groundwater for June 2012

Site Name	pH	EC mS/m	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	PALK mg/L	MALK mg/L	Cl mg/L	SO4 mg/L	N NO3 mg/L	Al mg/L	Fe mg/L	Mn mg/L	F mg/L	TDS mg/L	Susp solids	Turb NTU	Ba mg/L	Cd mg/L	Hg mg/L	Pb mg/L	Se mg/L	Zn mg/L
F6	7.29	123	169	45	59	3.51	0	304	109	209	5.39	<0.004	<0.004	0.011	-0.10	920	1	0	0.011	<0.001	<0.0001	<0.010	<0.006	0.045
BA2	7.17	178	230	55	114	4.36	0	351	161	342	24.82	0.005	<0.004	0.052	-0.10	1368	23	13	0.021	<0.001	<0.0001	<0.010	0.008	0.074
E2	7.38	79	102	46	22	3.78	0	301	52	81	0.48	<0.004	<0.004	0.003	0.71	610	36	14	0.027	<0.001	<0.0001	<0.010	<0.006	0.008
E3	7.32	73	99	38	17	3.40	0	291	35	75	0.14	<0.004	<0.004	0.108	0.96	562	28	12	0.036	<0.001	<0.0001	<0.010	<0.006	0.007
E4	7.04	132	169	81	45	6.33	0	472	71	199	2.97	<0.004	<0.004	0.013	0.14	1057	21	6	0.016	<0.001	<0.0001	<0.010	<0.006	0.010
E7	7.37	96	119	34	47	4.07	0	212	137	114	4.34	<0.004	<0.004	0.311	0.05	688	61	241	0.015	<0.001	<0.0001	<0.010	<0.006	0.007
E15	6.48	14	8	4	10	1.33	0	29.9	9	11	3.02	0.024	0.031	0.010	0.08	88	39	21	0.013	<0.001	<0.0001	<0.010	<0.006	0.011
E17	7.46	60	69	40	10	2.68	0	240	46	33	-0.05	<0.004	<0.004	0.069	0.20	440	91	88	0.041	<0.001	<0.0001	<0.010	<0.006	0.007
E19	6.59	71	41	27	64	6.14	0	107	75	147	1.26	<0.004	0.570	0.165	0.06	475	47	335	0.042	<0.001	<0.0001	<0.010	<0.006	0.009
E20	7.19	102	104	96	13	6.93	0	561	18	45	-0.50	<0.004	<0.004	0.199	0.18	840	285	346	0.016	<0.001	<0.0001	<0.010	<0.006	0.011
E21	7.24	143	154	114	45	17.30	0	825	22	163	-0.50	<0.004	<0.004	0.012	0.17	1336	1537	480	0.081	<0.001	<0.0001	<0.010	<0.006	0.010
E22	7.39	39	44	22	11	3.32	0	179	17	15	0.28	<0.004	0.006	0.012	0.12	293	251	619	0.012	<0.001	<0.0001	<0.010	<0.006	0.009
E23	7.62	39	42	26	11	3.01	0	193	14	9	0.40	<0.004	0.004	0.013	0.11	300	123	106	0.013	<0.001	<0.0001	<0.010	<0.006	0.007
E24	7.43	298	249	187	233	5.50	0	323	298	1102	7.85	0.004	0.011	0.017	-0.10	2433	27	77	0.013	<0.001	<0.0001	<0.010	<0.006	0.010
E25	7.24	216	276	66	175	7.01	0	278	137	784	8.90	<0.004	0.008	0.561	-0.10	1762	44	155	0.036	<0.001	<0.0001	<0.010	<0.006	0.013

Site Name	pH	EC mS/m	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	PALK mg/L	MALK mg/L	Cl mg/L	SO4 mg/L	N NO3 mg/L	Al mg/L	Fe mg/L	Mn mg/L	F mg/L	TDS mg/L	Susp solids	Turb NTU	Ba mg/L	Cd mg/L	Hg mg/L	Pb mg/L	Se mg/L	Zn mg/L
E26	7.13	251	309	76	207	5.89	0	232	172	1004	12.54	0.005	0.007	0.117	0.12	2060	31	46	0.024	<0.001	<0.0001	<0.010	0.009	0.009
E27	7.24	144	136	78	85	6.13	0	355	84	352	0.91	0.011	<0.004	0.024	1.24	1099	38	24	0.038	<0.001	<0.0001	<0.010	0.007	0.009
E28	7.14	163	196	55	97	8.46	0	291	168	355	5.31	<0.004	<0.004	0.020	-0.10	1194	14	3	0.020	<0.001	<0.0001	<0.010	<0.006	0.008
E29	7.58	58	25	30	50	4.62	0	165	92	13	-0.05	0.007	<0.004	0.137	0.02	381	47	53	0.032	<0.001	<0.0001	<0.010	<0.006	0.010
E30	7.66	100	108	37	46	4.13	0	209	131	103	4.57	0.008	<0.004	0.018	0.13	657	44	6	0.018	<0.001	<0.0001	<0.010	<0.006	0.007
E31	6.88	42	26	14	45	2.88	0	70.3	36	58	9.78	0.011	0.008	0.005	0.07	295	56	25	0.015	<0.001	<0.0001	<0.010	<0.006	0.008
F4	7.37	125	127	59	83	3.13	0	325	71	265	-0.50	0.013	0.020	0.890	0.56	930	68	46	0.024	<0.001	<0.0001	<0.010	<0.006	0.011
F5	7.74	65	41	46	48	2.42	0	315	7	49	0.68	0.014	0.017	0.016	1.68	514	8	4	0.017	<0.001	<0.0001	<0.010	<0.006	0.010
F8	7.31	139	145	63	101	3.24	0	352	75	312	2.67	0.007	0.018	0.024	0.35	1062	32	21	0.026	<0.001	<0.0001	<0.010	0.011	0.020
G3	7.66	42	30	31	13	5.08	0	137	34	21	6.01	0.011	0.037	0.014	0.12	297	76	97	0.020	<0.001	<0.0001	<0.010	<0.006	0.008
G4	7.53	41	40	24	13	3.13	0	196	17	8	-0.05	0.008	0.017	0.088	0.08	301	1260	606	0.015	<0.001	<0.0001	<0.010	<0.006	0.009
G8	7.99	64	47	55	17	6.20	0	309	27	11	2.16	0.010	0.029	0.007	0.05	482	29	11	0.022	<0.001	<0.0001	<0.010	<0.006	0.008
G12	7.59	58	64	32	16	3.30	0	289	19	13	-0.05	0.010	0.027	0.307	0.25	437	42	66	0.029	<0.001	<0.0001	<0.010	<0.006	0.010
GA01A	7.65	100	105	63	29	3.75	0	360	72	84	1.23	0.010	0.018	0.017	0.14	722	7	10	0.016	<0.001	<0.0001	<0.010	<0.006	0.016
GA02A	7.58	98	98	59	29	3.52	0	281	105	71	12.20	0.007	0.017	0.010	0.12	702	21	9	0.021	<0.001	<0.0001	<0.010	<0.006	0.009
GA03	7.36	132	128	80	42	4.58	0	406	150	109	0.64	0.012	0.016	0.018	0.13	922	13	6	0.027	<0.001	<0.0001	<0.010	<0.006	0.008
GA04A	7.95	119	83	70	81	3.02	0	164	120	314	-0.50	0.012	0.016	0.021	0.12	832	13	8	0.036	<0.001	<0.0001	<0.010	<0.006	0.011
GA04B	7.29	160	103	78	138	1.53	0	136	137	567	-0.50	0.008	0.022	0.430	-0.10	1158	63	376	0.027	<0.001	<0.0001	<0.010	<0.006	0.011
GA05	7.48	93	109	46	28	2.89	0	297	84	110	0.95	0.009	0.017	0.046	0.55	683	10	3	0.030	<0.001	<0.0001	<0.010	<0.006	0.011
KLM4	7.62	68	73	40	16	2.48	0	261	47	51	2.26	0.009	0.020	0.037	0.35	501	10	3	0.027	<0.001	<0.0001	<0.010	<0.006	0.009
KLM5	7.7	246	195	106	246	19.10	0	326	171	876	2.24	0.012	0.017	0.020	0.13	1949	122	98	0.028	<0.001	<0.000	<0.010	<0.006	0.010

Site Name	pH	EC mS/m	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	PALK mg/L	MALK mg/L	Cl mg/L	SO4 mg/L	N NO3 mg/L	Al mg/L	Fe mg/L	Mn mg/L	F mg/L	TDS mg/L	Susp solids	Turb NTU	Ba mg/L	Cd mg/L	Hg mg/L	Pb mg/L	Se mg/L	Zn mg/L
	8																				1			
KLM6	7.36	167	156	69	173	7.85	0	500	39	429	-0.50	<0.004	0.015	0.020	-0.10	1371	162	34	0.022	<0.001	<0.0001	<0.010	<0.006	0.010
M1	7.50	129	126	54	65	4.63	0	162	164	226	12.06	0.009	0.016	0.026	-0.10	854	34	14	0.019	<0.001	<0.0001	<0.010	<0.006	0.017
M4	7.24	128	190	57	20	4.13	0	369	82	236	-0.50	0.009	0.015	0.462	0.85	956	16	6	0.040	<0.001	<0.0001	<0.010	0.007	0.016
M6	7.62	92	99	45	29	3.89	0	244	91	115	6.51	0.012	0.017	0.021	0.30	657	14	9	0.022	<0.001	<0.0001	<0.010	<0.006	0.007
M8	7.73	65	92	25	11	2.77	0	211	26	116	-0.05	0.009	0.015	0.276	0.46	483	39	12	0.038	<0.001	<0.0001	<0.010	<0.006	0.012
M9	7.72	73	89	36	14	3.82	0	184	82	56	10.11	0.004	0.015	0.007	0.02	510	10	4	0.012	<0.001	<0.0001	<0.010	<0.006	0.008

Table 27: Chemical analysis for groundwater for November 2012

Site Name	pH	EC mS/m	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	PALK mg/L	MALK mg/L	Cl mg/L	SO4 mg/L	N NO3 mg/L	Al mg/L	Fe mg/L	Mn mg/L	F mg/L	TDS mg/L	Susp solids	Turb NTU	Ba mg/L	Cd mg/L	Hg mg/L	Pb mg/L	Se mg/L	Zn mg/L
E2	7.33	76.7	82.24	38.28	17.66	3.14	0	293	46.90	77.30	0.32	0.011	0.022	0.011	0.81	561	85.81	28.10	0.028	<0.001	-0.0001	<0.010	0.007	0.009
E3	7.34	72.1	86.81	33.77	13.84	2.85	0	287	33.15	72.40	0.14	0.013	0.027	0.114	1.17	532	49.3	7.09	0.030	<0.001	-0.0001	<0.010	<0.006	0.008
E4	7.08	146	155.75	80.45	40.55	5.48	0	501	85.05	221.49	2.87	0.005	0.019	0.010	0.10	1102	50.8	9.82	0.009	<0.001	-0.0001	<0.010	0.009	0.006
E7	7.39	105	109.07	31.21	42.67	3.71	0	217	130.90	117.83	4.38	<0.004	0.082	0.094	-0.10	674	52.9	175.00	0.006	<0.001	-0.0001	<0.010	<0.006	0.009
E15	6.41	14.4	8.30	3.57	10.18	1.101	0	28.8	9.34	11.64	2.94	0.021	0.064	0.016	0.04	86	42.0	25.50	0.039	<0.001	-0.0001	<0.010	<0.006	0.012
E17	7.40	60.5	56.93	35.47	8.70	2.48	0	237	45.42	34.05	0.05	0.008	0.028	0.052	0.18	421	140.9	107.00	0.035	<0.001	-0.0001	<0.010	<0.006	0.010
E20	7.26	104	87.45	87.33	10.41	5.96	0	554	17.86	51.55	-0.50	0.013	0.053	0.168	0.12	812	300.1	404.00	0.011	<0.001	-0.0001	<0.010	<0.006	0.007
E21	7.17	140	154.84	106.95	43.89	12.49	0	813	17.41	173.35	-0.50	0.006	0.024	0.048	0.13	1318	324.7	106.00	0.051	<0.001	-0.0001	<0.010	0.009	0.007
E22	7.00	31	25.37	12.95	11.42	2.72	0	114	20.27	12.93	1.14	<0.004	0.028	0.034	0.07	205	58.0	179.00	0.007	<0.001	-0.0001	<0.010	<0.006	0.011
E23	7.53	38.8	34.68	22.92	9.30	2.86	0	190	13.37	9.24	0.43	0.006	0.092	0.012	0.08	285	138.4	129.00	0.005	<0.001	-0.0001	<0.010	<0.006	0.008
E24	7.38	286	222.95	185.59	203.81	5.01	0	317	244.15	1128.00	5.11	0.005	0.116	0.025	0.10	2330	50.4	68.00	0.005	<0.001	-0.0001	<0.010	<0.006	0.009
E25	7.23	228	285.93	68.82	183.85	7.28	0	249	142.18	921.00	11.12	0.005	0.134	0.142	-0.10	1907	45.8	50.10	0.028	<0.001	-0.0001	<0.010	0.010	0.008

Site Name	pH	EC mS/m	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	PALK mg/L	MALK mg/L	Cl mg/L	SO4 mg/L	N NO3 mg/L	Al mg/L	Fe mg/L	Mn mg/L	F mg/L	TDS mg/L	Susp solids	Turb NTU	Ba mg/L	Cd mg/L	Hg mg/L	Pb mg/L	Se mg/L	Zn mg/L
E26	7.26	245	297.64	74.77	193.45	5.57	0	228	164.32	1015.00	12.64	0.010	0.094	0.025	-0.10	2035	54.5	59.50	0.007	<0.001	-0.0001	<0.010	0.030	0.011
E27	7.49	146	136.55	81.41	76.86	5.58	0	352	83.04	371.36	1.00	0.008	0.034	0.022	1.08	1111	63.1	13.40	0.023	<0.001	-0.0001	<0.010	0.016	0.011
E28	7.27	161	180.90	48.54	81.09	7.17	0	273	160.10	350.94	6.13	0.006	0.036	0.031	-0.10	1127	88.3	72.20	0.008	<0.001	-0.0001	<0.010	0.010	0.009
E29	7.71	56.2	18.56	29.70	47.30	4.71	0	159	83.20	0.91	-0.05	0.005	0.020	0.064	0.01	344	109.0	181.00	0.025	<0.001	-0.0001	<0.010	<0.006	0.006
E30	7.81	98.2	102.51	32.24	38.04	3.61	0	206	127.00	105.50	5.71	0.005	0.039	0.012	0.02	641	45.0	8.42	0.005	<0.001	-0.0001	<0.010	<0.006	0.009
E31	6.85	35.2	18.25	10.13	32.96	2.40	0	58.1	29.19	31.68	10.72	0.011	0.035	0.016	0.05	230	52.3	27.80	0.014	<0.001	-0.0001	<0.010	<0.006	0.011
F4	7.30	111	106.64	47.65	51.78	2.32	0	311	57.44	217.41	-0.50	0.007	0.018	0.261	0.36	792	138.1	79.80	0.010	<0.001	-0.0001	<0.010	0.006	0.011
F5	7.79	66.1	37.47	44.09	44.01	2.12	0	306	8.27	55.01	0.94	0.012	0.020	0.015	1.65	503	14.7	4.82	0.005	<0.001	-0.0001	<0.010	<0.006	0.007
F6	7.34	120	148.08	38.00	48.40	3.07	0	300	100.27	200.43	4.84	0.013	0.036	0.012	-0.10	859	4.5	1.52	0.005	<0.001	-0.0001	<0.010	<0.006	0.167
F8	7.44	123	124.71	53.88	63.45	2.44	0	324	60.56	276.97	1.52	0.054	0.066	0.040	-0.10	911	43.5	13.20	0.012	<0.001	-0.0001	<0.010	0.018	0.016
G3	7.70	43.4	23.96	28.43	10.97	4.82	0	138	31.01	20.82	5.84	0.009	0.054	0.026	0.11	284	42.1	50.40	0.010	<0.001	-0.0001	<0.010	<0.006	0.009
G4	7.39	32.1	26.92	18.67	10.76	2.50	0	149	17.66	0.38	-0.05	<0.004	0.062	0.121	0.09	226	46.1	96.80	0.010	<0.001	-0.0001	<0.010	<0.006	0.008
G8	8.02	63.5	39.06	52.85	15.04	5.43	0	317	24.80	10.89	0.62	0.009	0.021	0.009	0.07	468	38.8	9.72	0.015	<0.001	-0.0001	<0.010	<0.006	0.008
G12	7.55	58.3	53.49	34.25	13.68	2.69	0	290	17.28	13.71	-0.05	0.012	0.033	0.216	0.27	425	35.8	30.20	0.017	<0.001	-0.0001	<0.010	<0.006	0.008
GA01a	7.77	97.3	91.95	59.74	26.49	3.25	0	350	74.10	90.80	0.95	0.013	0.028	0.019	0.09	701	15.9	2.05	0.006	<0.001	-0.0001	<0.010	0.010	0.008
GA02a	7.63	96.6	84.14	53.24	26.59	3.12	0	277	93.90	69.30	12.84	0.039	0.052	0.014	0.10	665	14.0	0.80	0.005	<0.001	-0.0001	<0.010	<0.006	0.011
GA03	7.57	130	122.64	79.30	37.99	4.12	0	397	141.99	112.45	-0.50	0.020	0.033	0.011	0.15	893	27.5	0.80	0.014	<0.001	-0.0001	<0.010	<0.006	0.011
GA04a	8.02	116	73.13	64.92	70.69	2.25	0	161	110.21	296.70	-0.50	0.039	0.045	0.020	0.49	776	46.8	9.04	0.030	<0.001	-0.0001	<0.010	<0.006	0.012
GA04b	6.92	145	75.42	70.54	120.69	1.06	0	69.6	130.88	519.00	-0.50	<0.004	0.054	0.424	-0.10	984	72.3	6.13	0.027	<0.001	-0.0001	<0.010	<0.006	0.015
GA05	7.62	88.7	100.95	46.08	22.31	2.14	0	292	65.10	98.90	1.65	0.009	0.026	0.029	0.46	636	31.7	17.84	0.019	<0.001	-0.0001	<0.010	<0.006	0.007
KLM4	7.7	68.4	68.65	36.83	13.03	1.97	0	257	43.69	49.98	2.24	0.012	0.028	0.021	0.29	482	17.4	8.48	0.015	<0.001	-	<0.010	<0.006	0.008

Site Name	pH	EC mS/m	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	PALK mg/L	MALK mg/L	Cl mg/L	SO4 mg/L	N NO3 mg/L	Al mg/L	Fe mg/L	Mn mg/L	F mg/L	TDS mg/L	Susp solids	Turb NTU	Ba mg/L	Cd mg/L	Hg mg/L	Pb mg/L	Se mg/L	Zn mg/L
	5																				0.0001			
KLM5	7.90	241	186.20	107.64	218.91	17.56	0	315	166.55	893.00	2.00	0.007	0.023	0.013	0.13	1914	51.0	12.08	0.012	<0.001	-0.0001	<0.010	<0.006	0.011
KLM6	7.47	165	145.95	67.63	145.91	7.10	0	505	37.49	419.18	0.57	0.008	0.018	0.009	-0.10	1329	111.9	11.49	0.012	<0.001	-0.0001	<0.010	0.008	0.014
M1	7.69	132	128.88	56.35	58.95	4.30	0	161	165.57	245.28	11.94	0.006	0.040	0.018	0.10	873	36.2	7.71	0.005	<0.001	0.0003	<0.010	<0.006	0.009
M4	7.28	124	178.61	53.87	16.00	3.69	0	358	76.71	234.59	-0.50	0.005	0.020	0.494	0.71	920	287.3	2.02	0.022	<0.001	0.0002	<0.010	<0.006	0.009
M6	7.75	87.1	86.30	42.09	22.55	3.37	0	232	77.90	106.10	5.54	0.014	0.029	0.013	0.28	596	24.0	2.40	0.009	<0.001	0.0002	<0.010	<0.006	0.010
M8	7.65	67.6	96.60	24.07	9.08	2.28	0	218	24.23	116.60	-0.05	0.015	0.029	0.418	0.48	492	24.3	6.42	0.025	<0.001	0.0002	<0.010	<0.006	0.008
M9	7.79	70.9	76.45	30.58	10.54	2.94	0	178	72.60	51.91	10.39	0.032	0.044	0.013	0.02	470	20.2	1.89	0.005	<0.001	-0.0001	<0.010	<0.006	0.012
BA2	7.47	177	216.26	50.26	94.60	3.51	0	343	154.44	348.86	25.05	0.008	0.022	0.033	0.14	1323	22.1	8.08	0.007	<0.001	-0.0001	<0.010	0.012	0.093

According to the tables above, little pollution occurs in the aquifer. Most constituents are within the acceptable range for the drinking water standard. The exception is the old FRD dams which definitely have an influence on the groundwater, with elevated Ca, Mg and sulphate values. The sulphate values for these boreholes increased during the November 2011 sampling run, except for E26 and E27 which decreased dramatically. The decrease in sulphate values may be the result of dilution due to the high rainfall conditions that occurred earlier in the year. The borehole next to the sewage farm is also slightly elevated. (Golder, 2006)

Manganese is present in a number of boreholes all over the site and is probably geology related.

The suspended solids in a number of the boreholes are still high, with an above normal turbidity in a number of the boreholes. For drinking water, both suspended solids and turbidity should be <1 to be acceptable

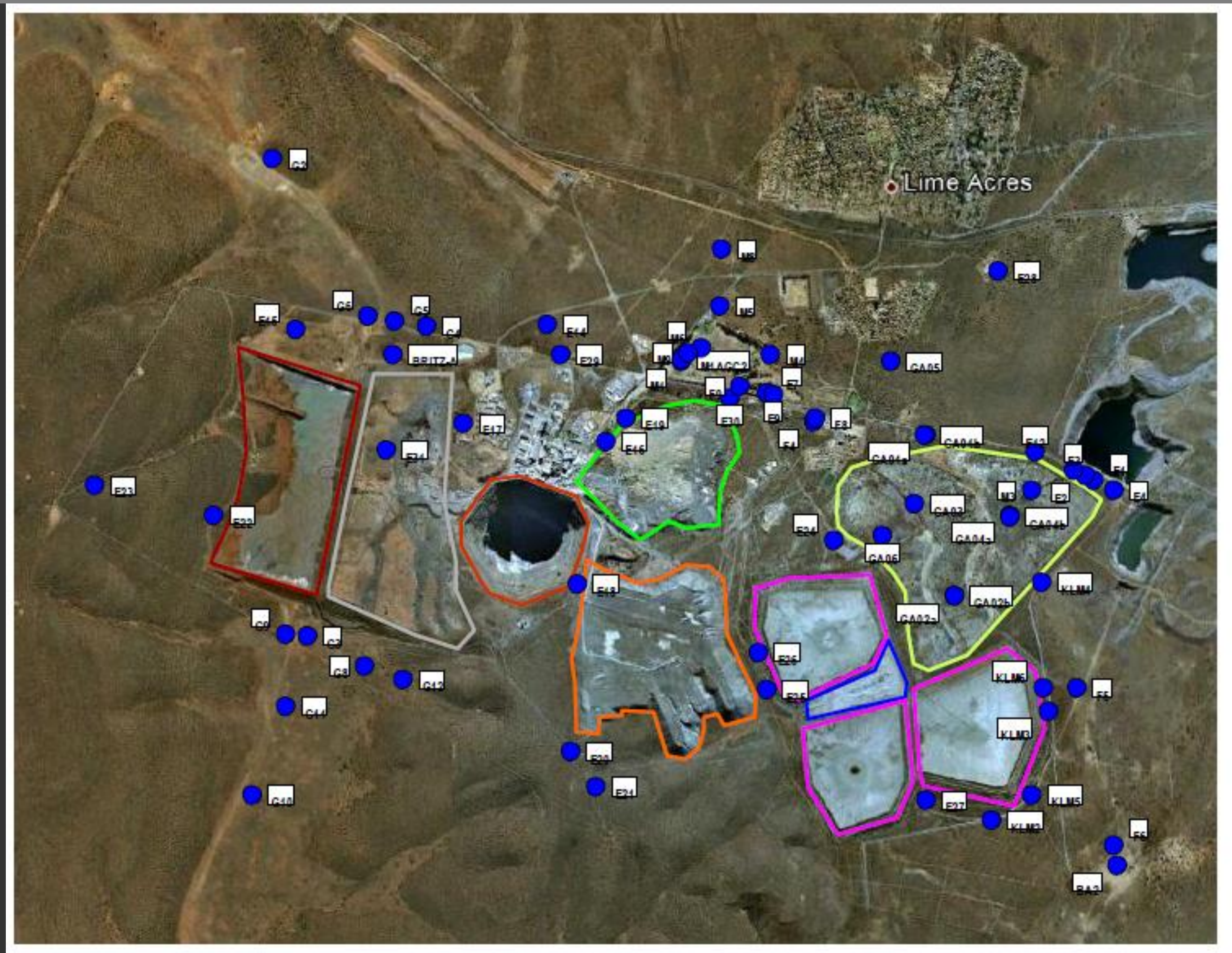

Figure 5: Groundwater monitoring borehole localities

Client: Petra Diamonds, Finsch Mine

Project: EMP Amendment

Date: May 2012

Shangoni Management Services (Pty) Ltd

1.1.11 Air quality

The air quality of the area is affected by the PPC stack emissions, Idwala stack emissions, fall-out dust from the mines in the area, as well as, by the Lime Acres community due to vehicle emissions, etc.

An integrated air quality management plan was done by Bohlweki SSI environmental sector in 2009. The sources outside the mine as well as inside the mine below have been included from this study.

1.1.11.1 Sources outside the mine

Priority sources in the general area that have been found to be significant in terms of their contributions to ambient air pollutant concentrations and associated health risks in the vicinity of the mine include are outlined below.

- Motor vehicles - Primary air pollutants emitted by vehicles may include oxides of nitrogen (NOx), CO_2, HCs, SO_2, PM and lead. Secondary pollutants associated with vehicle emissions include NO_2, photochemical oxidants (e.g. ozone) and sulphuric or nitric acids, and sulphate and nitrate aerosols. Toxic hydrocarbons emitted include benzene, 1.2-butadiene, aldehydes and polycyclic aromatics hydrocarbons (PAH). Benzene represents an aromatic HC present in petrol, with 85% to 90% of benzene emissions emanating from the exhaust and the remainder from evaporative losses. Emissions from diesel-fuelled vehicles include PM, NO_x, SO_2, CO and HC, the majority of which occurs from the exhaust.
- Petrol stations– VOCs are released during the filling of the petrol storage tanks and petrol car tanks.
- Railway –CO_2 emissions occur in small quantities form the trains.
- Domestic fuel burn- CO2, $PM_{2.5}$ and PM_{10} emissions occur due to the burning of wood as well as different compounds depending on the type of wood burned. Inefficient combustion of the coal results in high emission rates of PM comprised mostly of condensed droplets of semi-VOCs, CO, and sulphur-containing gases (hydrogen sulphide and SO_2).
- Commercial fuel burning appliances – Boilers that are similar to domestic fuel burn.
- Industrial activities- Other industrial sources, particularly activities associated with lime and cement production as well as other mining activities in the area result in emissions released to atmosphere. The main air emissions from these processes include SO_2, PM, NO_x, various heavy metals, dioxins and furans as well as greenhouse gases (CO_2, CH_4 and N_2O) and VOCs.
- Agricultural activities -Can be considered a significant contributor to PM emissions, although tilling, harvesting and other activities associated with field preparation are seasonally based.
- Asphalt mixing and road building - Asphalt is important in road building, and it consists mainly of heavy organic compounds. Hazardous air pollutants (HAP) are volatilised from asphalt as it is heated and agitated during processing and roofing manufacturing operations.

- Biomass burning (veldt fires) - Widespread across the country and in the District, occur mostly in winter. In addition to controlled burning for fire-breaks and veldt management, many fires are set deliberately for mischievous reasons. Some are accidental, notably those started by motorists throwing cigarettes out of car windows. Emissions from veldt fires are similar to those generated by coal and wood combustion.

1.1.11.2 Sources from the mine

Air emissions sources form the mine is given below.

- Aircraft and helicopters - The airport at the mine is associated with the emission released from aircraft, motor vehicles, and aircraft maintenance procedures. These emissions include NO_x, NO_2, CO_2, CO, VOCs and SO_2.
- Motor vehicles – Air pollutants are similar as described in paragraph 1.1.11.1 of section 1 (EIA above.
- Batch plant– Dust from the cement production transfer, storage and delivery vehicles.
- Waste management (incineration) - Emissions from incinerators may be grouped into: criteria pollutants (SO_2, NO_x, CO, lead, PMs and benzene), acid gases (HCl, hydrogen bromide, hydrogen fluoride), metal gases (chromium, arsenic, cadmium, mercury, manganese, etc.), and dioxins and furans - (such as polychlorinated dibenzo-p-dioxins and dibenzo furans).
- Waste management (landfills) - About 99% of landfill gas is comprised of methane and CO_2 which are primarily of concern due to them being greenhouse gases. The remaining 1% is comprised of a range of odoriferous and toxic gases.
- Waste management (sewage works) – There is a potential for emissions of VOCs
- Subsurface mining operations - -Result in small quantities of PM, SO_2, NO_2 and CO, released from shaft vents primarily as a result of blasting and drilling operations, and diesel powered vehicles working underground.
- Fuel and oil storage - There are various diesel, petrol and oil storage tanks above and below ground on site. This also adds to pollutants such as VOCs.
- Bioremediation plant – Air pollutant such as VOCs may be released
- Mine and plant residue facilities - Such sources are frequently associated with localised nuisance dust that contributes to the concentration of fine PM in the atmosphere. Wind erosion from the FRD takes place when it dries out during periods when not in use.
- Remining of pre-1979 CRD - Windblown dust at the stockpile is a result from the pre-screening activities.
- Surface mining activity - Dust fallout and inhalable PM emissions are generated due to aeolian action on exposed storage piles, material transfer activity, vehicle entrainment on both paved and unpaved road networks, drilling and blasting operations, as well as due to various process related emissions (crushing, screening and milling of ore and ore products). Dust generated during these processes at the mine are generally captured and sent to atmosphere via a dust plant.

- Topsoil recovery- In the vicinity of the mine also results in dust generations.

1.1.11.3 Dust fall-out, PM10 and PM2.5

Fall-out dust results for December 2011 to January 2013 are given in Table 22.

Table 28: Fall-out dust results for the period December 2011 to January 2013

SAMPLE NUMBER	SAMPLE DATE	TWA CONCENTRATIONS mg/m²/day	LEVEL OF CONTAMINATION
L.A School East	22.01.2013	58	Slight deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	41	Slight deposition
	03.09.2012	275	Moderate deposition
	August	No monitoring	No monitoring
	27.07.2012	1	Slight deposition
	11.06.2012	64	Slight deposition
	18.05.2012	37	Slight deposition
	24.04.2012	102	Slight deposition
	No measures taken in March 2012		
	24.02.2011	103	Slight deposition
	04.01.2012	247	Slight deposition
	31.12.2011	78	Slight deposition
L.A School West	22.01.2013	32	Slight deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	17	Slight deposition
	03.09.2012	273	Moderate deposition
	August	No monitoring	No monitoring
	27.07.2012	4	Slight deposition
	11.06.2012	49	Slight deposition
	18.05.2012	43	Slight deposition
	24.04.2012	24	Slight deposition
	No measures taken in March 2012		
	24.02.2011	16	Slight deposition
	04.01.2012	350	Moderate deposition
	31.12.2011	141	Slight deposition
West New FRD North	22.01.2013	326	Moderate deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	221	Slight deposition
	03.09.2012	224	Slight deposition
	August	No monitoring	No monitoring

SAMPLE NUMBER	SAMPLE DATE	TWA CONCENTRATIONS mg/m²/day	LEVEL OF CONTAMINATION
	27.07.2012	221	Slight deposition
	11.06.2012	14	Slight deposition
	18.05.2012	74	Slight deposition
	24.04.2012	24	Slight deposition
	No measures taken in March 2012		
	24.02.2011	39	Slight deposition
	04.01.2012	36	Slight deposition
	31.12.2011	210	Slight deposition
West New FRD South	22.01.2013	218	Slight deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	226	Slight deposition
	03.09.2012	101	Slight deposition
	August	No monitoring	No monitoring
	27.07.2012	226	Slight deposition
	11.06.2012	27	Slight deposition
	18.05.2012	271	Slight deposition
	24.04.2012	8	Slight deposition
	No measures taken in March 2012		
	24.02.2011	6	Slight deposition
	04.01.2012	77	Slight deposition
	31.12.2011	61	Slight deposition
West new FRD west	22.01.2013	196	Slight deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	261	Slight deposition
	03.09.2012	182	Slight deposition
	August	No monitoring	No monitoring
	27.07.2012	131	Slight deposition
	11.06.2012	26	Slight deposition
	18.05.2012	259	Slight deposition
	24.04.2012	132	Slight deposition
	No measures taken in March 2012		
	24.02.2011	137	Slight deposition
	04.01.2012	117	Slight deposition
	31.12.2011	201	Slight deposition
West New FRD East	22.01.2013	388	Moderate deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	91	Slight deposition

SAMPLE NUMBER	SAMPLE DATE	TWA CONCENTRATIONS mg/m²/day	LEVEL OF CONTAMINATION
	03.09.2012	188	Slight deposition
	August	No monitoring	No monitoring
	27.07.2012	91	Slight deposition
	11.06.2012	52	Slight deposition
	18.05.2012	23	Slight deposition
	24.04.2012	21	Slight deposition
	No measures taken in March 2012		
	24.02.2011	16	Slight deposition
	04.01.2012	63	Slight deposition
	31.12.2011	312	Moderate deposition
New FRD North	22.01.2013	259	Moderate deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	61	Slight deposition
	03.09.2012	127	Slight deposition
	August	No monitoring	No monitoring
	27.07.2012	35	Slight deposition
	11.06.2012	29	Slight deposition
	18.05.2012	43	Slight deposition
	24.04.2012	34	Slight deposition
	No measures taken in March 2012		
	24.02.2011	31	Slight deposition
	04.01.2012	361	Moderate deposition
	31.12.2011	146	Slight deposition
New FRD West	22.01.2013	412	Moderate deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	187	Slight deposition
	03.09.2012	91	Slight deposition
	August	No monitoring	No monitoring
	27.07.2012	60	Slight deposition
	11.06.2012	82	Slight deposition
	18.05.2012	351	Slight deposition
	24.04.2012	45	Slight deposition
	No measures taken in March 2012		
	24.02.2011	41	Slight deposition
	04.01.2012	367	Moderate deposition
	31.12.2011	177	Slight deposition
New FRD East	22.01.2013	352	Moderate deposition
	December	No monitoring	No monitoring

SAMPLE NUMBER	SAMPLE DATE	TWA CONCENTRATIONS mg/m²/day	LEVEL OF CONTAMINATION
	November	No monitoring	No monitoring
	03.10.2012	75	Slight deposition
	03.09.2012	254	Moderate deposition
	August	No monitoring	No monitoring
	27.07.2012	25	Slight deposition
	11.06.2012	164	Slight deposition
	18.05.2012	100	Slight deposition
	24.04.2012	28	Slight deposition
	No measures taken in March 2012		
	24.02.2011	29	Slight deposition
	04.01.2012	247	Slight deposition
	31.12.2011	847	Heavy deposition
New FRD South	22.01.2013	218	Moderate deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	33	Slight deposition
	03.09.2012	412	Moderate deposition
	August	No monitoring	No monitoring
	27.07.2012	20	Slight deposition
	11.06.2012	31	Slight deposition
	18.05.2012	458	Slight deposition
	24.04.2012	41	Slight deposition
	No measures taken in March 2012		
	24.02.2011	27	Slight deposition
	04.01.2012	177	Slight deposition
	31.12.2011	223	Slight deposition
South NFRD south	22.01.2013	310	Moderate deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	90	Slight deposition
	03.09.2012	472	Moderate deposition
	August	No monitoring	No monitoring
	27.07.2012	14	Slight deposition
	11.06.2012	19	Slight deposition
	18.05.2012	16	Slight deposition
	24.04.2012	41	Slight deposition
	No measures taken in March 2012		
	24.02.2011	27	Slight deposition
	04.01.2012	148	Slight deposition
	31.12.2011	332	Moderate deposition

SAMPLE NUMBER	SAMPLE DATE	TWA CONCENTRATIONS mg/m²/day	LEVEL OF CONTAMINATION
South NFRD north	22.01.2013	289	Moderate deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	45	Slight deposition
	03.09.2012	259	Moderate deposition
	August	No monitoring	No monitoring
	27.07.2012	19	Slight deposition
	11.06.2012	20	Slight deposition
	18.05.2012	189	Slight deposition
	24.04.2012	156	Slight deposition
	No measures taken in March 2012		
	24.02.2011	151	Slight deposition
	04.01.2012	197	Slight deposition
	31.12.2011	418	Moderate deposition
South NFRD east	22.01.2013	229	Moderate deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	39	Slight deposition
	03.09.2012	224	Slight deposition
	August	No monitoring	No monitoring
	27.07.2012	12	Slight deposition
	11.06.2012	11	Slight deposition
	18.05.2012	66	Slight deposition
	24.04.2012	63	Slight deposition
	No measures taken in March 2012		
	24.02.2011	57	Slight deposition
	04.01.2012	29	Moderate deposition
	31.12.2011	259	Moderate deposition
South NFRD west	22.01.2013	354	Moderate deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	117	Slight deposition
	03.09.2012	149	Slight deposition
	August	No monitoring	No monitoring
	27.07.2012	88	Slight deposition
	11.06.2012	17	Slight deposition
	18.05.2012	106	Slight deposition
	24.04.2012	129	Slight deposition
	No measures taken in March 2012		
	24.02.2011	136	Slight deposition

SAMPLE NUMBER	SAMPLE DATE	TWA CONCENTRATIONS mg/m²/day	LEVEL OF CONTAMINATION
	04.01.2012	230	Slight deposition
	31.12.2011	113	Slight deposition
WRD North	22.01.2013	283	Moderate deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	226	Slight deposition
	03.09.2012	697	Heavy deposition
	August	No monitoring	No monitoring
	27.07.2012	40	Slight deposition
	11.06.2012	8	Slight deposition
	18.05.2012	60	Slight deposition
	24.04.2012	52	Slight deposition
	No measures taken in March 2012		
	24.02.2011	49	Slight deposition
	04.01.2012	70	Slight deposition
	31.12.2011	114	Slight deposition
WRD South	22.01.2013	230	Slight deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	46	Slight deposition
	03.09.2012	116	Slight deposition
	August	No monitoring	No monitoring
	27.07.2012	314	Moderate deposition
	11.06.2012	22	Slight deposition
	18.05.2012	86	Slight deposition
	24.04.2012	75	Slight deposition
	No measures taken in March 2012		
	24.02.2011	75	Slight deposition
	04.01.2012	318	Moderate deposition
	31.12.2011	181	Slight deposition
WRD West	22.01.2013	292	Moderate deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	254	Moderate deposition
	03.09.2012	379	Moderate deposition
	August	No monitoring	No monitoring
	27.07.2012	66	Slight deposition
	11.06.2012	16	Slight deposition
	18.05.2012	184	Slight deposition
	24.04.2012	155	Slight deposition

SAMPLE NUMBER	SAMPLE DATE	TWA CONCENTRATIONS mg/m²/day	LEVEL OF CONTAMINATION
	No measures taken in March 2012		
	24.02.2011	7	Slight deposition
	04.01.2012	197	Slight deposition
	31.12.2011	167	Slight deposition
WRD East	22.01.2013	254	Moderate deposition
	December	No monitoring	No monitoring
	November	No monitoring	No monitoring
	03.10.2012	114	Slight deposition
	03.09.2012	228	Slight deposition
	August	No monitoring	No monitoring
	27.07.2012	27	Slight deposition
	11.06.2012	35	Slight deposition
	18.05.2012	177	Slight deposition
	24.04.2012	34	Slight deposition
	No measures taken in March 2012		
	24.02.2011	41	Slight deposition
	04.01.2012	57	Slight deposition
	31.12.2011	172	Slight deposition

Acceptable dust limits:

Residential area – D<600mg/m²/day;

Non-residential area – 600<D<1,200 mg/m²/day

According to the table above, two dust results were not within the acceptable limits for residential areas. These were the samples taken east of the new FRD in December 2011 and the September 2012 samples taken at WRD north. Dominant wind direction in December is NNW; therefore dust settlement from the new FRD will be mostly SSE. High dust settlement east of the new FRD is therefore either due to strong short-term western wind or due to the new FRD and additional sources north of the mine. Dominant wind direction in September is also NNW; therefore dust settlement from the north of the WRD will be mostly SSE. Dust is most probably from the WRD as well as the red dump.

USK Environmental & Waste Engineering (Pty) Ltd is in the progress to review of the Air Quality Management Plan for the Finsch Mine. This plan will include the monitoring of PM10 and PM2.5 on and around the mine.

1.1.11.4 Asbestos contaminated areas

Asbestos monitoring was done by SKC in 2012. Asbestos is locally present in the natural geology. Refer to Table 23 below for the asbestos results November 2011 to January 2012. All asbestos results were within the asbestos occupational exposure limit.

Table 29: Latest asbestos results

DATE	POSITION	FLOW RATE	ASBESTOS FOUND	ASBESTOS CONCENTRATION
	Office	1.0	0	0
	South fence	1.0	0	0
	Mine fence	1.0	0	0
24.11.2011	Office cleaning & change house	1.0	0	0
24.11.2011	FRD	1.0	0	0
24.11.2011	FRD	1.0	2 Crocidolite	0.0029 f/ml
24.11.2011	FRD	1.0	0	0
24.11.2011	FRD	1.0	0	0
24.11.2011	Rehabilitation site	1.0	1 Crocidolite	0.0014 f/ml
24.11.2011	FRD	1.0	0	0
08.12.2011	Recovery dust plant	1.0		Filter Rejected high dust load
26.01.2012	Rehabilitation site	1.0	2 Crysotile	0.0029 f/ml
26.01.2012	Rehabilitation site	1.0	2 Crocidolite	0.0029 f/ml
26.01.2012	Rehabilitation site – low site	1.0	0	0
26.01.2012	Rehabilitation site – high site	1.0	1 Crocidolite	0.0014 f/ml

Asbestos Occupational Exposure Limit – 0.2f/ml

In March 2012, an analytical assessment was done at the mine. According to this report two crocidolite asbestos fibres were identified in 420 fields of three filters, and one asbestos fibre was identified in 420 fields of two filters.

1.1.12 Noise

Noise monitoring was done by Gerry Kuhn: environmental & hygiene engineering. Noise limits for residential and non-residential areas are given in Table 24 below. The communities surround the mine area are given in Table 25 below. There is no noise report after April 2012.

Table 30: SANS 10103 - Referring to residential districts and non-residential districts

District	$L_{Req}T$ dBA					
	Outdoors			Indoors with open windows		
	Day-night	Day time	Night time	Day-night	Day time	Night time
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30

c) Urban districts	55	55	45	45	45	35
NON-RESIDENTIAL DISTRICTS						
d) Urban districts with workshops, business premises and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial	70	70	60	60	60	50

Table 31: Communities that could be affected by noise

VILLAGE/AREA	NOTES
5 mission village	Nearest village with dump noise
Golf club	Recreation area but no permanent residents
Norfin village	Village residents area also exposed by the second mine
Lime acres village	Village residents area also exposed by the second mine
Mine single-quarter	Closest exposed persons but refer to architectural notes.

In April 2012, a noise study was done for Finsch Mine. The noise monitoring was done at 25 points on and surrounding the mine. These points are given in Table 26 below.

Table 32: Noise monitoring localities for April 2012

POSITION	NOTES AND OBSERVATIONS
A	FRD south boundary – 10 minute determinations
A1	FRD south boundary – 5 minute determinations
B	FRD west/south corner – (far noise from vent shaft)
B-	FRD nearer corner on west side
C	FRD west boundary
D	FRD west boundary – (some truck noise noted)
E	Shooting box position (a little fan noise from vent shaft)
F	On west boundary between shooting box and pan
G	Near a small pan
H	Reversing siren audible but machine not visible. Second shooting box position
I	At DustWatch position. Wind changed to bring in noise from plant before determination started
J	At topsoil stockpile 2 haul trucks passed within 1km and 1 watering cart along the haul truck route.
K	Monitor 200m from nearest working dozer site.
L	150km from the above working dozer site but dozer stopped during measurement

POSITION	NOTES AND OBSERVATIONS
M	5 missions water tower with trucks on the dump
MM	Pump noise – Instrument facing PPC
MO	Facing Finsch mine (same position as MM)
MP	In street
MQ	Norfin boundary – in street
MR	At corner of Norfin boundary
MS	Nyala street Terrapins, Lime Acres Village
MT	ESS offices – Lime Acres Village
MU	Single-quarter health centre
MV	Single-quarter health centre
MW	Back of single-quarter

Determinations on 23rd and 24th April 2012

CRITERIA	L_{AEQ}	L_{AF}	L_{CEQ}	L_{AFMX}	L_{CPK}	DURATION	TIME
A	31.6	55.4	53.1	58.9	80.0	10min	10H00
A1	31.5	54.6	49.7	56.6	80.0	10min	10H10
B	39.6	51.3	50.6	67.1	81.6	10min	10H20
B-	33.9	47.5	51.3	52.5	78.4	5min	10H25
C	34.9	47.9	54.9	54.1	83.6	6min	10H32
D	37.1	69.9	50.3	64.3	91.3	7min	10H39
E	35.4	48.8	50.4	59.1	72.5	6min	10H45
F	36.3	45.5	51.3	64.6	90.0	6min	10H51
G	37.0	57.9	52.5	57.9	82.4	10min	11H50
H	36.3	37.8	49.8	66.8	89.5	10min	12H00
I	40.3	99.0	51.6	59.0	82.0	10min	12H15
J	42.7	47.5	54.8	66.6	79.4	10min	12H25
K	50.7	57.6	56.5	77.6	88.1	10min	12H35
L	40.1	47.1	56.1	58.8	79.9	10min	12H47
M	36.3	44.2	52.6	64.3	84.4	10min	14H15
M	48.7	52.8	57.4	68.6	90.7	5min	19H40
MM	42.7	49.5	54.8	68.6	90.9	5min	19H50
MO	37.4	43.5	54.7	55.6	80.1	5min	20H00
MO1	49.4	50.3	65.8	63.1	78.3	5min	07H00
MP	49.2	38.5	52.7	70.3	84.4	5min	20H10
MP1	48.6	52.3	57.4	68.9	89.3	5min	07H08
MQ	40.7	36.1	53.4	59.3	79.4	5min	20H16
MQ1	47.3	53.8	59.1	63.8	90.1	5min	07H15
MR	46.9	41.3	58.8	53.4	89.5	5min	20H28

CRITERIA	L_{AEQ}	L_{AF}	L_{CEQ}	L_{AFMX}	L_{CPK}	DURATION	TIME
MR1	48.6	49.2	54.1	63.4	72.3	5min	07H25
MS	38.2	53.8	55.7	55.8	78.4	5min	20H39
MS1	43.4	46.1	53.2	60.1	78.4	5min	07H32
MT	42.7	40.2	55.2	72.5	91.6	5min	20H46
MT1	46.1	60.0	62.4	67.1	70.1	5min	07H39
MU	53.5	55.3	57.9	64.1	86.2	5min	21H09
MU1	52.1	53.4	61.1	63.4	76.1	5min	07H50
MV	53.8	54.5	68.3	59.9	82.6	5min	21H18
MV	50.6	52.4	56.5	77.3	87.2	5min	08H00
MW	51.6	55.0	64.5	64.4	87.7	5min	21h30
MW	49.3	51.1	58.1	76.9	89.3	5min	08H10

L_{AEQ}: Energy averaging

L_{AF}: Sound pressure level

L_{CEQ}: The equivalent continuous C-weighted level

L_{AFMX}: Maximum noise level

L_{CPK}: Peak noise level

South boundary

The noise exported from the south side was L_{Aeq} of 31.5/31.6dBA. No machines could be seen or heard at all from the monitor position. The nearest farm in this direction could not be seen. The main noise source appeared to be the fan noise at the ventilation shaft. The boundary enjoys a classification as rural district by virtue of the fact that there are no dwellings or multiple activities underway with day and day night ratings at 45dBA and night time ratings 35dBA. The above values were well below 35dBA night and 45dBA day/night.

West boundary

The noise was exported from the shaft fan noise and in isolated positions from the EMV hauls vehicles working on the dump. Levels were ranging from lows of 33.9dBA to point noise highs of 36.3 to 37dBA. The values were in line with the values expected to find during the day with machine and haul vehicle noise resulting in the slightly elevated levels. With a day night rating of 45 the mine complied totally. At night it can be expected that the vehicles will have stopped all work and thus the expected levels will be in the order of 33dBA which is also below the night time rating levels of 35dBA.

North boundary

Activities surrounding the topsoil stockpile building activities were the major noise generators in the area and if considering the values including these activities (I) (J) (K) and (L) it was noted that noise levels at the dozer working position (without the dozer operating) the value was down to 40.1dBA. The zone in this case will not be a definite day/night of 45 due to other mining or prospecting activates to the north. This then raised the rating to 50dBA and thus even at the closest position with the dozer operating the mine bordered compliance. For night condition there will be no machines or haul trucks operational and a compliance level of 40dBA. Again the mine will be compliant especially considering that building of the topsoil stockpile is only a temporary task.

East boundary (5 Missions village)

It certainly will not be as easy to arrive at a clear conclusion as was the case in the south, west and north boundaries as the 5 Mission Village must be considered in the first instance. The district rating for 5 Missions will likely be (Suburban districts with little road traffic) with day/night of 50dBA and night time of 40dBA. All day/night values were compliant even if the pump noise up to 44.2 is considered. The night time values (Refer MM, MO, and MP) ranged between 37, 4 and 49.2dBA if the pump noise is included. The pump noise alone resulted in the closest monitor position exceeding a compliance level of 40dBA. There was more noise at this village resulting from the PPC operation than Finsch with the PPC origin noise indicating non-compliance. Finsch Mine is fortunate that the dump does screen the plant from 5 Missions and to a point Norfin as well.

East boundary – Norfin Village

The district rating for Norfin will be similar to 5 Missions at 50dBA day/night and 40dBA night time. (Refer MP, MQ and MR) for day conditions 47.3-48.6dBA. This indicated compliance with the limit at 50dBA. For night conditions (40.7, 46.9 and 49.2dBA) there was a non compliance. There are two sources of noise which should be addressed to re-establish compliance. The pump should either be enclosed in a small pump house or casing attenuated. The latter will not be easy and covers are to incorporate (for the attenuation required) 100mm Isocoustics material compressed to 75mm with an external cover of 3 mild steel and a perforated light 20 gauge plate inside cover. This option should be cheaper than an enclosure building however. A second source of noise emanates from operations at PPC which being directly upwind during the night assessment showed a noise contamination of an excess of 45dBA at Norfin.   Five missions remained non-compliant at night from Finsch as well.

East boundary – Lime Acres

The point is to be made that if compliance in respect of Finsch Mine noise is achieved at 5 Missions and Norfin then LA which is further away should not have a problem. (Refer to MS & MT). For the district rating a night time level of 40dBA will indicate compliance while day values will need to be below 50dBA. Both MS & MT for day time indicate value below 42.7dBA which is well within 50dBA as a limit. Night compliance was compromised with a 42,7dBA at the ESS offices.

East boundary (single-quarters)

While the day time values were noted (early morning at 49.3 – 50.6-52.1 dBA) the district rating is 50dBA day/night and 40dBA night time.

1.1.13 Sensitive landscapes

The pans, as described in paragraph 1.1.9.5 of section 1 (EIA), in the ephemeral drainage line of the valley are considered to be sensitive habitats, with a number of protected species associated with their slopes.

There is one formal and no informal land-based protected area near the mine. This formal protected area is the Eastern Kalahari Bushveld and is situated over 31km away from the mine. The formal protected areas layer was used in the National Protected Area Expansion Strategy 2008 (NPAES). Focus areas for land-based protected area expansion are large, intact and unfragmented areas of high importance for biodiversity representation and ecological persistence, suitable for the creation or expansion of large protected areas.

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing of threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The ecosystems listed make up 9.5% of the country, with critically endangered and endangered ecosystems together accounting for 2.7% and vulnerable ecosystems a further 6.8%. The NEMBA list of ecosystems that are threatened and in need of protection, (G 34809, GN 1002); 9 December 2011 has listed a map showing remaining protected ecosystems. According to this map no protected ecosystem lies close to the mine.

The mine falls more than 6km south of a free flowing river and a Freshwater Ecosystem Priority Areas (FEPA). River FEPAs achieve biodiversity targets for river ecosystems and threatened/near-threatened fish species, and were identified in rivers that are currently in a good condition (A or B ecological category. There is also no fish sanctuary in the area.

1.1.14 Visual aspects

Although the headgear and CRDs are visible from the R 31 (Kimberley / Postmasburg) road, the rest of the mine has a low visual impact. Care has been taken to blend the profile of the CRDs into the surrounding hills. The mine is visible from the Lime acres village.

1.2 Concise description of each of the existing environmental aspects both on the site applied for and in the surrounding area which may require protection or remediation

All environmental aspects must be protected from the mine's impacts, however below is a list of important aspects to be protected:

- Soil;
- Surrounding land capability – the mining area must be closed afterwards to form part of the land capability of the area;
- All natural vegetation;

- All animal life;
- Ground water quality and quantity;
- Air quality; and
- All surface water resources especially the pans.

The potential significance of impacts on the above-mentioned environmental components has been rated in the risk assessment section.

1.3 Concise description of the specific land uses, cultural and heritage aspects and infrastructure on the site and neighbouring properties/farms in respect of which the potential exists for the socio-economic conditions of other parties to be affected by the proposed mining operation

1.3.1 Land use

Land use in the Province is predominated by stock farming, with an increasing game farming component (96%), while only 2% of the land is used for crop farming, and 1% is reserved for conservation. Mines and quarries constitute only 0.1% of the total land area.

There are no records kept on land use prior to 1964 when the mine started operating. However, there is an aerial photograph available that was taken in August 1959 prior to the start of mining. Interpretation of the photo clearly indicates that the land was used mainly for grazing purposes with one semi-permanent hut and accompanying kraal for the stock tender about 1.5 km north of the pipe. The area was accessed by a few random roads and tracks. To the north of the kimberlite pipe, where the current air strip is located today, a small patch of land was used for the dry land cultivation of an unknown crop (possibly maize). There was also an air strip located to the north east of the pipe for use by PPC. The PPC mine village of Lime Acres was located 3.5 km north-north-east of the pipe.

The railway track (Kimberley / Sishen) with accompanying dirt road was already in place to the north of the pipe. The depression in the Kimberlite pipe itself was used as a watering point for farm stock and game.

1.3.1.1. Historical Agricultural Production

The land use on this property was mainly restricted to grazing due to the climate and soil characteristics. The carrying capacity of the area is around 1 large livestock unit or 6 small livestock units per 10 ha.

1.3.1.2. Existing Structures

There were no structures on site except for the stock tender's hut and kraal to the north of the kimberlite pipe prior to the start of mining.

1.3.1.3. Land misuse

According to a report by Conservationist Hennie Erasmus, the *Acacia mellifera* vegetation is a natural biome and it's "encroachment" is limited by soil type (see vegetation around FRDs and in Bonza Game Farm area. Acacia mellifera is also a valuable food source for various species of antelope and the giraffe.

Due to mining activities large portions of the mining area is being covered by coarse residue. Spillages of fine residue have also occurred along pipelines.

1.3.2 Sites of archaeological and cultural interests

A heritage assessment was done by Zoë Henderson of the Department Archaeology of the National Museum in 2005.

1.3.2.1 Brits farm

1.3.2.1.1 Valley bottom which tapers from north to south

This was the largest area, covering the entire valley bottom from north to south of the property. It extends from the fence along the western side of the rock dump to the base of the hillside on the western side of the valley. It also includes the section north of the rock dump, through which the access road onto Brits runs.

Historic structures:

1. Foundation at 28 23 146 S by 23 25 704 E

The only structure located during the survey was the foundation of a small rectangular structure, measuring 10.30m by 4.80m. The structure foundation consisted of a wall of banded ironstone slabs, neatly packed, and held together with red clay. Some ceramic and iron fragments were scattered around the area, which seem to indicate that the structure had both a domestic as well as a work-related function. No other foundations were found in the vicinity, nor were there any traces of kraals or other stock-keeping related structures. The structure does not appear on the 1959 aerial photograph, so it could not have been roofed at that time, and was probably already a ruin. It is a reasonable distance from the pipe, and is probably not related to the mining activities at the pipe.

It is not possible to determine what the function of the structure was. It has a reasonably well-built foundation, so was not a temporary structure. The records suggest that there was no water available on Brits, so, if it was a dwelling, water would have had to have been supplied to the place. If, however, it was more work-related, but with a domestic component (i.e. people staying there for short periods of time), this would explain the cultural material noted in the vicinity.

2. Horseshoe-shaped trace at 28 22 386 S by 23 26 057 E

A second area was investigated. This was a horseshoe-shaped ‘structure’ identified from the aerial photographs in the area to the north of the rock dump. Although it was very clear in the aerial photographs, and appeared to be close to an old borrow-pit, almost no traces of it could be identified on the ground. It appears to have had earth walls, but these have largely disappeared in the last ten years. It is unknown what this structure could have been used for, unless it was some sort of a kraal.

Archaeological remains:

The archaeological remains consist entirely of lithic artefacts. These artefacts are mostly of Pleistocene age, but Holocene age artefacts also occur in places, most notably in the vicinity of the horseshoe-shaped earthen trace mentioned above. These artefacts appear to be flaked from a fine-grained raw material, and consisted mostly of flakes.

The soil of the valley bottom is deeper than that covering the hillsides, but is still classified as shallow (Morgenthal, 2001). The soils were probably derived from the banded ironstone and washed downslope into the valley. It is likely that artefacts abandoned on the hillside were washed downslope as well, and became incorporated into the valley fill.

The distribution of the artefacts noted in the valley area seemed to indicate a patchy distribution. Most artefacts observed in the valley area were observed in the vicinity of animal burrows. They appeared to have been thrown up as the burrows were excavated. However, not all animal burrows were surrounded by an artefact scatter, indicating that the artefacts were not generally distributed over the area.

The artefacts are both of Holocene and Pleistocene age (i.e. Later Stone Age and Middle Stone Age), which would indicate that the area was a target for settlement (although not continuous) over a considerable period of time. Most of the artefacts are flakes, but many cores also occur. These are of the single platform, radial or prepared platform type, mostly made on banded ironstone. Most of the cores are lightly abraded, but there are those which appear to be in mint condition. Scrapers were also noted.

It would appear that the distribution of the artefacts is not entirely random, but it is impossible to determine whether the distribution reflects human activities or whether it is related to natural patterns generated during the accumulation of artefacts being washed downslope.

1.3.2.1.2 Eastern slope of the hillside above the valley

This area comprises the entire flank of the hill of the western edge of the valley. The hill is of banded ironstone, with shallow soil cover, and in places dense vegetation. The hillside was walked along the contours. A light scattering of artefacts was observed. These were mostly of banded ironstone, and consisted of flakes, cores and scrapers, mostly of Pleistocene age. The artefacts were in most cases lightly or more extensively abraded.

1.1.3.2.1.3 Top of the ridge

Artefacts occur in this portion of the property, but not in very high numbers. Characteristic Middle Stone Age and Early Stone Age artefacts were noted. Most of the artefacts were from banded ironstone, but other raw materials are also present. Many of the artefacts noted were in the vicinity of the small pan.

1.1.3.2.1.4 Long slope of the tongue across the southern side of the rock dump

This area is the long slope down from the portion of the hill where the pipe is located, to the valley bottom. It forms therefore the eastern side of the north-south valley on Brits. In a couple of places old diggings were noted, and some earth moving seems to have taken place at some point. Almost no artefacts were noted on the hillside.

1.1.3.2.1.5 Hilly portion of the property which forms the southern buffer zone across the southern edge of the pipe and the coarse residue deposit

This section consists of the hill-top as well as the steep-sided valleys of the mountain range. The overhangs were all too shallow, and did not contain any cultural material. An extensive survey of the area produced almost no artefacts.

1.3.2.2 Graveyard near Five Mission

A graveyard is situated near Five Mission at 28° 22 765 S and 23° 28 218 E (GPS reading taken on southernmost grave). The graveyard is fenced off, but is no longer in use. Only 31 graves can be distinguished in the graveyard, 24 of which have cement surrounds.

The 22 graves which have inscriptions date to 1963 (1 grave), 1965 (3), 1966 (1), 1969 (4) and 1970 (9). There are four graves which only record name or family affiliation, but have no date attached.

Of the other information recorded, the records indicate that three of the graves were of still born infants, five were younger than one year, two were aged between one and two years, one was four years old and three others are indicated as being children. This indicates that almost half of the graves in the graveyard were of infants or children. Two of the graves indisputably belong to adults, while it is fairly certain that the other five graves with inscriptions but no ages recorded also belong to adults (graves 16 – 20) as these graves are larger than the graves of the children and infants. The other nine graves which have either head and footstones, or have cement headstones with no inscription probably also belong to adults.

Graves 1 – 22 were obviously “tidied” up at some stage, as they have all been standardised, with a cement surround, gravel across the top of the grave, and similar, commercially made name tags. The distinction between the children and infant graves and the adult graves was made at this stage, so it is evident that whoever was involved in the work was aware of who had been buried in the graveyard.

1.3.2.3 Bonza farmhouse and surrounding area

The farm includes FRD 3 and part of 2 on the western side, with Bonza Quarry and Dump in the north-western corner. The property includes the edge of the Asbesberge in the south-western corner. Most of the property from the FRDs/CRDs to the east is relatively flat, with a couple of pan areas on the southern section of the property. This site is divided into areas I to M.

1.3.2.3.1 Pan areas

This area is along the southern side of the property. The area was searched for rock engravings, but none were found. Artefacts occurred in small quantities, scattered over areas around the pans. *Acheulian handaxes* indicate Early Stone Age presence in the area. Middle Stone Age artefacts were also identified.

1.3.2.3.2 Marshy area

Later Stone Age artefacts were discovered in larger quantities than elsewhere on the property in the vicinity of the marshy area. The artefacts were from fine-grained raw material, and were unworn.

1.3.2.3.3 South-western section

Middle Stone Age artefacts made on banded ironstone were discovered in the red sands.

1.3.2.3.4 North-eastern area

No artefacts were discovered in the area, apart from a few flakes which could be Later Stone Age. In some cases these flakes had become incorporated into patches of calcrete.

1.3.2.3.5 Farmhouse area

The foundations of the old Bonza farmhouse are still visible. This house measured about 11m by 9.90m, and seemed to have had seven rooms and two passages and a front veranda. There were at least three outbuildings forming the farmyard around the house. A large pepper tree still stands in what was the yard behind the house. The farm rubbish heap is nearby, and further away in an easterly direction are the, presumably, labourers cottages. Near to the possible labourers’ cottages is a half circle of stones, which may be an open cooking or processing area. Domestic rubbish, such as tines and bottles, is scattered over the area, but seems to be concentrated between the rectangular structure and the half circle of stones.

Only one grave, which had been exhumed, was located. This was located on the other side of a pan near the farmhouse. The grave had obviously been fairly elaborate with cement surrounds and a headstone. However, the headstone had been removed, and there was no indication as to who might have been buried in the grave. Although the grave is fenced off, the gate is missing, and the grave is accessible from the outside. A young eland appears to have fallen into the grave at some point, and died there.

GPS co-ordinates of structures and features mentioned:

- Farmhouse: 28 24 698 S & 23 30 765 E
- Ash Heap: 28 24 706 S & 23 30 743 E
- Grave: 28 24 793 S & 23 30 901 E
- Labourers cottage: 28 24 701 S & 23 30 697 E
- Cooking area: 28 24 692 S & 23 30 693 E

Artefacts were also found in the vicinity of the farmhouse and outbuildings, attesting to occupation of the immediate area at various stages over a long period of time.

1.3.3 Regional socio-economic structures

SDM forms the mid-northern section of the Northern Cape Province. It covers an area of more than 100,000km² out of which 65,000km² compromises the vast Kalahari Desert, Kgalagadi Transfrontier Park and the former Bushman Land.SDM comprises six Local Municipalities namely: Mier Local Municipality; Kai Local Municipality, Gariep Local Municipality; Khara Hais Local Municipality; Tsantsabane Local Municipality, Kheis Local Municipality, and KLM. Daniëlskuil is the main town of the KLM.

1.3.3.1 Demographic Profile

1.3.3.1.1 Population and population distribution

The vast area of SDM is populated by roughly 200,000 people with a density of about 1.7people per square kilometre. According to the 2001 census, KLM has 14,743 people, with and increase to 21,498 people as given in the 2007 community survey. According to the SDM Integrated Development Plan (IDP), KLM has 12% of the total SDM population with 8.7persons per every square kilometre.

The two major concentrations of people are in the Lime Acres village and in Daniëlskuil. There is also living quarters for mine personnel next to the mine in a single-quarter complex.

1.3.3.1.2 Age, gender and households

The largest amount of people are coloured with a percentage of 45.7% of the total population, followed by 37.6% black, 16.5% white and 0.2% Indian/Asian. The highest percentage of first language spoken is Afrikaans with 59.9%, followed by Tswana with 32.9%, Xhosa 2.3% and other languages comprising the last 1.8%.

Workers at the mine get accommodation either in the mine's single or married quarters. Alternatively the people are accommodated in subsidized housing in the Lime Acres village or Daniëlskuil. The workforce from PPC is also accommodated in the Lime Acres village and Daniëlskuil.

1.3.3.2 Economic Profile

1.3.3.2.1 Industries

SDM accounts for about 30% of the Northern Cape economy. Agriculture compromises grape production, which is mainly exported to Europe, owing to peculiar grapes that are ripe and ready for export before the grapes of other countries can reach these markers, as well as livestock and game farming.

Livestock farming occurs mainly on large farms where farming is extensive. The larger majority of these farms are privately owned. In the jurisdiction of the SDM there are approximately 1,600 farmland units, which belong to 890 owners. Because of the difference in the carrying capacity of the field, there are fairly large differences in the sizes of the farms. The carrying capacity of the field in this area can differ considerably between (for instance) a10ha stock unit and 65ha stock unit further westwards. The central parts of the region consist mainly of semi-desert areas and are therefore, with a few exceptions, mainly suitable for extensive livestock farming.

Tourism is one of the most important economic sectors in the Northern Cape as well as within the SDM boundaries. Tourism is the fastest growing component of the economy. Tourism as a product cannot be seen in isolation, or as having its own identity, but should rather be seen in the context of the region as a whole. Tourism as such is one of the industries, which provides the most employment globally. The SDM has priceless natural resources, which should make tourism in the area flourish. The development of the tourism industry in this area will give momentum to increased job creation.

SDM's economy is largely dominated by mining and agriculture. As far as can be established, no economically viable mineral resources have been found in the area, except for recent findings in the Rietfontein (Mier Municipality) area. There are however small pockets of various minerals. The largest are copper and zinc of Areachap north of Upington. Various small concentrations of calcite, lead, fluorspar, barite, wolfram and amethyst have been mapped but not really at a notable scale. At the moment salt is being mined at two pans, namely Groot Witpan, 95 km northwest of Upington and at Witpan, 115km northwest of Upington. South of the above-mentioned pans are two smaller pans which were mined in the past, Klein Witpan and Lankpan. A third non-productive pan, which was mined in the past, is Soutpan, which lies 3.5km Southwest of Askham. Mining activity occurs in the local municipalities of Tsantsabane and KLM, where manganese, diamonds and the raw materials (ash) for producing cement are found.

Mining activity occurs in the KLM, where manganese, diamonds and the raw materials (ash) for producing cement are found. Mining is the mainstay of the local area with three very big mines operating in a radius of 30 km. The mine and PPC Lime Acres operate next to the village of Lime Acres with Idwala Lime operating near the town of Daniëlskuil. The only other major activity in the area is commercial farming.

1.3.3.2.2 Occupation and employment

Unemployment in the local area is low because there is no inflow of people into the Lime Acres Village area. The Village was built and run solely for the employees of the mine and PPC with very few businesses in private ownership.

1.3.3.3 Community, social and personal services

1.3.3.3.1 Schools and education

There are three primary schools and two pre-primary schools that serve the community. The mine established a community development office which focus on the developing its personnel through various courses and presentations. The mine also provides an Adult Education Centre for personnel wanting to improve their educational standard.

1.3.3.3.2 Recreational clubs

There are three recreational clubs plus a variety of sport facilities available. A variety of clubs and interest groups such as badminton, diving, gun, football, netball and a wildlife club offers members to practice their sport or interest. The recreational clubs offer a restaurant, swimming pools and weekly film shows. Each of the clubs also has a hall for functions.

1.3.3.3.3 Hospitals

KLM has 3 clinics. It should be noted that medical staff are not stationed at all these facilities on a full time basis and in some cases the staff are on site only once a month. There are two hospitals, one with an operating theatre, and a clinic seeing to health of the community.

1.3.3.3.4 Retail

A variety of shops provide merchandise for sale and services like banking facilities and telephone service providers are available. A public library is also available.

1.3.3.4 Health profile

In SDM the greatest social problems are illiteracy and poverty. According to the last socio-economic survey in 2000, approximately60% of the inhabitants has a monthly household income of between R 0 – R 800.As a result of the above-mentioned factors there is a close correlation between poverty and health. Generally speaking the poorer people are the worse is their health. Tuberculosis and HIV/AIDS are some of the infectious diseases, which are receiving priority attention. Shortcomings: Due to staff shortages certain specific expert services cannot be optimally delivered.

The mine also appointed an HIV AIDS co-ordinator who is working on a full time basis giving HIV AIDS counselling and promoting an AIDS awareness programme campaign.

1.4 Annotated map showing the spatial locality and aerial extent of all environmental, cultural/heritage, infrastructure and land use features identified on site and on the neighbouring properties and farms

Refer to Addendum 2C for the map indicating the environmental cultural/heritage, infrastructure and land use features identified on site and on the neighbouring properties and farms.

1.5 Confirmation that supporting documents in the form of specialist studies are attached as appendices

Refer to addendum 3 (specialist studies) for all specialist studies attached to this EMP. The measures contained in the specialist reports are only recommendations which have been incorporated into this EMP.

2 The proposed mining operation

Refer to Addendum 2for the Regulation 2(2) surface layout map of the mine.

2.1 The mineral to be mined

The Mineral mined has been classified as follows in accordance with the Department of Mineral Resources (DMR) classification.

Table 33: Mineral classification

CODE	MINERAL	TYPE
Dia	Diamond	Diamond
Da	Diamond (alluvial)	Diamond
D	Diamond (general)	Diamond
Dk	Diamond (in kimberlite)	Diamond

2.2 The mining method to be employed

2.2.1 Construction activities

The mine is an existing mine. In the event of any new construction activities taking place, it will be assessed if an EIA is necessary and the EMP will be updated. All new activities that took place as described in paragraph 2.5 of section 1 (EIA) are completed, therefore no construction activities are taking place at present.

2.2.2 Mining activities

2.2.2.1 Mine layout

The diamond pipe is cone shaped and has allowed the mining method to put in place a Rim Tunnel which completely circumnavigates the pipe. The Rim Tunnel is split into an East and a West section. All excavations on the West are numbered with even numbers and odd numbers on the East. Rim Tunnels are traversed at 18 m centres on the loading levels and 36m levels on the drilling levels. 8 x Vent Passes and 8 x Ground Passes (4 x East and 4 x West) are located on the outside of the Rim Tunnel (in competent Dolomite) and connect all production levels from Block 1 to Block 3. All ground passes (6m in diameter) culminate on 620 level. Grizzlies which size the ore to less than 400mm are located at the entrances to all 8 passes. The ore is then gravitated to 650m level where it is drawn out of the passes and onto conveyer belts. The East and West conveyer systems converge and deposit the ore into three storage passes near the shaft. The ore is again gravitated to the 700m Level where it is fed onto conveyers, through weightometers, into skips and then out to the plant via the shaft.

2.2.2.2 Mining method

Current mining operations are underground, using a block-cave method. The mine was started in 1962 as a surface operation, resulting in an open pit over time. The following description provides a brief historic record of the progression of sequential mining methods employed over the last forty seven years. Please refer to Figure 6 for a diagrammatic representation of the ore resources and Figure 7 for the cross-section of the mining operations.

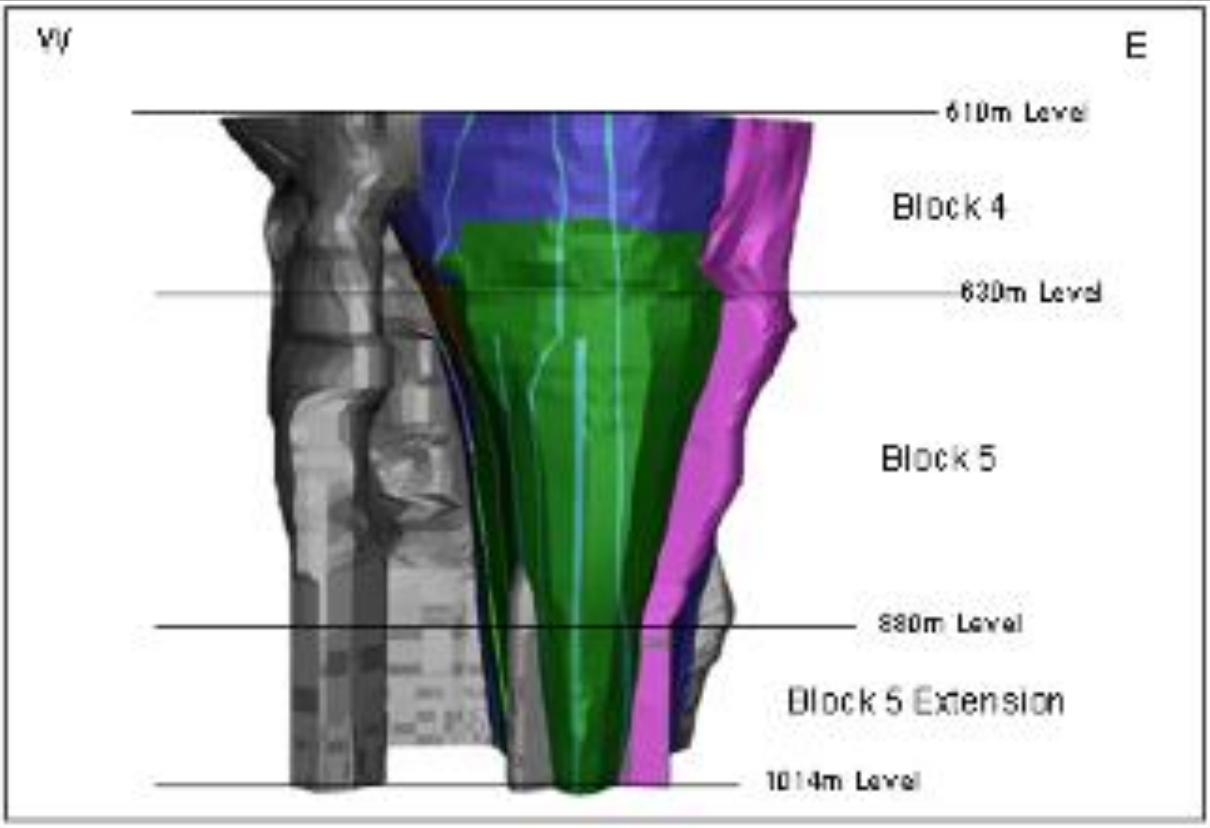

Figure 6: Diagrammatic representation of the Finsch Mine Kimberlite pipe

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2.2.2.2.1 Open cast mining

The opencast method was in use from 1962 until 1992, down to a depth of 430m. The pit is circular with a diameter of approximately 800m. The area of the pit is roughly 552,000m² of which 160,000m² is the centre core which has vertical slopes.

The conical shape of the diamond pipe enabled the excavation of a rim tunnel in the dolomite formation surrounding the pipe. This tunnel was split into an easterly and a westerly section, with all excavations on the west numbered even, while the easterly tunnels were allocated odd numbers. Rim tunnels were passed through at 18m centres on the loading levels and 36m levels on the drilling levels. Eight vent passes and eight ground passes were located on the outside of the rim tunnel (in competent dolomite), connecting all production levels from Block 1 to Block 3. The ground passes of 6m diameter all culminated on the 620m level. (L62). Grizzlies which size the ore to less than 400mm were located at the entrances to all eight passes, from where ore gravitated to 650m level, where it was put through sizers and from here it went into ore passes to 650m level (L65). From L65 it was finally drawn out of the passes and onto conveyor belts. The east and west conveyor systems converged and deposited ore into three storage passes near the shaft. The ore was again gravitated to the 700m level where it was fed onto conveyors and through weightometers, into skips and then out to the Plant via the shaft. The opencast mining operations were terminated in 1992.

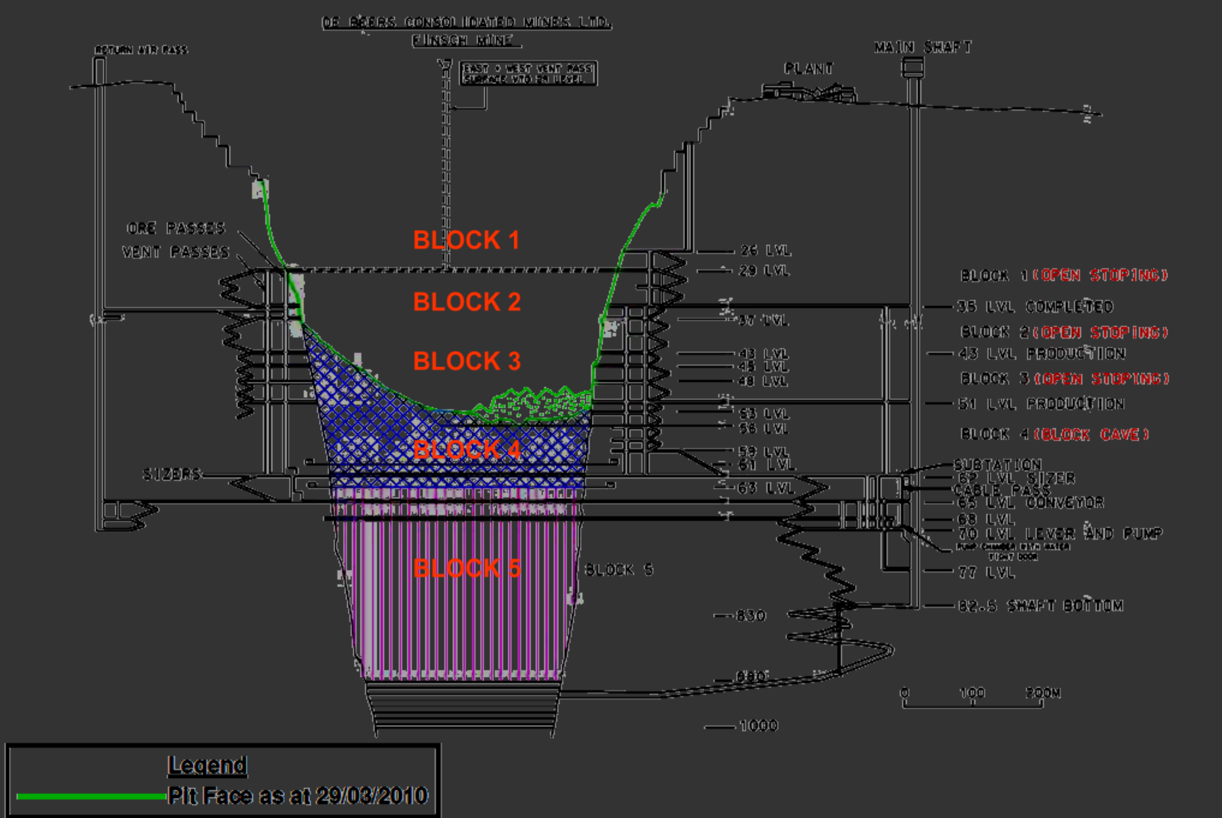

Figure 7: Cross-section of mining operations

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2.2.2.2.2 Underground mining

The underground blast hole open stoping method of mining came into operation in 1992, from the 430m level down to the 510m level, extracting the ore in Blocks 2 and 3. Whereas the pipe was surrounded by banded ironstone at levels nearer the surface, at increasing depth the formation is mainly dolomite, which poses a risk of cave-in of the pit's side walls.

The long hole drilling and blasting of Block 3 was replaced by caving. Underground mining activities are restricted to the mining of the kimberlite pipe with a surface area of 17.9ha. Remnant kimberlite reserves from the 256m level down to the 430m level were left to be mined with underground accessed operations. The deepest point of the mine is currently at 888 m below surface level.

The block caving method was introduced at depths below the 510m level, with the commencement of Block 4 extraction. This phase was oriented around an intelligent mine with remote controlled, rubber tyred vehicles being used; the current layout accommodates trackless equipment.

The mining method basically comprises of a loading action at the draw-bells by the LHD's. The LHD's then tram the ore to a loading point where the ore is deposited onto 50t automated dump trucks. The trucks will then tram the ore to the main crusher underground where the ore will be crushed to -150mm. From here the ore will be deposited onto conveyors on 650m level that will take the ore to the storage passes that will lead to 700m level from where it will be loaded into the skips in the shaft by the weightometers.

The mine has one main shaft, which is 9 m in diameter, in which two 28t skips are used solely for ore hoisting, while two personnel elevators also operate in this shaft. The skips are capable of handling 1 000tonnes of ore per hour. The larger of the two cages is a single deck conveyance which can carry 100 persons at a time. It also has the ability to lower or hoist more than 70% of the trackless vehicles used in the mine using a drive on drive off method. The second conveyance can lower or hoist 10 people at a time.

The prospect shaft, which was originally installed for prospecting purposes, is now used as a ventilation shaft to extract air from the underground workings and thereby causing a suction action through the main shaft. This ensures adequate ventilation within the underground workings The Northern Decline shaft which extends from surface to shaft bottom, together with the main and prospect shafts, serve as the main inlets of some 748m³ of fresh air. 640m³ of foul air is expelled via Vent shafts on the east and west of the mine, resulting in a constant positive pressure underground. The Plant and underground operations have a common control room on surface from where all vital activities are monitored, including the vehicle dispatch and communication system.

2.2.2.2.3 Block cave mining method

The block caving mining method is used for the mining of Block 4 and can only be used in operations where the ore body is concentrated in large chunks. As long as the extraction horizon can be maintained for the life of the draw, caving methods are usually the lowest cost technique of underground mining. For this system both an undercut level and an extraction level need to be developed, with the undercut level normally situated from 80m to 200m below the block to be mined. The undercut level is created to induce the ore above it to cave in to the extraction level some 20m below the undercut level. The caved ore then gravitates into conical shapes which have been blasted up to the undercut level from the extraction level. From here the ore is then loaded and trammed to the transfer tip where it is loaded onto a 50t automated truck. The automated truck will join the High Speed Tramming Loop and be directed by the Automated Management System (OMS) to the selected tip where the ore will be tipped into the Kawasaki gyratory crusher. Once the ore has been crushed, the ore is transported via conveyor to the existing Ground-handling system.

2.2.2.2.4 Residue mining

The various overburden dumps (1,890,000t in total) and old pre-1979 CRD (26 630 526 tonnes) are considered as resources and are being reprocessed. The post-1979 CRD (currently 27 844 942m³) could well be reprocessed in future depending on market demand. The WRD (47 444 766m³) is partially rehabilitated. It is envisaged that when the pre-1979 CRD has been reprocessed that the area will be used to dispose of coarse residue. The reclamation of the residue is carried out using the benching technique by employing earthmoving equipment. The loading of residue takes place at ground level (operating level).

2.2.2.3 Explosives

The explosive magazine is located east of the pit, south of the pre-1979 CRD and directly north of the post-1979 CRD. There is also an emulsions storage depot on surface adjacent to the shaft.

2.2.2.4 Mine residue

Currently no new mine residue is deposited on the mine. There are however existing mine residue deposits (MRDs) on the mine. These are given below. Refer to Table 28 for the size and status of these MRDs. The FRDs and CRDs are discussed under plant residue.

- Overburden: The waste from the mining process removed by earthmoving equipment and deposited on a dump. This is generally soil and weathered rock, and
- Waste rock: The waste from the mining process produced by blasting into host rock to access the Kimberlite Pipe. This is generally coarse rock, which is stockpiled separately from the overburden.

Table 34: Size and status of the mine residue deposits

NAME OF DUMP	SIZE (HA)	STATUS OF USE	COMMENTS
No. 1 Overburden dump	3.8	Inactive	Resource will be treated to extract diamonds
No. 2 Overburden dump	3.6	Inactive	Resource will be treated to extract diamonds
No. 3 Overburden dump	5.0	Inactive	Resource will be treated to extract diamonds

NAME OF DUMP	SIZE (HA)	STATUS OF USE	COMMENTS
Open pit WRD	117.0	Fully rehabilitated	New FRD on western side using western slope as a wall
Waste shaft dump	1.9	Rehabilitated	
U/G WRD (Capitol WRD)	6.4	Rehabilitated	
Bonza waste dump	38.6	Partially rehabilitated	

2.2.3 Estimated reserves, resources and deposits

Refer to Table 29 for the details of the mineral resources, Table 30 for details of the diamond reserves and Table 31 for the diamond deposits. Also refer to Figure 8 for the tailings and resources locality plan.

Table 35: Details of mineral resources

Diamond resources*	BCO(mm)	Classification	2012 Resource actual (June)	2011 Resource actual (Sep)	2012 Resource actual (June)	2011 Resource actual (Sep)	2012 Resource actual (June)	2011 Resource actual (Sep)
Finsch (BC)			Tonnes (million)		Grade (cpht)		Carats (million)	
Block 1 Pre Cursor	1.47mm	Inferred	0.179	0.181	48.00	72.68	0.086	0.132
Block 1 (256m 340m)	1.47mm	Indicated	-0.000	-0.000	1	-272.73	0.000	0.000
Block 2 Pre Cursor	1.47mm	Inferred	1.073	1.079	48.11	72.83	0.516	0.786
Block 2 (340m 423m)	1.47mm	Indicated	0.000	0.000	-	162.13	0.000	0.000
Block 3 Pre Cursor	1.47mm	Inferred	0.108	0.114	43.35	43.29	0.047	0.049
Block 3 (423m 510m)	1.47mm	Indicated	-	-	-	-	-	-
Block 4 Pre Cursor	1.47mm	Inferred	3.894	3.894	43.52	43.52	1.695	1.695
Block 4 (530m 630m)	1.47mm	Indicated	14.244	17.228	34.26	32.91	4.881	5.670
Block 5 Pre Cursor	1.47mm	Inferred	10.844	10.844	46.10	46.10	5.000	5.000
Block 5 (630m	1.47mm	Indicated	36.583	36.585	55.26	55.26	20.214	20.216

Diamond resources*	**BCO(mm)**	**Classification**	**2012 Resource actual (June)**	**2011 Resource actual (Sep)**	**2012 Resource actual (June)**	**2011 Resource actual (Sep)**	**2012 Resource actual (June)**	**2011 Resource actual (Sep)**
Finsch (BC)			**Tonnes (million)**		**Grade (cpht)**		**Carats (million)**	
880m)								
Block 6 (880m 1000m)	1.47mm	Inferred	12.050	12.050	63.59	63.59	7.662	7.662
Pre 79 CRD	1.47mm	Inferred	13.021	14.433	16.69	16.91	2.174	2.440
Oversize (Pre 79 CRD)	1.47mm	Inferred	0.144	0.094	18.12	18.43	0.026	0.017
Finsch Mine Total	Total	Inferred	41.314	42.690	41.65	41.65	17.206	17.781
	Total	Indicated	50.827	53.813	49.37	48.10	25.095	25.885
	Total		92.141	96.503	45.91	45.25	42.301	43.666

*

1. The figures quoted in the statement above reflect the total actuals for Finsch Mine as at June 2012;
2. Diamond resources are inclusive of those modified to produce diamond reserves;
3. Tonnage quoted as dry metric tonnes (t);
4. Grade quoted as carats per hundred metric tonnes (cpht);
5. Mining methods: BC= Block Cave;
6. The June 2012 actuals includes the Pre79 AGrills Estimate 06/2010 at 1.47mm BCO;
7. Revenue values are not shown;
8. 510 - 530m main pipe resource has been depleted and the remaining remnants relocated to Block 4 in 2008;
9. In 2009 BLK5 (PBK4) was not in reserve but was taken into reserve in 2010 after assurance of the pre-feasibility study in Nov 2009;
10. The June 2012 Lidar Survey was used to reconcile failed waste and kimberlite tons reporting to BLK4; and
11. The conversion factor of 0.6605 has being applied to convert the carats from 0.5mm BCO to 1.47mm BCO as at June 2012 for BLK1 and BLK2 precursors.

Table 36: Details of diamond reserves

Diamond reserves*	BCO (mm)	Classification	2012 actual (June)	2011 actual (Sep)	2012 actual (June)	2011 actual (Sep)	2012 actual (June)	2011 actual (Sep)
Finsch (BC)			Tonnes (million)		Grade (cpht)		Carats (million)	
Block 4 (530m 630m)	1.47	Probable	10.381	10.579	27.59	29.94	2.865	3.168
		Proved	-	-	-	-	-	-
Block 5 (630m 880m)	1.47	Probable	46.382	46.382	45.42	-	21.066	-
		Proved	-	-	-	-	-	-
Finsch Mine Total		Probable	56.763	56.961	42.16	5.56	23.930	3.168
		Proved	-	-	-	-	-	-
	Total		56.763	56.961	42.16	5.56	23.930	3.168

*

1. The figures quoted in the statement above reflect the total actuals for Finsch Mine as at June 2012;
2. Diamond reserves must not be added to diamond resources, as reporting is "inclusive";
3. Tonnage quoted as dry metric tonnes (t);
4. Grade quoted as carats per hundred metric tonnes (cpht);
5. Mining methods: BC= Block Cave;
6. Revenue to be confirmed;
7. In 2009 BLK5 (PBK4) was not in reserve but was taken into reserve in 2010 after assurance of the pre-feasibility study in Nov 2009; and
8. Reserves include relocations Waste & Kimberlite reporting to BLK4 based on June2012 Lidar Survey.

Table 37: Details of diamond deposits

Exploration results*					
Finsch (BC)	**BCO (mm)**	**Classification**	**Tonnes (million)**	**Grade (cpht)**	**Carats (million)**
Block 6 pre cursor	1.47mm	Deposit	5.091	47.41	2.414
Overburden stockpile	1.47mm	Deposit	3.396	17.00	0.577
Post 79 CRD	1.47mm	Deposit	78.460	7.00	5.492
	Total		86.947	9.76	8.483

*

1. The estimated tonnage and estimated number of carats contained in these deposits are conceptual in nature and do not conform to the definition of a "diamond resource" due to insufficient sampling. Further exploration will not necessarily provide the basis for determining a diamond resource;
2. Tonnage quoted as dry metric tonnes (t);
3. Grade quoted as carats per hundred metric tonnes (cpht);
4. Deposit types: TMR & BC;
5. Relocation = An estimate of 0.092 million carats and 1.309 mil tons of treated material (ROM & Pre-79 CRD) deposited onto the Post-79 CRD (Sept11-Jun2012);
6. June Lidar 2012 Accepted for the Post79 Reconciliation; and
7. The Conversion factor of 0.6605 has being applied to convert the carats from 0.5mm BCO to 1.47mm BCO as at June 2012 for the overburden stockpile and Post 79 CRD.

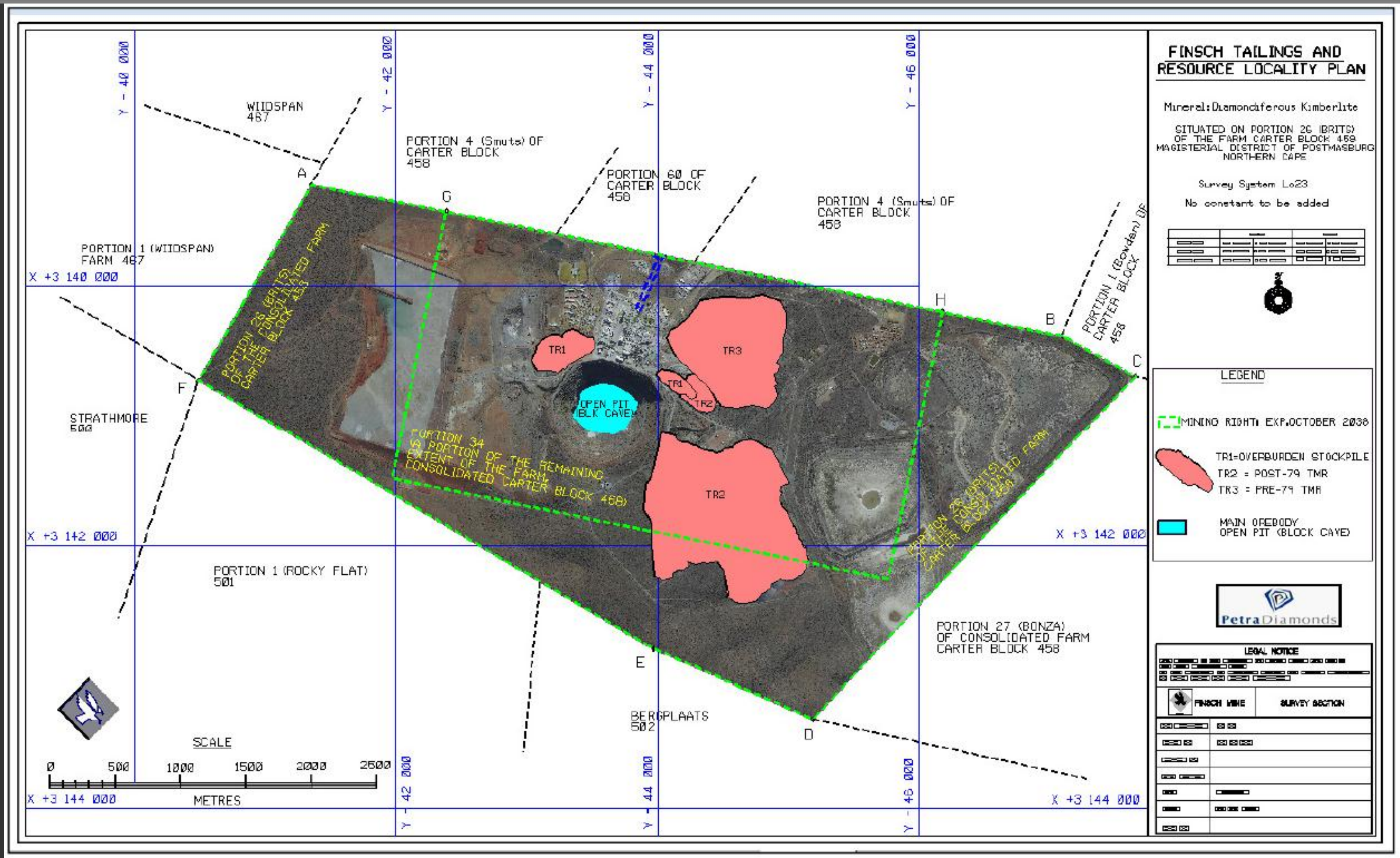

Figure 8: Tailings and resources locality plan

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The mine's primary resources are in-situ resources on which the plan is based. Although various resource confidence categories have been reflected in this table, the entire resource has been utilised in the development of this plan, as this is not intended to be to the confidence level of SAMREC requirements in determining a reserve, and as such the plan represents a "resource available for planning purposes." The intent will be to improve confidence in the resource as time passes and the resource becomes part of the detailed mining plans.

The Finsch Tailing and Work In Progress Resources are resources that are utilized to improve the profitability of the operation. It was not the intention to include this resource in the mining right conversion process, although it is necessary to reflect the benefits of processing the resource to support the mining plans. All underground material treated until 2009 is added to the Post-1979 coarse residue CRTR resource for re-treatment resulting in higher treatment tonnages than shown in the resource statement.

2.2.4 Production rate

To see current production rate please refer to Table 32.

Table 38: Production rates 2004 – 2012

YEAR	THROUGHPUT (MILLION TONNES)	ROM (MILLION TONNES)	COARSE RESIDUE (MILLION TONNES)	% COARSE RESIDUE
2004	5.693	4.289	1.404	24.7
2005	5.693	4.139	1.554	27.3
2006	6.26	4.200	2.060	32.9
2007	7.178	3.778	3.400	47.4
2008	7.200*	3.800	3.400	47.2
2009	7.200*	3.800	3.400	47.2
2010	7.200*	3.800	3.400	47.2
2011	7.109*	3.709	3.400	47.8
2012	7.195*	3.795	3.400	47.3

Approximately 3.8MTPA is underground ore and 3.4MTPA is CRD reprocessing.

2.2.5 Life of mine

The LoM is currently scheduled to the year 2028, mining 12 different resources during this time. It is hoped that further drilling of the ore body below the 980m level will prove extended resources for Block 6 and in so doing extend the life of the mine even further.

2.3 List of the main activities, or processes

2.3.1 Ore processing activities

2.3.1.1 Beneficiation plant

2.3.1.1.1 Ore processing

The treatment process used at the mine consists of three basic stages. These stages are discussed below. Refer to Figure 9 for the plant layout.

Ore preparation by crushing, washing and screening in order to size the material for further treatment:

- A variable speed apron feeder below the shaft bin feeds ore 300mm in size onto an incline conveyor, which transports it to the crusher,
- A conveyor then feeds the 300mm material into the gyratory crusher where it is reduced to 100mm,
- An apron feeder, situated immediately below the crusher, discharge the sized material onto a conveyor which runs along the length of the stockpile building,
- A belt feeder removes the excess feed from the overspill bin and transfers it via conveyors and the tripper to the stockpile
- From an Apron feeder the ore is fed via conveyors to the Scrubbers.
- The coarse residue is tipped onto a static grizzly located above a 300t reception bin.
- The coarse residue is withdrawn from the reception bin by eliptex feeder and fed on a conveyor that joins the ore that are reporting to the scrubbers.
- The two scrubbers receive feed via a split chute to give equal feed to each scrubber.
- The scrubbed ore is discharged with a large amount of slurry onto two double deck primary screens where washing takes place
- The oversize product from the top and bottom decks is transported to the secondary crusher's feedbin by conveyors. The ore gets crushed and screened. The oversize (+22) reports to the tertiary crushers by conveyors and the undersize (-22) gets conveyed to the wet screens. The Tertiary crushers crush and screen the ore again and the oversize reports back to the tertiary crushers until the desired size are reached were it then gets conveyed to the wet screens. Screening and washing takes place at the wet screens and the +1 material reports to the feed sep via conveyors. The -1 material reports to the screen underpan were it gets pumped to degrit cyclones for dewatering. The Cyclone overflow gets reused in the wetscreen system and the Underflow will report to a sump were it gets pumped to the FOS section for dewatering and screening.
- The undersize product from this screen reports to a screen underpan from where it Reports to the secondary screen for washing.
- The oversize product from the secondary screen (-22 +1mm) is discharged onto conveyors feeding to the Feed separation.
- The Undersize reports to an underpan from where it is pumped to the FOS section for dewatering and screening.

- The water supply to the scrubber section is drawn from the SCS/SCMS (Scrubbing, Crushing, Milling and Screening) clarified water tank at C & D thickeners and is pumped to the scrubber clarified head tank.
- The Feed separation sizes the ore into a coarse and fines fracture. The undersize reports to the underpan were it gets pumped to the FOS section for dewatering and screening. The Fines fracture report to B and C silo's via conveyor and the coarse fracture reports to a silo via conveyors.

Concentration of the sized material and preparation by means of dense media separation (DMS):

- The feed (- 22mm +12mm) from A silo reports to the Coarse DMS via conveyors.
- The 3 x Feed preparation screens for the Coarse DMS receives ore from a silo. The screens washes out the -1mm fracture which gets pumped to G Thickener.
- The CDMS receives its water from the DMS Clarified and G Thickener
- The Fines DMS feed preparation plant receives ground from the B and C silos and performs a wet screening operation to remove the –1mm material
- Kimberlite ore of size -12mm is withdrawn from the silo's at a controlled rate by the silo withdrawal conveyors.
- The silo withdrawal conveyors discharge onto the collection conveyor and the ground is diverted to the module feed conveyors or split evenly between the two.
- The ore from each module feed conveyor is fed into a pulping box where it is intimately mixed with water
- Most of the adhering water in the ore is removed on the last section of the screen.
- All the water and -1mm ore that passes through the screen deck is pumped by the degritting cyclone feed pumps to the degritting cyclones.
- The solids report to the spigot with some water, while most of the water with some very fine solids report to the overflow.
- Some water and solids overflow from the screen underpans to the transfer sump were it gets pumped to the FOS section for dewatering and screening.
- The feed preparation receives its water supply from the raw water head tank at the DMS pump house and is pumped to the head tanks in the feed preparation building.
- The + 1mm report to the Fines DMS

Fines DMS

- The Fines DMS receives Ore from the Feed Prep section via conveyors.
- The Ore is fed out of 8 x 100t bins with belt feeders into mixing boxes. In the Mixing box the ore gets mixed with FeSi and feeds down to the Cyclones.
- The Underflow/Concentrate of the cyclone reports to the sink screen and the Overflow to the Float screen. On the screens FeSi drains from the ore and Concentrate.
- The Ore and concentrate also gets washed to ensure all FeSi are recovered.
- The Concentrate reports from the sink screen via conveyors to the recovery for sorting.

- The Float screen splits the feed into 2 size Fractures. The oversize (+8mm) reports to the HPRC crushers via conveyors for recrushing. The undersize (-8mm +1mm) Reports to the Coarse residue section via conveyors. The Fines fracture (-1mm) gets washed to the Dilute sump from where it gets pumped to the magsep to recover the FeSi and dispose of the fines via a launder to G Thickener.
- The Fines DMS receives water from the DMS Clarified and G Thickener.

Coarse DMS

- The Ore is fed from the feed prep screens into mixing boxes. In the Mixing box the ore gets mixed with FeSi and gets Pumped to the Cyclones.
- The Underflow/Concentrate of the cyclone reports to the sink screen and the Overflow to the Float screen. On the screens FeSi drains from the ore and Concentrate.
- The Ore and concentrate also gets washed to ensure all FeSi are recovered.
- The Concentrate reports from the sink screen via conveyors to the recovery for sorting.
- The Float screen oversize (-22mm + 1mm) reports to the HPRC crushers via conveyors for recrushing. The Fines fracture (-1mm) gets washed to the Dilute sump from where it gets pumped to the magsep to recover the FeSi and dispose of the fines the effluent pump to the launder and G Thickener.
- The Coarse DMS receives water from the DMS Clarified and G Thickener.

HPRC

- The HPRC crushers receive the oversize from the Fines and Coarse DMS and crush the material.
- The Crusher material reports the HPRC scrubbers were the ore gets wash and size into 2 size fractures.
- The screen sizes the ore into +12 mm which reports to a silo via conveyors and +1mm – 12mm which reports to B and C silo via conveyors.
- The Fines (-1 mm) reports to the screen underpan and gets pumped to the FOS section for dewatering and screening.

FOS and Thickeners

- The FOS plant receives all undersize (-1 mm) from plant via pumps to the FOS Header tank.
- The Header Tank feeds Degrit cyclones.
- The Underflow which is your coarse fracture reports to screens for dewatering.
- The Overflow of the Cyclone which is the fines or fine residue fraction reports to the Thickener for settling.
- The screen over size (+ 0.5mm) Reports to the coarse residue section via conveyors.
- The screen undersize reports to the underpan which gets pumped to the thickener launder.
- The Thickeners receives al the Cyclone overflow material and the screens underpan material via a feed launder. Flocculent is added to the dirty water to improve settling rate.

- All the fine residue will settle in the thickener and get Pumped to the FRDs via excess pump station
- The clean water will overflow to the clarified and will be reused in the different plant sections.

Outside dams

- Water from the FRDs is pumped back into the plant circuit by using the Brits and Top dams.
- The Earth dam also recovers water from the old FRDs and delivers the water to the top dam.
- The Bottom dam receives water from dewatering and Vaal - Gamagara and supply the main plant with water.
- Some stormwater reports to the Five Mission Dam and gets pumped to the earth dam.

All three stages are closely interlinked with one another, but have buffers between them in the form of silos or storage bins in order to provide control and surge facilities. Refer to Figure 10 for the treatment plant process flow overview. The block flow diagrams for ore reception, ore preparation, feed separation, fines DMS, coarse DMS, recrush (HPRC), recrush scrubbing, degrit (FOS), fine residue (FRD) and coarse residue (CRD) are attached to this document.

2.3.1.1.2 Residue reprocessing

A purpose-made mobile screening plant unit is used in-situ on the CRD facilities where ore is loaded. This enables the relocation of the screening plant to various sites on the Pre-1979 CRD facility, ensuring that a continuous supply of screened coarse residue is available to the processing plant. Unwanted fine material is pumped from the unit as slurry and disposed of as fine residue through the fine residue disposal route. The remaining material is treated through the main plant fine ore processes for the removal of any small diamondiferous material.

2.3.1.2 Plant residue

All material processed in the Plant is disposed of either as the coarse or the fine fraction. The fine fraction, which is the thickener underflow product, is pumped to the FRDs as slurry in pipelines and the coarse fraction is conveyed in a semi-dry state to the deposit to the CRDs. The average proportion of the head feed treated reporting to the CRD as coarse waste is 60 % (based on 2003 to present figures) and the remainder to the FRDs.

Plant residue at the mine can be categorised as follows:

- FRD (Fine residue): The fine residue from the process Plant (-0.5mm) produced as thickener underflow and delivered as slurry to the fine residue dams,
- CRD (coarse residue and grits): The coarse residue from the DMS section screened out as the –6 mm fraction, and the grits from the degrit section screened out as the + 0.5 – 1.6 mm fraction, and delivered to the CRD by conveyor belt,

The geotechnical parameters have been obtained by laboratory testing of residue. The characteristics are included in Tables 33 to 35. It is expected that the characteristics will vary from time to time due to the consistency of the ore body and treatment process.

Table 39: Geotechnical characteristics

PROPERTY	FINE RESIDUE	COARSE RESIDUE
Specific gravity	2.6t/m^3	2.7t/m^3
Typical grading	-1.6mm	+0.5 mm-8mm
Angle of friction	34Deg	40 Deg
Cohesion	0kPa	0 kPa
Deposited insitu dry density	1.3t/m^3	1.8t/m^3

Table 40: Chemical characterisation

AREA	MICRO ELEMENTS(MG/L) AND pH					
	FE	Mn	Cu	Zn	F	pH
Paddock 1	0.25	0.077	0.025	0.0055	1.85	7.95
Paddock 2	0.78	0.330	0.051	0.0120	0.31	8.06
Paddock 3	0.42	0.110	0.022	0.0044	0.14	7.85
FRD 3	0.22	0.035	0.067	0.0020	0.12	7.63
Rehabilitated Site FRD 3	0.17	0.030	0.067	0.0020	0.12	7.63
Natural topsoil	0.22	0.054	0.078	0.0058	0.03	7.52

Table 41: Macro elements

AREA	MACRO ELEMENTS(MG/L)					
	Ca	Mg	K	Na	PO4	B
Paddock 1	0.00120	0.61	24	320	<0.1	0.13
Paddock 2	0.00076	79	34	14	<0.1	0.12
Paddock 3	0.00072	34	31	20	<0.1	0.10
FRD 3	0.00410	12	94	1000	<0.1	0.10
Rehabilitated Site FRD 3	0.00150	0.34	16	27	<0.1	0.069
Natural topsoil	0.00140	0.27	12	0.44	<0.1	0.073

2.3.1.1.1 Fine residue dams

The mine has the following FRDs:

1 FRD paddock

- The decommissioned FRD paddocks are located east of the mine and occupy an area of 105ha and a volume of 5,432,907m³.
- These paddocks are decommissioned and in the process of being rehabilitated.

2 FRD No.1

- This FRD is located southeast of the mine.
- Occupies a surface area of 58.8ha and a volume of 17,000,000m³.
- The total capacity of the FRD is 14,319,218t.
- The FRD is under care and maintenance and will probably be re-commissioned in 2014.
- This FRD will be a permanent structure.
- The residue is delivered in a slurry form to the deposit by pipeline.
- Surrounding the deposit is a ring main, with rising mains to delivery station, and a number of valves.
- The slurry (fines) was deposited on the outer wall using techniques developed to suit the residue properties.
- All water expelled from the slurry on deposition, or stormwater, migrated to the pool on the deposit.
- The water was then decanted in a controlled manner to ensure that the minimum quantity of water is maintained on the deposit and that clear water is decanted.
- Decanted water passed into a RWD and pumped to the Plant for re-use in the process.
- The outer edge of the wall was maintained at a level above the pool of the water such that all water collected on the deposit can be contained without overtopping.
- No underdrains are in operation at the FRDs.
- A solution trench surrounds the entire deposit and collects all bench penstock water; drain outflows and dirty stormwater and leads it to the return water dam.
- Paddocks are provided at the toe of the wall to collect and contain runoff water and eroded solids within the confines of the deposit.
- Benches were constructed at regular intervals on the outer face of the wall to ensure a stable outer face and to control water runoff and erosion.

3 FRD No.2

- This FRD is located southeast of the mine.
- Occupies a surface area of 65.1ha and a volume of 16,500,000m³.
- The total capacity of the FRD is 13,408,354t.
- The FRD is under care and maintenance and will probably be re-commissioned in 2014.
- This FRD will be a permanent structure.
- Operation was as with FRD No.1

4 FRD No.3

- This FRD is located southeast of the mine.
- Occupies a surface area of 65.4ha and a volume of 20,000,000m³.
- The total capacity of the FRD is 16,367,514t.
- The FRD is under care and maintenance and will probably be re-commissioned in 2014.
- This FRD will be a permanent structure.
- Operation was as with FRD No.1

5 Infill FRD

- Occupies a surface area of 10.68ha and a volume of 4,000,000m³.
- The total capacity of the FRD is 16,367,514t.
- The FRD is under care and maintenance and will probably be re-commissioned in 2014.
- This infill FRD will be a permanent structure.

Brits FRD

- This FRD is active.
- The FRD is located adjacent to the current WRD in the valley to the west of the treatment plant within the mining rights area.
- The FRD will be 198ha in size and have a volume of 14,880,000m³.
- The total capacity of the FRD will be 20, 8000, 0000t.
- Maximum elevation of 19mamsl.
- Deposition rate is 200,000tpm.
- The slurry is disposed of by the open-end discharge method (as for the existing facility) and the slurry density is expected to vary from 1.2t/m³ to 1.35t/m³.
- Fine residue/fines do not have the engineering properties to construct the outer wall with, so an engineered embankment was constructed between the hills on the western side of the facility and the WRD to the east, to create an impoundment.
- The south wall was constructed with soil excavated from the WRD.
- The northern wall was constructed in the same manner as the south wall using material excavated from the floor of the FRD.
- Conventional spigotting FRD with down pipes is used to shape the fines beach in order to drive the pool back and manage the pool position.
  - The FRD is not lined, versus the return water dam that is HDPE lined because water is removed off the FRD with surface barge pumps to the return water dam.

A report was done by Jones & Wagener in 2012 to analyse the available capacity on the FRDs. The analysis is based on the latest projected LoM, and Pre-79 CRD tonnages to be generated until 2028.

Different options were assessed to determine available capacity on the FRDs for the planned life of mine. Results are summarized below.

Option 1

During this phase it was assumed all fines are deposited to the Brits FRD to embankment height (1512.5mamsl). The total life of the Brits FRD is estimated to be up to 3 years (June 2012 to May 2015).

Option 2

The second strategy analysed available capacity on the Brits FRD if it is raised by 10m from the current embankment level to 1522mamsl. The analysis yields a total life of 6.6 years. However, the deposit will be raised at a high rate of rise of 2.8m/yr, which is not believed to be viable.

Option 3

During this option, the Brits FRD was raised by 10m from current embankment level and the old FRDs re-commissioned to their maximum height for additional capacity. The available life is summarised below. The latest possible re-commissioning date for the old FRDs is July 2013.

Table 42: Deposition from June 2013 – June 2016

DAM	DEPOSITION (tpm)
FRD 1	33,000
FRD 2	15,000
FRD 3	35,000
Infill	12,000
Brits	Balance (61%)

The Brits FRD will reach the current embankment height mid-2016 and the FRD will have to be developed upstream using spigotted fine residue, at a rate of rise of below 1.5m/yr. During the same period deposition to the old FRDs will have to be increased to lower the rate of rise on the Brits FRD. The available capacity on the FRDs is indicated in the Table below.

Table 43: Deposition from July 2016 – Dec 2028

DAM	DEPOSITION (tpm)	END DATE DESIGN	ELEVATION (mamsl)	DAM FINAL LEVEL (mamsl)	RATE OF RISE (m/yr)
FRD 1	31,500	Dec 2020	1515	1515	0.83
FRD 2	19,500	Dec 2020	1509	1509	0.50
FRD 3	44,000	Dec 2020	1491 x	1509	0.50
Infill	13,000	Nov 2023	1516	1505	0.85
Brits FRD	Balance (54% - 87%)	Nov 2023	1522	1522	1.10

The analysis yields a total life of 11.5 years, which is insufficient as the projected LoM is until 2028. If Brits FRD is raised by a further 6m, then the deposit, in conjunction with the Infill dam can be operational until 2028 at a rate of rise of 1.13m/yr and 0.87m/yr for the Brits FRD and Infill dam respectively. However, the stability of the Brits FRD will have to be closely monitored to determine whether it is possible to increase the dam further.

The Brits FRD on its own does not have enough capacity for the projected LoM. Available life is estimated to May 2015. If the Brits FRD is raised by a further 10m, total life available will be 6.6 years. However, the FRD will be raised at a rate of rise of 2.8m/yr which is not viable. The old FRDs will have to be re-commissioned and the Brits FRD is raised by 10m from current embankment level for additional capacity. Available capacity will be up to 2023. FRD1, 2 and 3 will be operational until 2020; the Infill dam and Brits FRD will be operational until 2023. The Brits FRD can be raised by a further 6m and operated for the remaining LoM in conjunction with the Infill dam until 2028. However, raising Brits FRD further will depend on the stability of the FRD.

2.3.1.1.2 Coarse residue deposits

The mine has the following CRDs:

1 Old pre-1979 CRD

- The CRD has a total footprint of 55.0ha.
- The CRD is inactive and being reprocessed, therefore the sizes are not given.

2 Post-1979CRD

- Portions of the CRD are active. New deposition only takes place on extreme southern section. Sampling for reprocessing is ongoing.
- Situated to the north of the plant area
- The CRD has a total footprint of 52.4ha.
- Average deposition rate is 350,000tpm.
- Max height of 1,598mamsl.
- Coarse residue is delivered in a dry state with average moisture content of approximately 15 % using conveyers to the coarse residue resource.
- The residue is deposited over the end of the coarse residue resource and allowed to fall at its natural angle of repose.

2.3.1.3 Run of mine

The mine has two stockpiles:

- The live stockpile is 1.9ha in size and is used intermittently.
- The low grade stockpile is 1.4ha in size and is used intermittently.
- Buffer stockpile used continuously, which is the main ore stockpile.

2.3.1.4 Dust plants

The mine has ten dust plants. These plants are located at the following areas:

- Near tailings reception bin;
- Shaft bin area;
- Gyratory crusher area;
- Cemented area on south side of building;
- Behind overspill bin transfer house;
- 103/112/11318 transfer house;
- West side of SCMS;
- At SCMS transfer house area;
- Outside recovery building; and
- Outside recovery building.

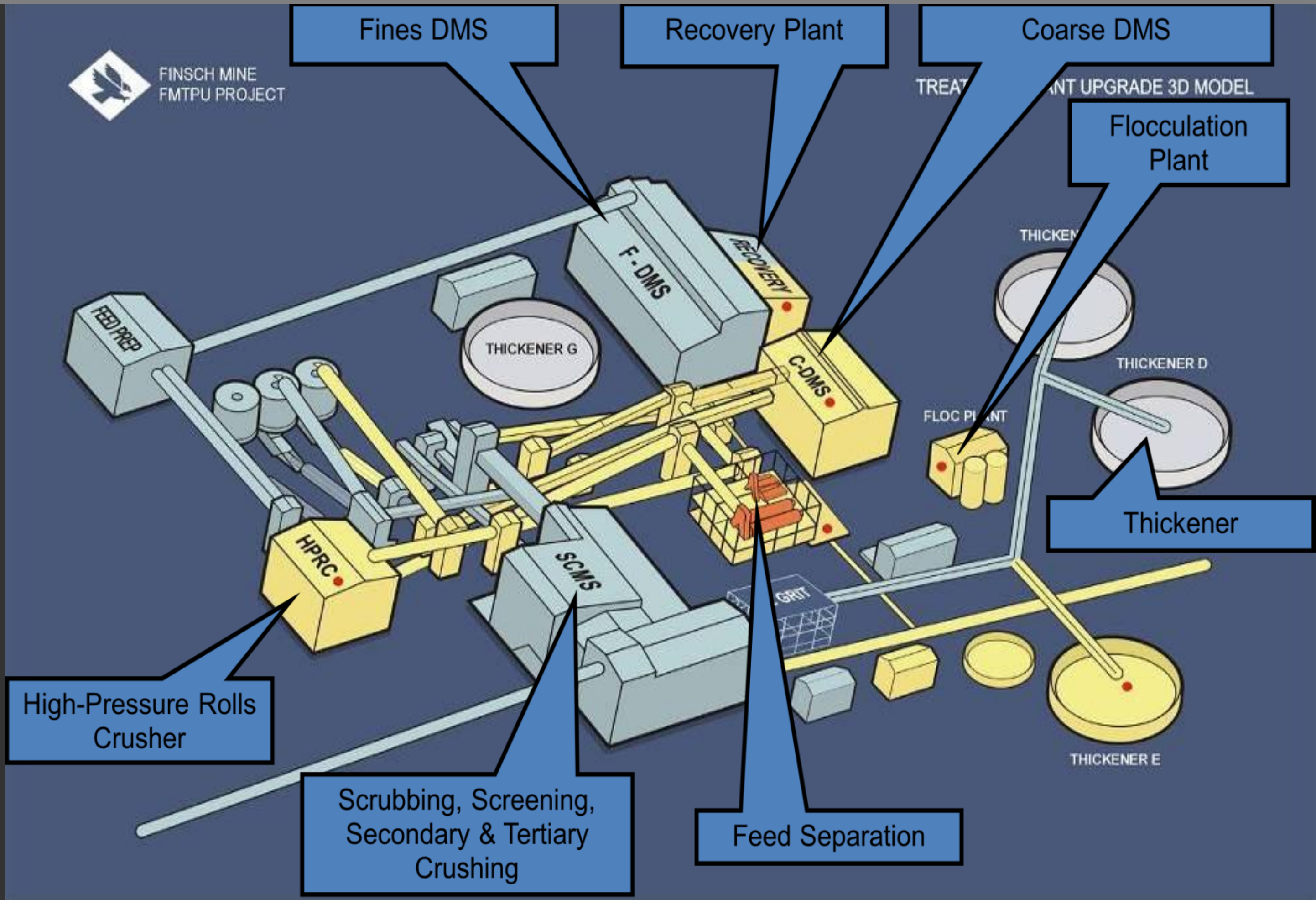

Figure 9: Plant layout

Client: Petra Diamonds, Finsch Mine

Project: EMP Amendment

Date: May 2012

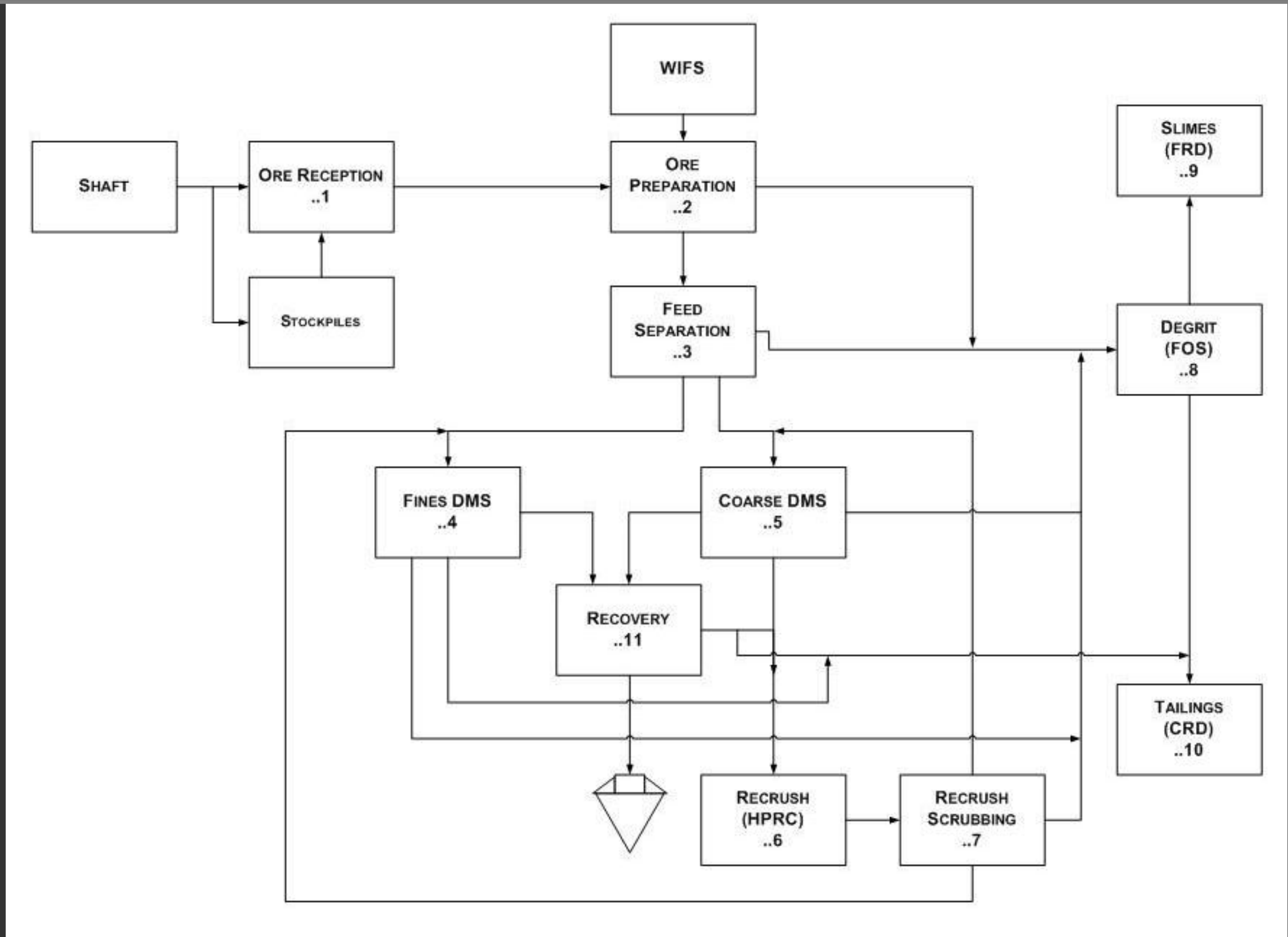

Figure 10: Finsch treatment plant process flow	
Client: Petra Diamonds, Finsch Mine	SHANGONI Management Services (Pty) Ltd
Project: EMP Amendment	
Date: May 2012	

2.3.2 Support services

2.3.2.1 Waste management

2.3.2.1.1 Waste streams

Finsch Mine generates general and hazardous waste streams from the underground mining operations, workshops and washbays and on surface from the ore treatment processes and related maintenance activities. Hydrocarbon contaminated soil is treated at the WAMY at an established bioremediation facility. Domestic waste is produced from the office environments, change houses, material stores and contractor sites within the mine. Table 38 below is a summary of all waste streams identified on the mine.

Table 44: Waste streams classification

HAZARDOUS WASTE (BLACK)	GENERAL WASTE (GREY)	SCRAP METAL (BLUE)
Hydrocarbon or any other chemically contaminated PPE	Glass bottles	Pipes
Heavy metals, i.e. components of electronic devices, circuit boards (cadmium, mercury, zinc, copper) food	Domestic waste — black bags containing tissues, milk bottles, tea bags, waste.	Metal shavings
Incinerator ash if not tested.	Incinerator ash if tested and deemed not hazardous.	
Electrical waste: redundant electrical elements and circuit boards of kettles, geysers, fridges, electrical cables, etc.		
Old paint brushes	Used personal protective equipment	Empty open fire extinguishers
Printer and copy machine cartridges — returned to supplier by IT	Plastic pipes	Wire cages
Asbestos (brake pads, gaskets, off cuts) To be handled according to Asbestos Regulations.	Paper, Cardboard	Aluminium, Copper, Brass
Explosives and some explosive packaging; African Explosives (AEL) emulsion spillage waste at Emulsion Silo — handled in accordance with FDM-MI-WP-51, Explosives Handling Procedure	Ferrosilicon bags	Drill bits
Radioactive waste and disposal of X-ray tubes — refer to procedure FDM-EN-38, safe handling of radio-active sources.		Short pieces of electrical cable

HAZARDOUS WASTE (BLACK)	GENERAL WASTE (GREY)	SCRAP METAL (BLUE)
Electronic waste — computers, cell phones, key boards, screens, cell phone batteries.		

The WAMY is a designated managed site that exists for the receipt, collection and control of waste generated at Finsch Mine. The WAMY includes a hazardous waste storage area, a general waste disposal landfill site as well as a bioremediation site. The landfill at the mine consists of a space in the overburden WRD where the WAMY is situated. Surface waste is transported by tractor and telecon (from plant area) or cassette carriers (from the mining logistics area) to the WAMY. This facility was authorised under the Environmental Conservation Act, 1989 (ECA) and is currently being re-registered in terms of the National Environmental Management Waste Act, 59 of 2008. It is classified as a General disposal site (G:S:B + and G:S:B -). The intention is for the contractor to manage all the waste streams in accordance with the Minimum Requirements for recycling, landfill and safe disposal standards.

2.3.2.1.1.1 Conveyor belts and scrap metal

Conveyor belts are auctioned. Scrap metal is taken by a recycling company.

2.3.2.1.1.2 Waste tyre stockpile

Waste tyres are currently stockpiled and will be recycled.

2.3.2.1.1.3 Garden waste

Green telecons may be requested from the WAMY supervisor for the disposal and removal of garden waste. This waste is disposed of as mulch or topdressing to the WRDs within the mining area Outside the mining area garden waste is taken to the Water Care Works; tree branches are put through a wood chipper and along with grass cuttings are used as a bulking agent for the composting of sewage sludge.

2.3.2.1.1.4 Sewage sludge

Dried sewage sludge is mixed with wood chips and grass cuttings and composted. Once the sewage sludge has been denatured by the composting process the final material is used for the surface rehabilitation of Residue Deposits. The use of this compost is authorised.

2.3.2.1.1.5 Medical waste

Medical waste is collected from the hospital and clinic by a licensed disposal company

2.3.2.1.2 Waste management facilities

2.3.2.1.2.1 Domestic waste landfill site

General waste is currently disposed of at the Domestic waste landfill site, located at the WAMY. This facility is authorised under ECA. Finsch has historically operated the landfill by “end tipping” without compacting waste. This practice contravenes the “Minimum Requirements” and does not optimize available space. An existing void was used and waste was disposed of over the edge and then covered. This practice will be replaced by compaction of general waste before it is landfilled.

2.3.2.1.2.2 Wood chippings

The wood chipping yard is located on the same plot of land as the sewage plant and the incinerator. The wood is sourced from garden refuse and off-cuts (seed free) from trees that were cut down during invasive plant eradication operations. The chips are used together with the dry sewage, originating from the sewage plant, for the production of compost, to be used during rehabilitation.

2.3.2.1.2.2 Incinerator

The mine has 2 waste incinerators. One incinerator operates at the sewage plant which is used to burn grits. The second incinerator is located in the recovery plant where it used to be for the incineration of general waste, however this no longer happens and the incinerator is in the process to be decommissioned.

2.3.2.1.2.3 Hazardous waste storage area

The Hazardous waste storage area (HWSA) is a designated site used for the temporary storage of hazardous waste. All hazardous waste is labelled in containers and stored in the HWSA area. The hazardous waste is supposed to be placed in drums painted in black colour. The full drums are removed from source and transported to the WAMY for temporary storage. At the HWSA, the waste is verified and labelled prior to collection by EnviroServ for disposal to an H:H landfill site (Holfontein).

2.3.2.1.2.4 Bioremediation site

The bioremediation site consists of an elevated concrete slab surrounded by a bund wall. There is a ramp leading up to the side to assist the off loading of the material. The site receives all oil and fuel contaminated soil, sand and sawdust. It also receives the absorbing material (such as Drizit or Supazorb) used to clean up spills on the mine. The contaminated material is to be spread out on the concrete and wetted. Hydrocarbon consuming bacteria is added to the material. During a process that can last up to 12 weeks the material is kept wet and occasionally nutrients will be added for the bacteria. Afterwards the material is tested for hydrocarbon content and if within specified limits, the absorbent fibre is disposed of in the landfill site and soil and sand is used in the rehabilitation process.

2.3.2.2 Water management

2.3.2.2.1 Groundwater management

2.3.2.2.1.1 Groundwater dewatering

Groundwater in the underground working reports to the underground sumps (dams) 1, 2, 3 and 4 on 68level. The mine affected water is then abstracted from these underground sumps (dams) and re-used in the process.

As the mine extends downwards, groundwater drains into the excavations. In order for mining to proceed, this water must be pumped out of the excavations. Currently this water is pumped to underground sumps on 68level and 88level. From here the water is either used underground or pumped to the surface Bottom Dams where it enters the closed water reticulation system of the mine as process water. The pump is situated on 70level. Refer to Figure 11 for the underground main water flow / pumping.

2.3.2.2.1.2 Potable water boreholes

Groundwater is also abstracted from one (1) borehole located on the Bonza Farm. Currently 200 m^3/month of groundwater is abstracted from this borehole for potable use as well as for the watering of game on the Bonza Game Farm.

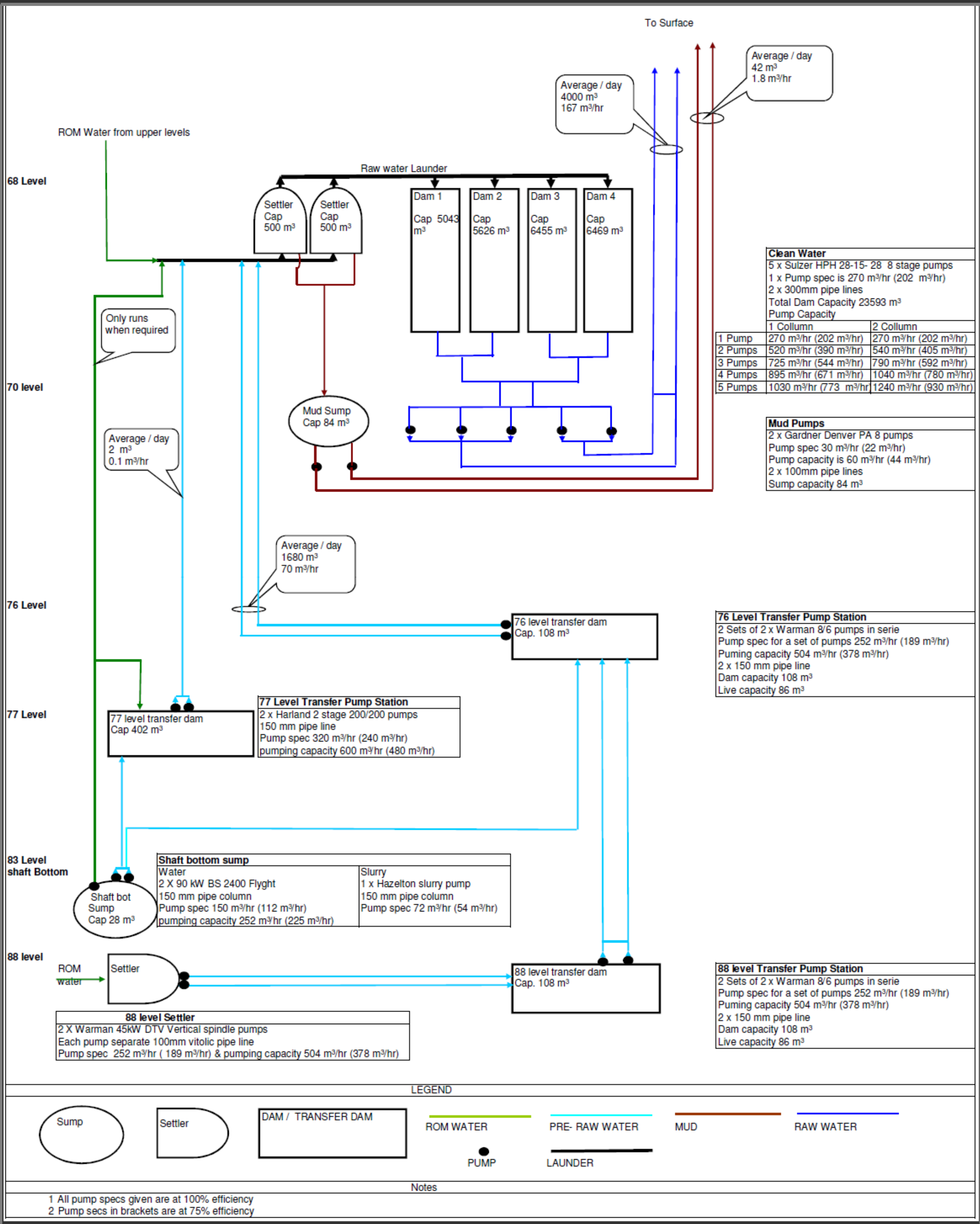

Figure 11: Underground main water flow / pumping

Client: Petra Diamonds, Finsch Mine

Project: EMP Amendment

Date: May 2012

SHANGONI Management Services (Pty) Ltd

2.3.2.2.2 Surface water management

2.3.2.2.2.1 Process water circuit

A volume of 5.2million m³ per year of water is used in the Plant. This volume is based on an average daily volume of 14 250m³ with a peak daily volume of 17 375m³. The rate of process water use is 600m³/h. The Plant operates 24 hours per day for 365 days of the year. It is estimated that the upgraded Treatment Plant will require a volume of 6 684 497m³ of process water per year. Process water supplied to the Plant is used in order to make up that portion of water which is lost to infiltration and evaporation through fine and coarse residue and is therefore not returned to the raw water system. The water used in the process is obtained from the major sources as listed below:

1. <u>Mine affected water from the Bonza Quarry, which is pumped from the adjacent PPC quarry 4 or 5:</u>
   The mine no longer makes use of the Bonza Quarry as a reliable water source because the PPC pumping has ceased. The mine now uses the potable water to make up the treatment water supply.

2. <u>Treated potable water from the Vaal–Gamagara Water Scheme:</u>
   The mine obtains water from the Vaal–Gamagara Water Scheme for make-up water in the process. A volume of approximately 0.29m³ of clean water from the Vaal–Gamagara Pipeline is required per tonne of ore processed.No.1 Incoming line [Vaal-Gamagara (VG) 1 / DB1] supplies water to Bottom Dam.

3. <u>Treated effluent water from the Domestic Wastewater Care Works:</u>
   Treated effluent from the Domestic Wastewater Care Works is currently pumped into the Earth Dam from where it enters the process water system.

4. <u>Contaminated stormwater runoff from the residential areas as well as stormwater runoff from the mining area:</u>
   Affected stormwater from the surface of the mining area is diverted to the Five Mission Dam where it enters the process water system.

5. <u>Mine affected water from the underground workings at the mine:</u>
   The groundwater ingress into the underground mining operation as well as accumulated rainwater within the pit is pumped from the four underground sumps into the surface storage facilities (Bottom Dams) for re-use in the process.

6. <u>Water obtained from boreholes</u>
   This category of inflows has been included for the sake of completeness, as no water is currently obtained from boreholes for augmentation of the raw water supply.

7. Plant effluent (recycle overflow)

All water used in the plant is recycled for re-use, the consumption by the plant being used to "top-up" that portion of water which is removed in either fine residue or coarse residue. The water for treatment and re-use is discharged to Streichers Dam. Overflow from this small silt control dam is discharged into a concrete channel which bypasses the Bottom Dam and discharges into Five Mission Dam. Most of the plant effluent is washed down and reports as surface runoff to either the Streichers Dam (western portion of plant area). On the eastern site of the mine the water goes via Fyndraai channel to a stormwater channel outside the mine after is passes a silt water trap. From both of these facilities, water is channelled via concrete channels to the Five Mission Dam. Spillages from the thickeners and the pipelines leading from them toward the FRDs are mostly contained on the paved or channelled surfaces of the plant area, following the stormwater route via either the Streichers or Fyndraai channel to the Five Mission Dam.

8. Old FRDs runoff

A solution trench surrounds the entire deposit and collects all bench penstock water. Decanted water from the old FRDs passes into a central penstock with an underdrain which gravitates via a concrete channel to Bonza quarry.

9. Brits FRD runoff

Return water is salvaged through a floating barge pump system and pumped back to the silt trap and return water dam. Water is then transferred from there to Top Dam and Bottom Dam and reused in the plant. The water balance for the facility indicates that about 4725m^3/day of water is on average available for return to the plant. The surface water storage capacity will be approximately 43 000m^3. All runoff and shallow seepage from the FRD is intercepted by cut-off trenches.

There is a number of process water storage facilities located in and around the mining area. Not all of these process water storage facilities supply water to the plant; however, all storage water facilities that contain process water or supply the plant with water for the process are listed below:

1 Spillage Dam (Streichers Dam)

This dam (holder tank) has a surface area of 424m^2, a depth of 1.25m, and a capacity of 530m^3. It acts as a settling pond for spillages in the plant area. Water is received from surface water run-off out of the plant area. Water from this dam supplied to Five Mission Dam.

2 Five-Mission Dam

This dam has a capacity of 9 000m^3. It is immediately north of the Five Missions residential area and is concrete lined. This dam acts mainly as a settling pond for spillages and run-off from the plant and single-quarter area. The dam is cleaned out annually. Water is received from stormwater from the Single-quarter complex, water from the Streichers Dam, Bottom Dams (overflow in canals) and stormwater from Five Mission Village Dam. It supplies water to Earth Dam. The overflow goes to Five Mission Overflow/Overspill Dam.

3 Five Mission Overflow/Overspill Dam

This dam receives water as overflow from Five Mission Dam. The dam is concrete lined with a surface are of 3 600m², depth of 2.5m, and a capacity of 900 000l.

4 Earth Dam

This dam has a capacity of 21 000m³. It is located immediately south of the Five Missions residential area and is concrete lined. The dam receives water from village and mine stormwater via Five Mission Dam, sewage and PPC effluent, Bonza Quarry (pumped), FRDs 1, 2 & 3 (pumped), and overflow from Top Dams. It supplies water to Top dams and overflow goes to Bonza Quarry and Five Mission Dam.

5 Bonza quarry (dam)

The dam has a capacity of 3 508 000m³. It is partially backfilled and the area to the south and east of the existing quarry consists of backfill material. The dam receives water from PPC, FRDs No. 1, 2, 3 through canals and Infill FRD overflow, Earth Dam overflow, Bottom Dam overflow, rain and seepage. It supplies water to Earth Dam, and Bottom Dam.

6 Top Dams

There are two top dams with a combined capacity of 4 600m³. The dams receive water from Earth Dam (pumped), and SCS/SCMS clarified water tank (pumped). They supply water to D – Thickener, SCS/SCMS clarified water tank, and DMS clarified tank. The overflow goes to Earth Dam, and Bottom Dam.

7 Bottom Dam

There are two dams with a combined capacity of 4 600m³. The dams receive water from Vaal Gamagara No. 1 Incoming line, Vaal Gamagara No. 2 Overflow, Bonza Quarry (Pumped), Top Dams (Gravity flow), Main Rock Shaft (Pumped). They supply water to Raw Water tank, Transfer tank, DMS Clarified Tank, and Ring Main – Fire Hydrants. All overflows go to Five Mission Dam, and Bonza Quarry.

8 SCS/SCMS Clarified Water Tank

This tank receives water from Top dams, A, B, C & D thickeners overflow, and DMS Clarified Water Tank via the Transfer Tank. It supplies water to flushing and hosing water and Top Dams.

9 DMS Clarified Water Tank

This tank receives water from SCS/SCMS clarified water tank, DMS Thickener, and Bottom Dams. It supplies water to DMS, Feed prep, and SCMS clarified water tank.

10 Transfer Water Tank

The tank receives water from Bottom Dam, and DMS clarified water tank. It supplies water to SCS/SCMS clarified water tank

11 DMS Thickener

It receives water from DMS, and dust scrubbers and supplies water to clear overflow to DMS clarified water tank, underflow to wet screens in SCMS, and SCMS thickener feed launder

12 A & B - Thickeners

The thickeners receive water from Degritting section (Cyclone overflow), and A – thickener is a standby for G – thickener. These thickeners supply water to clarified overflow to SCMS clarified tank. The underflow goes to excess sump, and pumped to FRDs.

13 C & D – Thickeners

It receives water from degritting section (Cyclone overflow) and supplies water to clarified overflow to SCMS clarified tank. Underflow goes to Excess sump, and pumped to FRDs.

14 Golf Course Dam

This dam receives water from Bonza Quarry and supplies water to Golf course.

15 Potable Water Dam

This dam receives water from Vaal Gamagara No.2 Incoming line and supplies water to Ring Main.

16 Old FRD Dam

This dam has a capacity of 23 500m^3. It receives water from drainage water from hills south of the mine, and the old FRDs. It supplies water to Bonza quarry.

2.3.2.2.2.3 Potable water circuit

Potable water is supplied from the Vaal - Gamagara Pipeline to the mine and the residential areas in Lime Acres. The Vaal River water is abstracted and purified at the Sedibeng Water's water treatment works near Delportshoop. This treatment plant comprises of a raw water pumping station, purification works and six booster pump stations, as well as the supporting administration, provisioning and maintenance facilities. The scheme is designed to purify and deliver 36 400 m^{3}water per day. Water is pumped from the purification works to the Clifton reservoir, situated on the farm Wildspan, and from there to the various storage reservoirs situated in Lime Acres.

VG water is also piped by the mine to Lime Acres for domestic use. This is subjected to all filtration / tests required by the DWEA.

Potable water is provided to four residential areas (Lime Acres, Norfin, Five Mission Village and Finville) for domestic consumption. This consumption forms the bulk of the utilisation in the potable network, accounting for approximately 53%of all consumption. The consumption in the residential networks are extensively (although not exhaustively) metered. Data from metering points on the Vaal -Gamagara bulk supply network are checked by way of check meters installed by the mine (i.e. the DB metres), thereby ensuring accuracy of the bulk supply data.

Consumption by the mine and outside services accounts for approximately 32%of potable water consumption. This includes all potable water used on the mine, but excludes water used in the plant. As is the case with the residential areas, these flows are also extensively metered. Potable water is supplied to sports and recreational areas for both consumption and irrigation purposes. This consumption accounts for approximately 3% of the total. Potable water is supplied from the Vaal - Gamagara network to numerous off – site areas. This includes water supplied to the TNC operation, the SPCA, RDP Gardens and the Airstrip. This consumption accounts for approximately 1% of the total Vaal - Gamagara potable water consumption.

The following reservoirs and structures all receive potable water from the Vaal-Gamagara pipeline:

1. Bottom potable dam
   This reservoir has a wall height of 2.135m, covers a surface area of 0.0025haand has a capacity to store 37.85m³ of water and is constructed from concrete. It supplies potable water to the stores, security, Plant, Administration building, Change house, Finville and the training centre.

2. Norfin village reservoir
   This reservoir has a wall height of 2m, covers a surface area of 0.0025ha and has a capacity to store 50m³ of water. This reservoir is made from galvanised steel and it supplies Norfin village with potable water.

3. Lime Acres Village reservoir (concrete flask)
   This concrete reservoir has a height of 4m, covers a surface area of0.0176ha and has a capacity to store 600m³ of water. The reservoir supplies the Lime Acres Village with potable water.

4. Five Mission potable water reservoir
   The Five Mission reservoir has a wall height of 2m, covers a surface area of0.002ha and has a capacity to store 40m³ of water. It is constructed from galvanised steel and supplies Five Mission with potable water.

5. Finville potable water tank
This $73m^3$reservoir is 3m high and covers a surface area of 0.0024ha and is situated adjacent to the Single-quarter Complex. It supplies Finville Village and the Single-quarter Complex with potable water. It is constructed from galvanised steel.

6. Potable water tank on top of the Post-1979 CRD resource
This plastic potable water tank supplies potable water for contractors and employees at the Post-1979 CRD. It is 2m high, covers a surface area of 0.00001ha and can store $2.5m^3$ of water.

7. Brits Game Farm potable water tank
This tank covers a surface area of 0.0003ha, has a capacity to store $6m^3$of water and has a height of 2m. It is made of galvanised steel and supplies water to the water troughs on the Brits game farm.

8. Bonza Game Farm potable water tank
The abstracted groundwater (refer to paragraph 2.3.2.2.1.2 of section 1 (EIA)) is stored in the Bonza Game Farm potable water tank and is utilised for the watering of game as well as for domestic purpose sat the Game Farm. This tank covers a surface area of 0.006ha and has a capacity to store $217m^3$ of water. This galvanised steel tank has a height of3.6m.

9. Brits FRD stormwater dam
This dam was excavated to the north of the new Brits FRD facility. The capacity of this stormwater dam is180 $000m^3$, which is sufficient to accommodate runoff generated from the clean surface runoff to the north and northwest of the new FRD in a 50-year rainfall event. The dam covers a surface area of 15ha and a depth of 1.8m. During extended periods of high rainfall, the capacity of the dam will be exceeded and the excess water will be accommodated by a berm that will be constructed between the stormwater dam and the northern wall of the FRD. This will add a further 120 $000m^3$ capacity to the dam. Runoff in excess of this will back up against the northern wall of the FRD, and extend towards and into the pan located north of the FRD. The stormwater dam's capacity will thus only be exceeded during events greater than a 100-year design storm.

2.3.2.2.3 Domestic wastewater

2.3.2.2.3.1 Domestic wastewater care works

The mine is responsible for the management of the Lime Acres Domestic Wastewater Care Works, which is a joint facility for the residents of Lime Acres. The sewerage plant operation process is operated and is regularly monitored by a registered consultancy firm. The dried sewage sludge is disposed of through a controlled composting programme. The final compost product is used as a top dressing material for WRD rehabilitation purposes. The Environmental Management Section and Outside Services are responsible for the composting program.

The domestic wastewater care works treats a capacity of 1 620m³ per day serving both the mine and the village. At the moment the plant processes only 850m³ sewage water per day.

The domestic wastewater care works consists of three fermentation dams where the effluent undergoes a series of natural fermentation processes in order to decompose the solid component of the sewage. Incoming sewage are sieved in order to remove inorganic substances such as plastic bags, pieces of metal and cotton wool. These are then dried and incinerated.

The process is mostly anaerobic with aeration only at the end of the process to re-introduce oxygen. The effluent is then exposed to a natural settling out process in the settling tank. The clarified water is siphoned off and chlorinated before it is then pumped to the Earth Dam.

The remaining sludge is then pumped on to drying beds and left to dry naturally. Once completely dry it is loaded, transported and stockpiled in a fenced holding area next to the old slimes paddock. From here it is used in the rehabilitation of the CRDs and FRD walls.

2.3.2.2.3.2 Septic tanks and conservancy tanks

Various facilities are not linked to the Sewage Plant but are equipped with septic and conservancy tanks. The tanks are not located close to any groundwater supply boreholes and since the unsaturated zone is more than 20m in depth the movement of the effluent through the unsaturated zone will remove any contaminants by natural processes. These tanks operate under an existing lawful use.

Table 45: Location and volumes of septic tanks

SEPTIC TANK LOCATION	SIZE (m³)	NUMBER OF TIMES EMPTIED PER YEAR	ANNUAL DISPOSAL (m³)
Diggers	13000	4	52000
Pony club	6500	1	6500
Gun club	6500	1	6500
Bonza	13000	1	13000
Golf Club	9000	1	9000
LA Gym	6500	1	6500
Training Centre	1300	2	2600
Caravan Park	9000	2	18000
Air Strip	9000	2	18000
Norfin Contractors	9000	2	18000
Taxi rank	1000	2	2000
TOTAL	83800		152100

2.3.2.2.3.3 French drains

French drain systems are located at the following places:

- Brits Farm;
- Bonza Farm;
- ECMP Office;
- Post-1979 CRD;
- Gun Club; and
- The SPCA.

2.3.2.2.3.4 Waterless toilet systems

In a continuing effort to improve water management and to attain more environmentally friendly systems, a dry type toilet has been installed at the WAMY.

2.3.2.2.4 Stormwater management

A clean-dirty water separation trench is constructed to the west of the Brits FRD and a stormwater dam to the north of the north wall. Runoff from West sub-catchment will flow towards the FRD, and a stormwater diversion canal is constructed to divert this runoff around the FRD. The FRD stormwater system has been designed to temporarily accommodate stormwater on the FRD, subject to certain pool restrictions. Water is pumped from the barge to the return water dam, after which it is then pumped into Top Dam. Three sub-catchments drain towards the FRD:

- The West sub-catchment, draining in an easterly directory towards the FRD;
- The North sub-catchment, draining in a southerly direction, towards the FRD; and
- A portion of the existing WRD drains in a westerly direction towards the FRD.

1 North sub-catchment

Stormwater generated from the 7.5km² catchment is intercepted by a 220 000m³ borrow pit, located to the north of the northern wall of the FRD. This borrow pit has sufficient capacity to contain stormwater from a 50-year rainfall event. The full height of the northern wall of the FRD has also been designed to accommodate water. This additional storage increases the storage capacity to the north of the FRD to more than 2,000,000m³. This is sufficient to accommodate runoff from a RMF rainfall event. Water that is captured by this borrow pit infiltrates and evaporates. This water may also be harvested and used in the process circuit. This is preferable, as the mine will be able to reduce its raw water intake.

2 West sub-catchment

The catchment to the west of the FRD measures 2.3km². The catchment is relatively steep compared to the surrounding areas with average gradients of around 6%. Runoff from this catchment flows towards the FRD. A stormwater diversion canal is constructed to divert this runoff past the FRD. Two diversion canals flow adjacent to the western edge of the 2022 footprint of the

FRD. The one canal flows in a southerly direction and discharge downstream of the FRD, the topsoil stockpile, and the seepage cut-off drain. The second canal flows in a northerly direction and discharge to the north of the FRD into the borrow pit.

3 WRD

A stormwater management plan for the WRD has already been designed by Eko Rehab (Eko Rehab, 2001). The plan has been designed to route stormwater on the top of the WRD in a southerly direction. The top of the WRD is drained by a grassed waterway located at the southern end of the WRD. Two gabion waterways are designed to route water from the western sides of the WRD down to the natural drainage path at the foot of the WRD. The northern gabion waterway is to the south of the footprint of the proposed FRD. The catchment reporting to this waterway is covered by the new FRD. Berms have been constructed around the western perimeter of the WRD. These berms prevent runoff from the top of the WRD from flowing down the sides of the WRD.

2.3.2.2.5 Water balance

The latest documented water balance was the one compiled by REDCO 2010 as an addendum to the IWWMP. There is a proposal from SRK to complete a comprehensive water balance for Finsch in the new financial year (August 2014). Refer to Addendum 4B for the water balance.

2.3.2.3 Transport and conveyance

Ore produced underground is transported by the rock hoist to surface and is tipped directly into a surge bin at the shaft.

The mine is traversed with cement, gravel and dirt roads. Most of the roads on the site are cement surfaced. Unpaved, dirt roads include the section of road from the main shaft to the shaft electrical workshop up to the Jaw Crusher, and the Pre-1979 CRD roads. The roads used to reach the Pre-1979 CRD are gravel roads.

The mine is served by a private airstrip, shared by the mine and PPC Lime Acres, located 1km to the northwest of the mine. The facility is managed by the mine, while the land belongs to PPC. There is also a helipad on site used for the collection of product. This is situated at the recovery section of the plant.

2.3.2.4 Energy supply

The mine is served by the Eskom power grid.

2.3.2.5 Chemical and hazardous substances facilities

The following chemical and hazardous facilities occur underground:

- Old oil disposal system at the surface large earthmoving workshop. This oil is collected by a registered old oil collection facility;
- Hazardous and non-hazardous storage areas;
- Diesel stores;
- Oil stores; and
- Explosives storage facilities.

The following chemical and hazardous facilities occur above ground:

- Material stores with hazardous substances;
- Bulk oil and diesel storage at the decline
- Fuel tanks of 180 000l at decline;
- Fire extinguishers in headgear;
- TCE solvent for bonding of hot splicing conveyor belts;
- Weightometers- nuclear;
- Measuring flasks on skips – nuclear;
- At recovery hazardous chemical stores; and
- Oil and paint storage.

2.3.2.6 Maintenance facilities

The following maintenance facilities occur underground:

- Large earthmoving workshop;
- Wash bays;
- Tyre bay;
- Auto electrical workshops;
- Contractors' workshops; and
- Batching plant - Raw materials for cement production transfer and storage for underground mixing is stored at the batch plant. The batch plant services x2 shafts. Deliveries generally arrive by 30t trucks with approximately 3 truck loads per day expected during peak periods. This area is only in use when underground construction works are taking place

The following maintenance facilities occur above ground:

- Boiler shops
- Electrical shops
- Earth moving workshops
- Carpenter workshops
- Lubrication rooms
- Wash bays

- Lube bay. The lube bay at the Mechanical Surface Workshop consists of a pumping mechanism inside the lube bay that transfers used oil from drums into the two 2000 litre storage tanks situated in the lubricant storage yard.

2.3.2.7 Administration and other buildings

Buildings at the mine include:

- Administration buildings
- Training centre
- Production offices
- Human resources offices
- Projects offices
- Geology offices
- Control room – CCR
- Change houses

2.3.2.8 Housing, recreation and other employee facilities

According to the social and labour plan (SLP) of 2011, the mine has 1193 housing units allocated for mine employees. Employee facilities include a Finsch Resource Learning Centre with internet access and accredited computer based training for community, youth and employees. An Internet Café opened in December 2011.

2.3.2.9 Support services contractors

The following is a list of contractors on the mine.

- 40 Shore
- AEL Explosives
- Benleg
- Crane Aide
- D&L Maintenance
- Drill Corp
- Dolerite
- ESS
- Event Spec
- GHN Construction
- Group T
- Jim-Ka's Tuckshop
- Johal Transformers
- Jonric
- Katleho Solutions

- Kevkor
- Lenfield
- Master Drilling
- Leslie's Plumbers
- Max T Solutions
- MSD Mining
- Multotec
- Moeng Maintenance
- M&R Cementation
- Noble Switchgear
- Oss Bottles
- PA Building
- PA Walter Africa
- Profmaki
- Rema Tip Top
- Sandvik
- Securisolve
- Somca
- Steelmaster
- Steffanutti Stocks
- Unity Events
- Wilmar

2.4 Plan showing the location and aerial extent of the aforesaid main mining actions, activities, or processes as required to calculate the financial provision

Refer to Addendum 2B for the site layout plan.

2.5 Listed activities (in terms of the NEMA EIA Regulations) which will be occurring within the proposed project

An EIA was conducted for the construction of a new FRD. This EIA was prepared by Golder Associates and completes in 2006. The new FRD was constructed after the EIA approval.

An EIA was conducted for the destruction and relocation of the explosive magazine. This EIA was prepared by Shangoni Management Services and completed in 2008. It was afterwards decided not to decommission and relocate the old explosives magazine.

Proposed new activities that may require an EIA under the National Environmental Management Act, (Act 107of 1998) NEMA EIA regulations are as follow:

- The extension of the CRD deposition area – 2010 to 2016;
- The new treatment plant for treatment of the red dumps –ongoing;
- Recommissioning of the old FRDs and infill dam – end of 2014;
- Construction of accommodation for the contractors - ongoing;
- Replacement of potable water pipelines – until end 2014; and
- Upgrade of the aircraft runway.

2.6 Indication of the phases and estimated time frames in relation to the implementation of these actions, activities or processes and infrastructure

The current LoM is 2028. Below is Figure 12 which indicates the phases and estimated timeframes of the mine with the inclusion of Block 5 activities.

The pre-1979 CRD re-mining will take place 2014 and 2015. The post-1979 CRD treatment plan will take place 2016 to 2021. The re-commissioning of the old FRDs (FRD 1, 2 and 3 and infill dam) is planned for 2013. CRD extension is planned for 2013. Plant simplification and improvement projects will take place up to 2014.

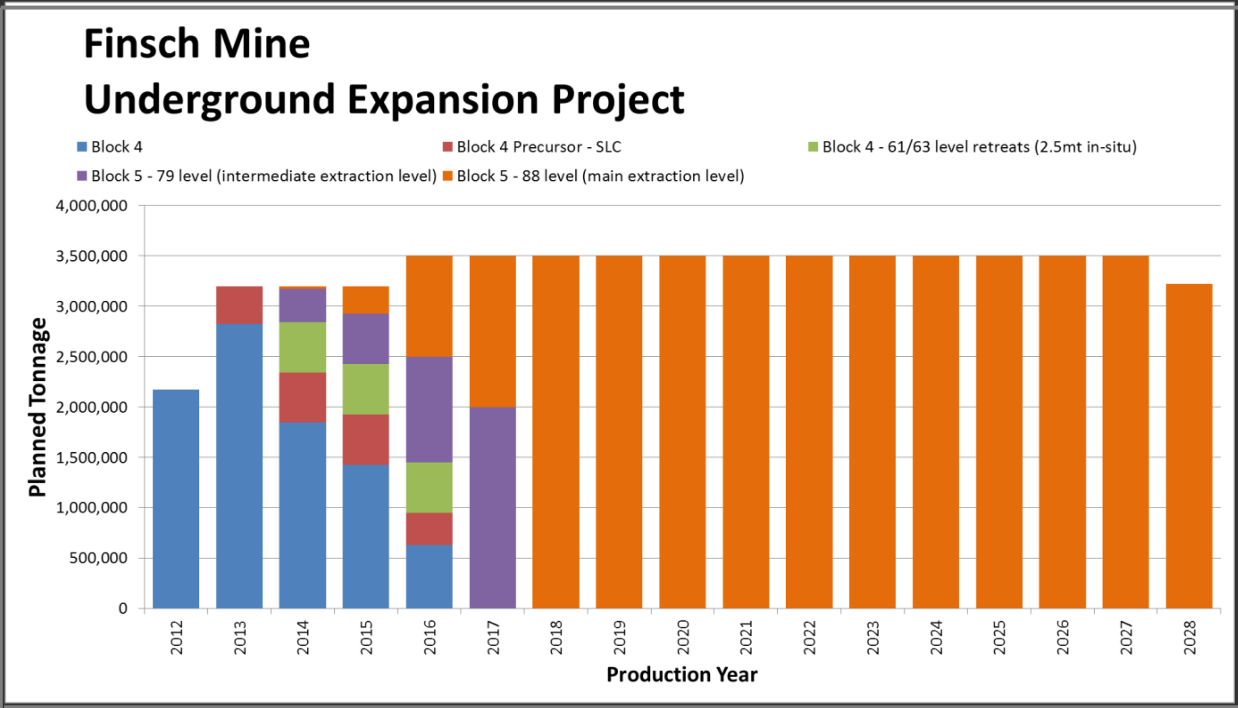

Figure 12: Phases and estimated timeframes with the inclusion of Block 5 activities

2.7 Confirmation if any other relevant information is attached as appendices

Refer to addendum 3 (specialist studies) for all specialist studies attached to this EMP. The measures contained in the specialist reports are only recommendations which have been incorporated into this EMP.

3 The Potential Impacts

3.1 List of the potential impacts, on environmental aspects separately in respect of each of the aforesaid main mining actions, activities, processes, and activities

3.1.1 Construction phase

Mining production commenced in 1967. The construction of the Brits FRD was completed in 2007 and the facility was commissioned in 2008. The economic LoM under the curatorship of De Beers was planned until 2014, but with the sale to Petra Diamonds on 14 September 2011 the LoM planning was extended by approximately another 20 years. In the case of any other activity taking place that requires an EIA, an impact assessment screening process will be followed.

3.1.2 Operational phase

The operational phase is divided into four sections. These sections are mining activities, ore processing activities, support services and general. Each section is divided into the different activities that currently take place as part of the operational phase. Please note, all impacts related to waste for all sections, transport and hazardous substances will be dealt with under the support services section.

3.1.2.1 Mining activities

Refer to paragraph 7.1.2.1 of section 1 (EIA) for the complete impact and aspect register.

3.1.2.2 Ore processing activities

Refer to paragraph 7.1.2.2 of section 1 (EIA) for the complete impact and aspect register.

3.1.2.3 Support services

Refer to paragraph 7.1.2.3 of section 1 (EIA) for the complete impact and aspect register.

3.1.3 Decommissioning phase

Refer to paragraph 7.1.3 of section 1 (EIA) for the complete impact and aspect register.

3.2. List of all potential cumulative environmental impacts

Refer to Table 40 for the potential cumulative environmental impacts. The mine is in close proximity to the PPC Lime mine and the Lime Acres residential area.

Table 46: Potential cumulative environmental impacts

ASPECT	IMPACT DESCRIPTION
Dust generation from Surface and Underground mining	Air pollution.

ASPECT	IMPACT DESCRIPTION
operations, transportation, etc. Neighbouring PPC Lime operations also generates a significant amount of dust.	Nuisance / health risk to community and neighbouring residents.
Dewatering of the Underground mining operations Dewatering takes place at both at Finsch mine and PPC Lime mine.	Reduction of the groundwater resource
Reduction in groundwater quality. Groundwater quality is impacted by kimberlite residue facilities.	Surface water and groundwater pollution
	Disturbance to aquatic vegetation and animal life due to polluted water.
Invader plants establishing on disturbed areas	Disturbance and destruction of biodiversity
Change in topography due to MRDs and mine infrastructure	Visual impact
The mining activities lead to the loss of soil and surface biodiversity.	Reduction in land capability.

3.3 State specifically whether or not there is a risk of acid mine drainage or potential groundwater contamination associated with the mineral to be mined

Kimberlite MRD facilities produce a saline leachate which includes raised levels of sulphates. (National Drinking Water Standard, SANS 241:,2:2011). No acid mine drainage (AMD) is produced due to the large neutralising potential of carbonates present in the geochemistry of the kimberlite, (Pulles, W. 2005). The pH of the process water and leachates ranges from 7.7 – 8.5

Regulation 50 (b)

4 The alternative land use or developments that may be affected

4.1 Concise description of the alternative land use of the area in which the mine is proposed to operate

Full mining production commenced in 1967. Most of the mining activity at the mine today takes place on the original Brits Farm. The farm does not have water, and was therefore not suitable for agriculture, apart from some grazing for cattle.

4.2 List and description of all the main features and infrastructure related to the alternative land uses or developments

There are no features or infrastructures related to alternative land uses or developments. Refer to paragraph 4.1 of section 1 (EIA) above.

4.3 Plan showing the location and aerial extent of the aforesaid main features of the alternative land use and infrastructure related to alternative land developments identified during scoping

There are no features or infrastructures related to alternative land uses or developments; therefore there is no plan. Refer to paragraph 4.1 of section 1 (EIA) above.

5 The Potential Impacts of the Alternative Land Use or Development

5.1 List of the potential impacts of each of the aforesaid main features and infrastructure related to the alternative land use or development and related listed activities

Due to the fact that full mining commenced in 1967, there will be no alternative land uses or developments. Therefore, there are no potential impacts for alternative land uses or developments.

5.2 Description of all potential cumulative impacts of the main features and infrastructure related to the identified alternative land uses or developments

Due to the fact that full mining commenced in 1967, there will be no alternative land uses or developments. Therefore, there are no potential cumulative impacts for alternative land uses or developments.

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Regulation 50 (c)

6 Identification of potential social and cultural impacts

6.1 List of potential impacts of the proposed mining operation on the socio-economic conditions of other parties' land use activities

6.1.1 Construction phase

Mining production commenced in 1967. The construction of the Brits FRD was completed in 2007 and the facility was commissioned in 2008. The economic LoM under the curatorship of De Beers was planned until 2014, but with the sale to Petra Diamonds on 14 September 2011 the LoM planning was extended by approximately another 20 years. In the case of any other activity taking place that requires an EIA, an impact assessment screening process will be followed.

6.1.2 Operational phase

The operational phase is divided into four sections. These sections are mining activities, ore processing activities, support services and general. Each section is divided into the different activities that currently take place as part of the operational phase. Please note, all impacts related to waste for all sections, transport and hazardous substances will be dealt with under the support services section.

6.1.2.1 Mining activities

Refer to paragraph 7.1.2.1 of section 1 (EIA) for the complete impact and aspect register.

6.1.2.2 Ore processing activities

Refer to paragraph 7.1.2.2 of section 1 (EIA) for the complete impact and aspect register.

6.1.2.3 Support services

Refer to paragraph 7.1.2.3 of section 1 (EIA) for the complete impact and aspect register.

6.1.3 Decommissioning phase

Refer to paragraph 7.1.3 of section 1 (EIA) for the complete impact and aspect register.

6.2 Description of the cultural aspect that will potentially be affected, and describe the potential impact on such cultural aspect

Refer to paragraph 7.1 of section 1 (EIA) for the complete impact and aspect register.

6.3 Description of heritage features and the potential impact on such heritage feature

Refer to paragraph 7.1 of section 1 (EIA) for the complete impact and aspect register.

6.4 Quantification of the impact on the socio-economic conditions of directly affected persons, as determined by the findings and recommendations of a specialist report in that regard

6.4.1 The amount of the quantified potential impact on property or infrastructural assets

There is no potential negative impact on property of infrastructural assets. For the years 2008 to 2012 an amount of R5, 156,000-00 was spent to improve the infrastructure of the area.

6.4.2 State the amount of the quantified potential impact on commercial, economic or business activity which will be impacted upon as a result of the mining activity

For the year 2008 to 2012 an amount of R2, 194,000-00was to be spent on community upliftment and R7, 974,000-00 on poverty eradication.

6.4.3 The sum of the amounts, referred to in paragraphs 6.6.1 and 6.6.2 above

Below is a table to summarise the above.

Table 47: Sum of amounts for Social and Labour plan

LED Elements	2008	2009	2010	2011	2012	Total
Community Upliftment	15,600	230,000	386,200	945,500	616,700	2,194,000
Poverty Eradication	290219.3	277,280.70	2,900,000	2,800,000	1,706,500	7,974,000
Infrastructure	0	1,287,116	2,104,518	1,764,366	0	5,156,000
TOTAL	**305,819**	**1,794,396**	**5,390,718**	**5,509,866**	**2,323,200**	**15,324,000**

7 Assessment and evaluation of potential impacts

7.1 List of each potential impact identified in paragraphs 3 and 6 above

7.1.1 Construction phase

Mining production commenced in 1967. The construction of the Brits FRD was completed in 2007 and the facility was commissioned in 2008. The economic LoM under the curatorship of De Beers was planned until 2014, but with the sale to Petra Diamonds on 14 September 2011 the LoM planning was extended by approximately another 20 years. In the case of any other activity taking place that requires an EIA, an impact assessment screening process will be followed.

7.1.2 Operational phase

The operational phase is divided into four sections. These sections are mining activities, ore processing activities, support services and general. Each section is divided into the different activities that currently take place as part of the operational phase. Please note, all impacts related to waste for all sections, transport and hazardous substances will be dealt with under the support services section.

7.1.2.1 Mining activities

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
Underground mining	Underground mining operations	Depletion of the ore body and a certain amount of country rock.	Loss of geological structures	Definite	Immediate	Low
			Geological instability	Possible	Immediate	High
	Use and storage of explosives	Incorrect maintenance and operations of explosive storage areas	Pollution of surface and groundwater	Possible	Site	Moderate
	Project development of underground infrastructure: Tunnel support: Batching Plant operations	Incorrect handling, storage or use can cause spillages of cement, additives, & other hazardous materials, blocked water drains	Pollution of the underground water	Possible	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Underground dewatering: Dewatering of the mine takes place in order to remove groundwater from the workings so that mining may take place.	Groundwater dewatering	Possible subsidence of ground, and alteration of the natural topography.	Possible	Local	High
			Depletion of the groundwater resource.	Possible	Local	Moderate
	Underground dewatering. Groundwater users are neighbouring farmers and PPC Lime Quarry operations. The PPC Quarries and Finsch mining operations are likely to be hydraulically connected	The inflow of surface water during rainfall events into the Open Pit D.	Loss of surface water resource. No adjacent community is likely to be adversely influenced by this loss of surface water	Possible	Local	Moderate
		The dewatering of the mine has resulted in the development of a cone of depression around the open pit.	Potential increase in the flow of seepage contaminated water from Brits FRD towards the open pit.	Probable	Local	Moderate
			The potential increase of water in the workings and potential increase in the risk of a mud push and / or mud rush	Possible	Immediate	High
			Potential loss of groundwater resource by neighbours	Probable	Local	High
	Mining engineering; infrastructure operations; Headgear; Mechanical & electrical workshops operations: the use and maintenance of transformers, gearboxes & motors, winder drum, hydraulic power pack filters, fans, and winches	Spillages and leakages of hydrocarbons. Use of hazardous chemicals (solvents, paints)	Soil pollution.	Possible	Immediate	Moderate
			Groundwater pollution	Possible	Local	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Energy supplies for mining. Finsch uses a significant amount of purchased Eskom generated electricity	Use of purchased electricity	150,000 tons of CO_2 per annum contributing to climate change	Probable	National	Moderate
		Use of fossil fuels	Loss of fossil fuel resources	Probable	National	Moderate
	Bulk fuel & lubricant storage, dispensing & reticulation; Pollution prevention controls (bund walls, fuel dispensing shut off valves at refuelling Bays 62 /63 L; Diesel delivery shut off controls on surface; Oily water separator maintenance; Old oil reticulation system operations; Oily water separator operations	Failure of pollution control systems due to inadequate maintenance	Water pollution	Possible	Local	High
			Fire risk	Possible	Immediate	High
	Main shafts and headgear. This includes	The constructed mine shaft and head gear changes the topography of the landscape.	Visual impact.	Definite	Local	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	transformers, a diesel generator, gearboxes & motors, winder drum and ropes, hydraulic power pack ,braking system, filters, fans, and winches, fire suppression systems, workshop activities, weightometers containing nuclear materials, cage operations	Spillages and leakages of hydrocarbons from equipment in the Headgear.	Groundwater pollution.	Possible	Local	Moderate
	Underground Water Reticulation; Water treatment & flocculation 68 L (Chlorine); Water Recovery; Water & Mud pumping to Surface 70 L	Inadequate treatment of water	Pollution of water with *E coli*	Possible	Immediate	High
		Potential failure of pumps	Flooding of the mine	Possible	Immediate	High
		Use of chlorine mixes with hydrocarbons in the water to form organo chlorine which is a toxic substance	Potential pollution of water at the Settlers with organochlorine	Possible	Local	High
	Operation of ventilation shafts and passes	PM, SO_2, NO_2 and CO, released from shaft vents primarily as a result of blasting and drilling operations, and diesel powered vehicles working underground.	Air pollution	Probable	Local	Moderate
			Damage to vegetation: PM can clog stomatal openings of plants and interfere with photosynthesis functions and may lead to growth stunting or mortality in some plant species.	Possible	Local	Moderate
		Generation of noise from ventilation fans	Noise pollution	Definite	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Underground mining operations	Underground mining result in PM, SO_2, NO_2 and CO_2, CO released from shaft vents primarily as a result of blasting and drilling operations, and diesel powered vehicles working underground.	Health hazard: PM inhalation causes respiratory problems. SO_2 inhalation can cause respiratory difficulties and disease. NO_2 inhalation may cause severe irritation and burns of eyes, skin, mucous membranes, and any other exposed tissue as well as breathing difficulties. Over exposure to CO may cause damage to target organs.	Probable	Local	High
		Noise is generated from operating fans and drill rigs.	Nuisance to workers and community	Definite	Site	Moderate
		The formation of a mud push or mud rush at the draw point from the breakdown of kimberlite and shale in the presence of water.	Safety hazard to workers	Possible	Immediate	High
		Radiation exposure may occur due to the use of nuclear sources such as weightometers and measuring flasks on skips.	Health hazard to workers	Possible	Immediate	High
	Underground dewatering: Dewatering of the mine takes place in order to remove groundwater from the workings so that mining may take place.	Groundwater dewatering	Safety hazard to employees and nearby community	Probable	Local	High

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Underground dewatering. Groundwater users are neighbouring farmers and PPC Lime Quarry operations. The PPC Quarries and Finsch mining operations are likely to be hydraulically connected	The dewatering of the mine has resulted in the development of a cone of depression around the open pit.	Potential safety risk	Possible	Local	High
	Mining engineering; infrastructure operations; Headgear; Mechanical & electrical workshops operations: the use and maintenance of transformers, gearboxes & motors, winder drum, hydraulic power pack filters, fans, and winches	Spillages and leakages of hydrocarbons. Use of hazardous chemicals (solvents, paints)	Health risk	Possible	Local	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Bulk fuel & lubricant storage, dispensing & reticulation; Pollution prevention controls (bund walls, fuel dispensing shut off valves at refuelling Bays 62 /63 L; Diesel delivery shut off controls on surface; Oily water separator maintenance; Old oil reticulation system operations; Oily water separator operations	Failure of pollution control systems due to inadequate maintenance	Health risk	Possible	Local	High
	Main shafts and headgear. This includes transformers, a diesel generator, gearboxes & motors, winder drum and ropes, hydraulic power pack ,braking system, filters, fans, and winches, fire suppression systems, workshop activities, weightometers containing nuclear materials, cage operations	Generation of electromagnetic radiation; Generation of ionising radiation	Potential health risk to workers	Possible	Immediate	High

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Use and storage of explosives	Blasting	Structural damage due to blasting	Possible	Immediate	High
		Use and storage of explosives	Theft of explosives	Low	Local	High
Reprocessing of mine residue	Reprocessing activities of Pre-1979 CRD – Wet Infield Screening (WIFS) Operations. Loading and hauling. The proposed re-mining of Red Dumps and Post 80 CRD	Change in topography	Visual impact	Definite	Local	Moderate
		Surface water run-off from the new face of the re-mined residue, may lead to siltation of drainage channels down slope from the residue.	Siltation and pollution of surface water	Possible	Local	Moderate
		Siltation of drainage channels resulting in siltation of the storage dams limiting the storage capacity, causing overflow.	Loss of water resource from the water reticulation circuit	Possible	Local	Moderate
		Dust generation during the loading and hauling of pre 79 tailings	Air pollution creating a potential impact for human health	Possible	Site	Moderate
			Air pollution creating a potential ecological impact	Possible	Site	Moderate
		Leakages or spillages may occur from earthmoving and construction vehicles and machinery used for the re-mining of the residue.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		Generation of noise from tramming	Noise pollution	Definite	Site	Moderate
	WIFS operations	Noise is generated from the WIFS operations of the residue.	Nuisance to workers and community	Probable	Local	Low
		The tramming &loading of the residues on top of the facility may result in residue instability.	Safety hazard	Low	Site	High
Magazine Operations	Storage and transport of explosives. Explosives are stored in the various bunkers at the magazines. Maintenance of the area is carried out according to the Explosives and Hazardous Materials Regulations	Fire may occur at the magazines. Inadequate clearing of vegetation, inadequate maintenance of lightning conductors	Loss of biodiversity	Low	Site	Moderate
			Potential air pollution	Low	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Storage and transport of explosives. Explosives are stored in the various bunkers at the magazines. Maintenance of the area is carried out according to the Explosives and Hazardous Materials Regulations	Inadequate maintenance of magazines and possible spillage of Anfex may occur. Anfex can cause skin and eye irritation and respiratory problems if inhaled. Anfex can lead to eutrophication (nutrient enrichment) of water bodies.	Health and safety hazard to workers	Low	Immediate	High
	Storage and transport of explosives. Explosives are stored in the various bunkers at the magazines. Maintenance of the area is carried out according to the Explosives and Hazardous Materials Regulations	Fire may occur at the magazines. This hazard is increased if regular clearing of vegetation and maintenance of lightning conductors are not done. This risk is further increased if fire extinguishers are not adequate or maintained and if training of personnel is not adequate or up to date.	Safety hazard to the workers	Low	Immediate	High
	Storage and transport of explosives. Explosives are stored in the various bunkers at the magazines. Maintenance of the area is carried out according to the Explosives and Hazardous Materials Regulations	Fire may occur at the magazines. Inadequate clearing of vegetation, inadequate maintenance of lightning conductors	Safety hazard to the workers	Low	Immediate	High

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
Open Pit	The Open pit has an area of approximately 55ha. The pit bottom is lowered as the underground mining continues. Water is diverted away from the perimeter of the pit by cut off trenches and water on the benches is diverted to dams which are pumped out to surface	The pit perimeter will break back over time until it is stable	Risk of damage to infrastructure if the mine is operational	Probable	Immediate	High
			Mine closure risk	Probable	Immediate	High
		The inflow of surface water during rainfall events into the open pit occurs.	Loss of surface water resource.	Possible	Local	Moderate
	The Open pit has an area of approximately 55ha. The pit bottom is lowered as the underground mining continues. Water is diverted away from the perimeter of the pit by cut off trenches and water on the benches is diverted to dams which are pumped out to surface	The pit perimeter will break back over time until it is stable	Safety risk to workers of pit perimeter break-back affecting infrastructure. Loss of in-pit storm-capture dams and safety of people and equipment.	Probable	Immediate	High

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
Mine Residue Deposits Waste Rock Dumps (WRD)	Constructed WRDs. The WRDs are mainly made up of coarse dolomite, dolerite and some banded ironstone which reflects the geology of the surrounding area. The stormwater is channelled into the natural environment. All the WRDs are rehabilitated and top-dressed with a finer banded ironstone material and over seeded.	Change in surface water yield. Stormwater will only flow off the dumps in severe rainstorm events, which happen infrequently due the arid climate. Infiltration rates are high due to the coarse nature of the material of the rock dumps.	Loss of surface water resource.	Possible	Local	Moderate
		Leaching of pollutants from WRDs.	Potential pollution of groundwater	Definite	Local	Low
	Concurrent rehabilitation of WRD The open pit WRD	The rehabilitation trials of WRDs using composted garden waste, wood chippings and sewage sludge.	Improves the physical properties and fertility of soil.	Definite	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	contains Asbestos fibres which occur naturally in the banded ironstone geology. This material has been disturbed with the opening of the pit. • Use of compost • Use of topsoil as a topdressing material for areas undergoing rehabilitation	Use of topsoil taken from undisturbed areas containing a seed bank of indigenous flora provides a growth medium for indigenous plant species	Increase in biodiversity with the establishment of indigenous vegetation	Definite	Site	Moderate
	Constructed WRDs. The WRDs are mainly made up of coarse dolomite, dolerite and some banded ironstone which reflects the geology of the surrounding area. The stormwater is channelled into the natural environment. All the WRDs are rehabilitated and top-dressed with a finer banded ironstone material and over seeded.	Asbestos is locally present in the surrounding banded ironstone geology, and some of the WRDs contain natural asbestos rock	Health hazard to workers	Probable	Site	High

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Concurrent rehabilitation of • The open pit WRD contains Asbestos fibres which occur naturally in the banded ironstone geology. This material has been disturbed with the opening of the pit. • Use of compost • Use of topsoil as a topdressing material for areas undergoing rehabilitation	Disturbance of the rehabilitated areas	Health hazard to people who may work in the area	Probable	Site	High

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
Mine Residue - Coarse Residue (CRD) and Fine Residue (FRD) Deposition	Deposition of Coarse Residues using conveyors and spreaders	Establishment of invader plant species	Invasive plant might be established. This may lead to: • Displacement of indigenous vegetation. • Change in plant species composition. • Change in vegetation composition and structure. • Competition for sunlight and 'living space' will increase between indigenous and alien species. • Competition for water and minerals between alien and indigenous vegetation. • Change in plant-pollinator composition. • Loss of habitat • Change in flammability of existing vegetation structure – pending the introduction of the alien species. • The spread of alien vegetation in areas previously free from such species causing a change in biodiversity.	Probable	Site	Moderate

7.1.2.2 Ore processing activities

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
Ore and CRD processing	Constructed plant and associated infrastructure	The plant and associated infrastructure has changed the local topography.	Visual impact	Definite	Local	Low
		Soil has been removed due to the footprint of the plant.	Loss of soil	Definite	Site	Moderate
			Loss of land capability	Definite	Site	Moderate
			Loss of biodiversity	Definite	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Crushing, screening and milling of kimberlite ore and country rock.	Dust fallout and inhalable PM emissions are generated at the Buffer Stockpile, on tramming routes and from dry ground ore spillages.	Air pollution	Probable	Local	Moderate
	Process water storage and activities	Spillages of contaminated process water outside of the closed reticulation system at. The G-thickener and C-thickener both have EC, Cl, Na, SO_4, Mn, S solids, Se, above the acceptable Drinking Water Standard (SANS 2011);	Surface water pollution	Possible	Local	High
			Groundwater pollution	Possible	Local	High
		Inadequate process water recovery within the water reticulation system for reuse from.	Loss of a water resources	Possible	Local	High
	Process water storage and activities	The ineffective maintenance of slurry transfer pumps and sumps or overflow due to inadequate operational controls of the water reticulation system and poor design of the water containment facilities leads to a depletion of the VG pipeline water resource.	Loss of surface water resource	Possible	Local	High
	Storage of FeSi	The incorrect storage or handling of FeSi may lead to the siltation of surface run-off, which in turn may lead to the siltation of drainage channels and waterways downslope of the plant.	Loss of water resources	Possible	Local	High
			Water pollution	Possible	Local	Moderate
	Plant operations	Siltation of drainage channels.	Siltation of surface water and additional water resources	Possible	Local	Moderate
	Plant operations	Hydrocarbon spillages due to lack of adequate maintenance of crushing and screening equipment, HPRC X, and other ore processing equipment and during maintenance of this equipment.	Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		The non-availability of material safety data sheets (MSDSs) and inadequate training of	Soil pollution	Possible	Immediate	Moderate
			Surface water pollution	Possible	Local	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
		personnel may further increase the risk of spillages and leakages of hazardous substances.	Groundwater pollution	Possible	Local	Moderate
	Dust plants	Dust emissions occur at some of the dust plant as well as transfer points on conveyor systems (transfer houses). Inadequate design and maintenance of dust plant leads to dust generation.	Air pollution	Probable	Local	Moderate
	Constructed plant and associated infrastructure	Generation of noise at the processing plant. Boundary surveys are done. The noise from the plant is audible from the villages	Nuisance to workers and community	Definite	Site	Moderate
		Spillage of Sodium Nitrite, Flocculant or screen cleaning acids due to incorrect storage or handling.	Safety hazard to workers	Possible	Local	High
			Pollution of the water and potentially the surrounding environment	Possible	Local	Moderate
	Crushing, screening and milling of kimberlite ore and country rock.	Dust fallout and inhalable PM emissions are generated at the Buffer Stockpile, on tramming routes and from dry ground ore spillages.	Health hazard	Definite	Site	Moderate
FRDs	Construction and operation of the Brits FRD; Two non-perennial pans were located within the footprint of the Brits FRD. These non perennial water bodies were lost after 2006 once the construction of the FRD commenced. The two non-perennial water bodies were located at the	The Brits FRDs leads to a change in the topography. The Brits FRD walls rise marginally above the surrounding ridgeline in a small section to the north and blend in with the existing WRD.	Visual impact	Definite	Site	Moderate
		Seepage water accumulation behind the north and southern dam walls	Loss of pans (sensitive landscape)	Definite	Site	High
			Pollution of surface water	Probable	Local	High

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	northern (northern pan) and southern (southern pan) ends of the FRD.		Potential pollution of groundwater	Probable	Local	High
	Construction and operation of the Brits FRD; Two non-perennial pans were located within the footprint of the Brits FRD. These non perennial water bodies were lost after 2006 once the construction of the FRD commenced. The two non-perennial water bodies were located at the northern (northern pan) and southern (southern pan) ends of the FRD.	Seepage water accumulation behind the north and southern dam walls	Loss of biodiversity	Probable	Local	Moderate
		The destruction of the pans has lead to a loss of aquatic habitats.	Disturbance of aquatic vegetation and animal life	Probable	Local	Moderate
		Fine residue spillages from pumping activities on the rehabilitated WRD	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		The Brits FRD leads to a change in the surface water yield of the area. This FRD is situated within sub-catchment-A within a drainage line. This drainage line flows towards the farm Rocky Flats.	Loss of surface water to environment	Probable	Local	Moderate
		The ineffective recovery of water from the barge pumps.	Loss of surface water	Possible	Local	Moderate
		Ineffective maintenance of the barge pumps, lack of capacity of pumping facilities to remove water off the FRD	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		One borehole (G4) north of the pan shows elevated Mn levels.	Loss of vegetation (sensitive landscapes): There are a number of species with conservation importance present in the pan. These include *Harpagophytum procumbens, Acacia erioloba Ammocharis coranica, Boophone disticha, Boscia albitrunca, Hereroa cf. wilmaniae, Orbeopsis lutea, Pachypodium succulentum, Ruscia cf. sedimentata, Lebeckia macrantha, Rhus tridactyla* and *Tarchonanthus cf. Obovatus*	Possible	Site	Moderate
	The recommissioning of	The old FRDs cover soil especially Hutton soil	Loss of soil	Possible	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	the Old FRD Dams 1, 2 and 3 & the infill dam may occur in 2013 / 2014. The on-going rehabilitation with the view to closure of the dams has subsequently ceased.	type which has not been removed prior to disposal.	Loss of land capability	Possible	Site	Moderate
			Loss of vegetation	Possible	Local	Moderate
		Ineffective vegetation management and rehabilitation practises on the sidewalls. Ineffective erosion control and vegetation cover of side walls leading to gulley erosion.	Colonisation of the dams with exotic and invader species of plants which compromise the establishment of indigenous vegetation.	Possible	Site	Moderate
	Operation and rehabilitation of old FRDs	The old FRDs lead to a change in the surface water yield of the area. These FRDs are situated within sub-catchment-B. Bonza farm and Bergplaas farm are either situated within or adjacent to this sub-catchment.	Loss of surface water to environment	Probable	Local	Moderate
	Operation and rehabilitation of old FRDs	The old FRDs cause seepage of EC, Ca, SO4, Mn, TDS, Turbidity, suspended solids, NO3, Mg and F into the groundwater. The monitoring data further shows that this pollution extends towards the south from the old FRDs as far as BH BA2 which is situated in the game farm.	Groundwater pollution	Probable	Local	High
		The No.1 FRD return water sump has been overflowing for an extended period. This has resulted in a body of water extending northeast from the return water sump and pools of water along the westernmost paddock wall causing seepage.	Surface water pollution	Probable	Local	High
			Groundwater pollution	Probable	Local	High
	Operation and rehabilitation of FRD	Elevated Mn, Mg, NO_3 and SO_4 levels were observed at the FRD paddocks.	Groundwater pollution	Probable	Local	High

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	paddocks	The FRD paddocks lead to a change in the surface water yield of the area. These FRD paddocks are situated within sub-catchment-B. Bonza farm and Bergplaas farm are either situated within or adjacent to this sub-catchment.	Loss of surface water to environment	Probable	Local	Moderate
	General operation and concurrent rehabilitation of all FRDs	Ineffective water management and rehabilitation practices on the sidewalls may occur.	Soil erosion, the erodibility of Hutton and Mispah is low.	Possible	Site	Moderate
		Wind erosion of the FRD takes place when the surfaces are dry dries out during periods when not in use.	Contamination of the surrounding environment with kimberlite FRD	Possible	Site	Moderate
		Surface water run-off as well as soil erosion from the FRDs may lead to siltation.	Siltation of surface water and additional water resources	Possible	Local	Moderate
		Siltation of drainage channels.	Disturbance of aquatic vegetation and animal life such as downstream pans	Probable	Local	Moderate
		Dust generation occurs which contributes to the concentration of fine PM in the atmosphere.	Air pollution	Probable	Local	Moderate
		Residual herbicides used for removal of alien vegetation and reeds on the dams may occur which will be washed down into the veld during rainy events. The amount of herbicide will be small.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
	Construction and operation of the FRDs	FRD wall failure may occur.	Safety hazard	Low	Local	Very high
		If the surveying measurements of the FRDs are inaccurate the heights of the FRDs could be exceeded and rehabilitation cost could be affected.	Loss of economic resource	Low	Immediate	Moderate
	Construction and operation of the FRDs	It is possible that the existing FRDs may cover some heritage or cultural aspect.	Loss of heritage or cultural aspects The archaeological aspects will be preserved.	Low	Immediate	No effect

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Construction and operation of the Brits FRD	The Brits FRD leads to a change in the surface water yield of the area. This FRD is situated within sub-catchment-A within a drainage line. This drainage line flows towards the farm Rocky Flats.	Loss of surface water to adjacent landowners	Probable	Local	Moderate
		The Brits FRD may lead to seepage into the drainage line continuing towards the farm Rocky Flats.	Surface and groundwater pollution of adjacent landowner.	Possible	Local	High
	The recommissioning of the Old FRD Dams 1, 2 and 3 & the infill dam may occur in 2013 / 2014. The on-going rehabilitation with the view to closure of the dams has subsequently ceased.	Inadequate bench penstock maintenance	Side wall instability and possible side wall failure.	Low	Local	Very high
	Operation and rehabilitation of old FRDs	The old FRDs lead to a change in the surface water yield of the area. These FRDs are situated within sub-catchment-B. Bonza farm and Bergplaas farm are either situated within or adjacent to this sub-catchment.	Loss of surface water to adjacent landowners	Probable	Local	Moderate
	Operation and rehabilitation of FRD paddocks	The FRD paddocks lead to a change in the surface water yield of the area. These FRD paddocks are situated within sub-catchment-B. Bonza farm and Bergplaas farm are either situated within or adjacent to this sub-catchment.	Loss of surface water to adjacent landowners	Probable	Local	Moderate
CRDs	Construction and operation of CRDs	The CRDs lead to a change of the topography. The final height of the post-97 CRD will be 1,598mamsl.	Visual impact	Definite	Site	Moderate
		The CRDs cover Hutton and Mispah soil types	Loss of soil	Definite	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
		which have not been removed prior to disposal.	Loss of land capability	Definite	Site	Moderate
			Loss of vegetation	Definite	Site	Moderate
		The ineffective removal and storage of topsoil from the post-79 CRDs.	Sterilisation of the footprint	Possible	Site	High
		The CRDs lead to a change in the surface water yield of the area. The CRDs are located within sub-catchment B and sub-catchment C. Bonza farm and Bergplaas farm are either situated within or adjacent to this sub-catchment.	Loss of surface water to environment	Probable	Local	Moderate
		Ineffective water management and rehabilitation practices on the sidewalls of the CRDs may occur.	Pollution of surrounding environment with CRD	Probable	Local	Moderate
		Surface water run-off as well as soil erosion from the CRDs may lead to siltation.	Siltation of surface water and additional water resources	Possible	Local	Moderate
		Siltation of drainage channels.	Disturbance of aquatic vegetation and animal life such as downstream pans.	Probable	Local	Moderate
		Levels of Mg, EC, Mn, Ca, Al, NO3 above the acceptable standards occurs at the post-1979 CRD and pre-1979 CRD.	Groundwater pollution	Probable	Local	Moderate
	Construction and operation of CRDs	CRDs have long slope lengths and are steep. It is not practicable to manage the vegetation on the slopes. CRDs are considered to be a resource and are more often than not subject to re treatment and therefore will not be considered for rehabilitation until the end of LoM.	Lack of indigenous re-vegetation.	Probable	Local	Moderate
		Residual herbicides used for removal of alien vegetation may occur which will be washed down into the veld during rainy events.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
	Transportation of CRD material	Increase in salt and siltation a may occur due to spillages of coarse residue from the conveyor	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
		belts. The CRDs cover both Hutton and Mispah soils.	Groundwater pollution	Possible	Local	Moderate
	Construction and operation of the CRDs	CRD failure may occur.	Safety hazard:	Low	Local	Very high
		If the surveying measurements of the CRDs are inaccurate the heights of the CRDs could be exceeded and rehabilitation cost could be affected.	Loss of economic resource	Low	Immediate	Moderate
		It is possible that the already existing CRDs may cover some heritage or cultural aspect.	Loss of heritage or cultural aspects. The archaeological aspects will be preserved.	Low	Immediate	No effect
		The CRDs lead to a change in the surface water yield of the area. The CRDs are located within sub-catchment B and sub-catchment C. Bonza farm and Bergplaas farm are either situated within or adjacent to this sub-catchment.	Loss of surface water to adjacent landowners	Probable	Local	Moderate
Run of mine (stockpile areas)	Run of mine (stockpile areas)	The run of mine stockpile areas used intermittently may generate dust.	Air pollution	Probable	Local	Moderate
		Surface water run-off as well as soil erosion from the run of mine stockpiles may lead to siltation.	Siltation of surface water and additional water resources	Possible	Local	Moderate
		Siltation of drainage channels.	Disturbance of aquatic vegetation and animal life such as downstream pans.	Probable	Local	Moderate
Dust plants	Dust plant operation	Dust emissions occur at some of the dust plant as well as transfer points on conveyor systems (transfer houses). Inadequate design and maintenance of dust plant leads to dust generation.	Health hazard	Probable	Local	Moderate

7.1.2.3 Support services

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
Waste management facilities	Waste separation	The incorrect separation of non-hazardous and hazardous waste at all sources throughout the mine may lead to excess waste transported to Holfontein.	Depletion of landfill space.	Possible	Site	Low
		The incorrect separation of non-hazardous and hazardous waste at all sources throughout the mine may lead to waste contamination by hazardous substances disposed at the general waste landfill site.	Depletion of landfill space.	Possible	Site	Low
			Potential wastage of recyclable material.	Possible	Site	Low
			Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
	Waste transportation	Incorrect transportation of hazardous waste, such as the use of damaged drums, may lead to spillages onto the ground.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
	Handling and storage of hazardous waste	Incorrect handling of hazardous waste while off-loading and storage at non-designated areas at the HWSA may cause spillages of hazardous substances.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		Storage of hazardous waste longer than 90days at the HWSA.	Depletion of hazardous waste storage space.	Possible	Site	Low
			Non-compliance	Possible	Site	High
		Incorrect design and inadequate maintenance of the bunded area for hazardous waste may cause spillages or seepage from this waste.	Depletion of hazardous waste storage space.	Possible	Site	Low
			Non-compliance	Possible	Site	High
			Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
	General operation and construction of the WAMY	Littering by windblown waste at the WAMY.	Potential visual impact	Possible	Local	Low
	General operation and construction of the WAMY	Increased surface water run-off due to removed vegetation, or decrease water infiltration from soil compaction leading to siltation. Siltation can be increased by soil erosion.	Surface water siltation could result in an increase in suspended solids concentration in runoff water and aquatic habitats further downstream.	Possible	Local	Moderate
		The historical incorrect disposal of hazardous	Soil pollution	Possible	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
		and non-hazardous waste at the WAMY.	Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		Inadequate recycling or reclamation of waste may lead to excessive final disposal at the domestic waste landfill site.	Depletion of landfill space	Possible	Site	Low
	Operation of landfill area	Striping of topsoil and removal of vegetation.	Soil erosion	Possible	Site	Moderate
		Dust generation due to removal of vegetation and soil erosion.	Air pollution	Possible	Site	Moderate
		Disturbance of topsoil, nuisance of odour, flies or other vectors, dust generation or CO_2 and toxic gases generation due to inadequate stabilisation and covering of the landfill which includes: • Incorrect materials used for backfill; • Incorrect cut and fill technique; • Inadequate depth of coverage; • Poor coverage of flanked areas; • Poor characterisation & consistency of cover materials; and Inappropriate cover used for prolonged periods.	Potential air pollution.	Possible	Site	Moderate
	Storage of tyres	Accidental burning of rubber due to cutting of steel or the storage or tyres may start fires.	Potential air pollution	Low	Site	Moderate
		Infiltration of decomposing liquid products or gradual leaching of ash and unburned residue, from accidental burning of rubber due to cutting of steel or the storage or tyres during a fire.	Soil pollution	Possible	Site	High
			Surface water pollution	Possible	Local	High
			Groundwater pollution	Possible	Local	High
		Incomplete tyre combustion leading to dioxin (highly toxic compounds) and noxious gases, leaching into the soil during accidental burning	Soil pollution	Possible	Site	High
			Surface water pollution	Possible	Local	High
			Groundwater pollution	Possible	Local	High

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
		of rubber due to cutting of steel or the storage or tyres during a fire. Other substances released include Volatile organic compounds (VOCs) polynuclear aromatic hydrocarbons (PAHs), furans, hydrogen chloride, benzene, PCBs arsenic, cadmium, nickel, mercury, zinc, chromium and vanadium.	Potential disturbance of plants due to uptake of dioxin in soil.	Low	Site	High
		Tyre combustion causes pyrolysis of the rubber, resulting in oily decomposition waste which could be carried to surface water run-off. In cases where water is used to put out the fire, chemical compounds like paraffin and aromatic liquids may be carried in water.	Soil pollution	Possible	Site	High
			Surface water pollution	Possible	Local	High
			Groundwater pollution	Possible	Local	High
	Use of garden waste	Using of garden waste or wood chippings contaminated by invasive vegetation seeds or other vegetative parts, for mulching or topdressing of WRDs.	The garden waste may include seeds, etc of alien vegetation.	Possible	Site	Moderate
		Using garden waste or wood chippings contaminated with hazardous substances such as herbicides and hydrocarbons for mulching topsoil area.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		The spillage of diesel used as incinerator fuel.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Operation of incinerator	Emissions of air pollutant such as criteria pollutants, acid gases, metal gases, and dioxins and furans occur at the incinerator. Given the range of pollutants emitted from incinerator operations and the toxic nature of such pollutants, areas within which incinerator operations are located are frequently labelled as potential "toxic hotspots" for air quality management needs purposes.	Potential air pollution	Possible	Site	Moderate
		Incorrect disposal of incinerator bottom ash. The mass and volume reduction of waste incineration causes an enrichment of a number of heavy metals in the bottom ashes compared to their concentration in the waste feed. The leaching ability of the bottom ash depends on the type of material that was incinerated.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
	Bioremediation activities. The bio remediated kimberlite and other material is put back into the Ore Treatment Process. The contaminated material is placed on the concrete	Seepage or incorrect water drainage of materials e.g. heavy metals during bioremediation processes at the bioremediation site due to incorrect bunding or maintenance of the bunded area.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		VOCs are generated at the bioremediation site.	Potential air pollution	Possible	Site	Moderate
		Incorrect or inadequate bioremediation practises on site	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	hydrocarbon consuming bacteria is added to the material. During a process that can last up to 12 weeks depending on the weather and time of the year the material is kept moist and aerated by turning		Groundwater pollution	Possible	Local	Moderate
	On mine waste management	Incorrect handling, storage & disposal of asbestos waste (old pipes, gaskets, structures)	Health hazard to workers, legal liability	Possible	Local	High
		Incorrect storage& handling of medical waste at the medical facilities and transport and disposal of medical waste by the contractor.	Health hazard to workers, legal liabilities,	Possible	Local	High
	Hazardous waste disposal by contractors	Incorrect storage & handling of hazardous waste at the WAMY and transportation of Hazardous waste from the WAMY to Holtfontein	Health risk to people	Possible	Local	High
	WAMY landfill operations	Disturbance of topsoil, nuisance of odour, flies or other vectors, dust generation or CO_2 and toxic gases generation due to inadequate stabilisation and covering of the landfill which includes: • Incorrect materials used for backfill; • Incorrect cut and fill technique; • Inadequate depth of coverage; • Poor coverage of flanked areas; • Poor characterisation & consistency of cover materials; and • Inappropriate cover used for prolonged periods.	Potential nuisance for workers or nearby neighbours. The landfill site is located at the WAMY. Legal liability	Possible	Site	Moderate
			Health and safety hazard	Possible	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
		Nuisance of odour, flies or other vectors.	Health hazard to employees	Possible	Site	Moderate
		Accidental burning of rubber due to cutting of steel or the storage or tyres may start fires.	Safety hazard to workers Potential air pollution	Possible	Site	Moderate
	On mine waste management	Complete tyre combustion produces CO_2; incomplete tyre combustion release dioxins and noxious gases. Other substances released include VOCs, PAHs, furans, hydrogen chloride, benzene, PCBs arsenic, cadmium, nickel, mercury, zinc, chromium and vanadium.	Potential health hazard to workers and neighbouring residents.	Possible	Site	Moderate
		Accidental fires from storage of dry wood chippings.	Potential safety and health hazard from fire and smoke, loss of biodiversity if fire spreads to the veld, loss of a resource	Possible	Site	Moderate
	Storage of tyres	Accidental burning of rubber due to cutting of steel or the storage or tyres may start fires.	Safety hazard to workers	Possible	Site	Moderate
	Sewerage farm composting operations	Incomplete or incorrect treatment of sewage sludge used as compost for rehabilitation leading to leaching of heavy metals or pathogenic bacteria, viruses and protozoa along with other parasites..	Potential health hazard	Possible	Site	Moderate
	Incinerator operations at the sewerage farm	Emissions of air pollutant such as criteria pollutants, acid gases, metal gases, and dioxins and furans occur at the incinerator. Given the range of pollutants emitted from incinerator operations and the toxic nature of such pollutants, areas within which incinerator operations are located are frequently labelled as potential "toxic hotspots" for air quality management needs purposes.	Health hazards from dioxins and furans.	Possible	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Sewerage Farm Operations	Inadequately treated effluent pumped into the earth dam from where it enters the process water system.	Health hazard	Possible	Site	Moderate
Water management	Groundwater use; Groundwater from the underground workings is currently contained in the underground sumps (dams) 1, 2, 3 and 4 on 680m level. The mine affected water is then abstracted from these underground sumps and re-used in the process. As the mine extends downwards groundwater drains into the excavations. In order for mining to proceed, this water must be pumped out of the excavations	Groundwater is also abstracted from one (1) borehole located on the Bonza Farm. Currently groundwater is abstracted from this borehole for potable use as well as for the watering of game on the Bonza Game Farm.	Potential loss of groundwater	Probable	Local	Low
	Potable water use; The mine obtains water from the Vaal–Gamagara Water Scheme for make-up water in the Ore Processing Treatment Plant and to supply the employees with potable water.	Ineffective use of water or inadequate maintenance of water storage facilities and pipelines.	Loss of water resources	Probable	Local	Low

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Storage of process water	The potential failure of the process water dams may cause spillages of process water.	Soil pollution	Possible	Site	High
			Surface water pollution	Possible	Local	High
			Groundwater pollution	Possible	Local	High
Water management	Storage of process water	Bonza Quarry is unlined. The volume of the seepage is unknown; however, the poor quality of this water implies that a pollution plume may have developed from Bonza Quarry.	Groundwater pollution	Probable	Local	High
	Transportation of water	Spillages may occur due to burst pipes, overflows, seepage from dirty water drains and pump failures.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		Installation or replacing of pipelines.	Veld disturbance	Probable	Site	Moderate
			Loss of animal habitat	Probable	Site	Moderate
			Destruction of vegetation	Probable	Site	Moderate
		Ineffective maintenance of water transport or storage facilities may result in surface run-off siltation.	Siltation and pollution of surface water	Possible	Local	Moderate
		Siltation of drainage channels resulting in loss of channel conveyance capacity	Loss of water resources	Possible	Local	Moderate
	Sewage Operations	There is a potential for emissions of VOCs at the wastewater works.	Air pollution	Possible	Local	Moderate
		Leakages or spillages from the honeysucker and sewage containers during the removal of sewage from the underground toilets and all other toilets on surface not connected to wastewater care works may occur.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
Water management	Sewage Operations	Incomplete or incorrect treatment of sewage sludge used as compost for rehabilitation leading to leaching of heavy metals or pathogenic bacteria, viruses and protozoa along with other parasitic helminths .	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Stormwater control measures	Inadequate stormwater management	Erosion can take place where vegetation has been removed and/or the topsoil has been compacted.	Possible	Site	Moderate
	Stormwater control measures	Inadequate stormwater management	Loss of vegetation (sensitive landscapes):	Possible	Site	Moderate
	Stormwater control measures	Inadequate stormwater management	Siltation of drainage channels affecting stormwater.	Possible	Local	Moderate
	Stormwater control measures	Any inadequate stormwater drainage design or lack of stormwater structures & lack of maintenance of existing structures.	Loss of surface water	Possible	Site	Moderate
	Stormwater control measures	Any inadequate stormwater drainage design or lack of stormwater structures & lack of maintenance of existing structures.	Surface water pollution	Possible	Local	Moderate
	Stormwater control measures	Any inadequate stormwater drainage design or lack of stormwater structures & lack of maintenance of existing structures.	Groundwater pollution	Possible	Local	Moderate
Water manageme nt	Groundwater use	The development of a cone of depression in the ground water around the open pit.	Potential loss of groundwater yield in surrounding areas.	Probable	Local	High
Transport and conveyance	Conveyance activities excluding road activities; Use of skips and conveyors underground and on surface to transport ore	Dust generation from tipping of ore into the surge bin at the shaft.	Potential air pollution	Possible	Site	Moderate
Transport and conveyance	Conveyance activities excluding road activities; Use of skips and conveyors underground and on surface to transport ore	Conveyors are operated using electrical energy	CO2 emissions global warming	Probable	National	Moderate
Transport and conveyance	Conveyance activities excluding road activities; Use of skips and conveyors underground and on surface to transport ore	Noise generation	Noise pollution	Possible	Site	Moderate
Transport and conveyance	Conveyance activities excluding road activities; Use of skips and conveyors underground and on surface to transport ore	Fire hazard	Air pollution	Low	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
Transport and conveyance	Transportation activities via road; The transportation of hazardous materials such as hazardous waste, hydrocarbons, explosives from the magazine the shaft bank on surface as well as the transportation of hazardous materials from the shaft to underground working. This includes the transportation of waste to the WAMY; the transportation of all goods and materials on and off the mine, and all earth-moving activities.	All fuel transport activities generate emissions	Potential air pollution: Primary air pollutants emitted by vehicles may include NOx, CO_2, HCs, SO_2, PM and Pb. Secondary pollutants associated with vehicle emissions include NO_2, photochemical oxidants (e.g. ozone) and sulphuric or nitric acids, and sulphate and nitrate aerosols. Toxic hydrocarbons emitted include benzene, 1.2-butadiene, aldehydes and polycyclic aromatics hydrocarbons (PAH). Benzene represents an aromatic HC present in petrol, with 85% to 90% of benzene emissions emanating from the exhaust and the remainder from evaporative losses. Light-duty petrol vehicles not equipped with pollution control devices have the highest exhaust emissions during acceleration, followed by deceleration, cruising and idling cycles. At higher cruise speeds HC and CO emissions decrease, while NO_x and CO_2 emissions increase.	Possible	Site	Moderate
		Emissions from diesel-fuelled vehicles include PM, NO_x, SO_2, CO and HC, the majority of which occurs from the exhaust.	Potential air pollution	Possible	Site	Moderate
		Dust generation during driving on dirt and gravel roads.	Potential air pollution	Possible	Site	Moderate
		Hydrocarbon leakages or spillages from vehicles transporting material as well as parked vehicles. .	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
	Construction and maintenance of roads	Increased run-off from rain water flowing off roads which are not connected to a drainage system.	Potential soil erosion.	Possible	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
		Soil compaction due to dirt roads and gravel roads, leading to changes of all other physical characteristics.	Compacted soil may lead to the decrease of water infiltration therefore leading to soil erosion.	Possible	Site	Moderate
Transport and conveyance	Construction and maintenance of roads		Potential decrease in vegetation growth. The effect of compaction on plant growth and yield depends on the type of vegetation and the environmental conditions that is encountered. In general, under dry conditions some compaction is beneficial, but under wet conditions compaction decreases vegetation.	Possible	Site	Moderate
			Surface areas that have been compacted due to the construction activities, may lead to localized increased runoff conditions.	Possible	Site	Moderate
		Degraded areas along roads may cause alien invasive plants to establish.	Invasive plant might be established.	Possible	Site	Moderate
		Increased surface water run-off due to removed vegetation, or decrease water infiltration from soil compaction leading to siltation. Siltation can be increased by soil erosion.	Surface water siltation could result in an increase in suspended solids concentration in runoff water and aquatic habitats further downstream.	Possible	Local	Moderate
		Siltation of drainage channels.	Disturbance of aquatic vegetation and animal life.	Probable	Local	Moderate
		Leakages or spillages of machinery during maintenance of roads.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		Veld disturbance may take place during road maintenance.	Disturbance or loss of vegetation.	Possible	Site	Moderate
			The removal and destruction of vegetation may also lead to the fragmentation and destruction of animal habitats.	Possible	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
Transport and conveyance	Aircraft transportation	The airport at the mine is associated with the emission released from aircraft, motor vehicles, and aircraft maintenance procedures. An airport is anticipated to contribute to NO_2 health threshold exceedance in its vicinity. The other most significant emissions released include CO_2 and CO. Smaller quantities of VOCs, SO_2, non-methane VOCs, methane, lead, and PM are also associated with these activities.	Potential air pollution	Possible	Local	Moderate
		Impacts associated with the helipad will be similar to the airport.	Potential air pollution	Possible	Site	Moderate
Transport and conveyance	Transportation activities via road	Noise on the mine can be generated by vehicular traffic and earth moving machinery. This includes the transportation of waste to the WAMY, the transportation of all goods and materials on and off the mine, all earth-moving activities, and road maintenance.	Nuisance to workers and neighbouring properties.	Possible	Site	Moderate
Stores	Underground stores of hazardous chemical materials	Leakages or spillages from the incorrect storage of hazardous substances underground, such as fuel, oil, paint, batteries, chemicals, acid & corrosive salt, reagents, paint, solvents and Beryllium x-ray tubes may occur.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		Inadequate bunding underground that does not meet specifications, damaged bunding, inadequate or damaged equipment such as storage tanks and underground tanks leaking may cause hazardous substances to spill or seep out of the bunded areas / tanks.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
Stores	Operation of underground	Redundant or mothballed equipment or material	Soil pollution	Possible	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	equipment	containing hydrocarbons underground may leak.	Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
	Operation and storage above ground; There are various diesel, petrol and oil storage tanks above ground on site	Leakages or spillages from the incorrect transport, loading, storage, use and removal of hazardous substances above ground, such as fuel, oil, paint, batteries, chemicals, acid & corrosive salt, reagents, paint and solvents. Spillages from off-loading may take place during refuelling of vehicles, or due to spillages from damaged delivery lines, or overfill at bulk storage tanks.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		Inadequate bunding above ground that does not meet specifications, damaged bunding, inadequate or damaged equipment such as storage tanks and underground tanks leaking may cause hazardous substances to spill or seep out of the bunded areas / tanks.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
Stores	Operation and storage above ground; There are various diesel, petrol and oil storage tanks above ground on site	Ineffective oil separator may cause hydrocarbon spillages or leakages. The oil separators have all reported oil and grease values above allowable level, but no diesel. The oil separators contain no VOCs and semi-volatile organic compounds (SVOCs), but 4 unknown halogenated compounds were detected.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		Redundant or mothballed equipment or material containing hydrocarbons above ground may leak.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		This adds to pollutants such as VOCs.	Potential air pollution	Possible	Local	Moderate
		The incorrect storage or use of foam, Water with Additive and Wet Chemical (F Class)	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
		extinguisher contents containing chemicals may cause leakages or spillages.	Groundwater pollution	Possible	Local	Moderate
Stores	Underground stores of hazardous chemical materials	Fire can occur which is caused by storage of incompatible reagents in a storage area underground.	Safety hazard to workers	Possible	Site	Moderate
		Incorrect storage and operation of explosives at explosive bay underground may cause fire or explosions.	Safety hazard to workers	Possible	Site	Moderate
	Operation and storage above ground; There are various diesel, petrol and oil storage tanks above ground on site	There are various diesel, petrol and oil storage tanks above ground on site. This adds to pollutants such as VOCs.	Safety and health hazard to workers due to fire and smoke	Possible	Site	Moderate
Stores	Operation and storage above ground; There are various diesel, petrol and oil storage tanks above ground on site	When inhaled, TCE may produce the following effect: • Central nervous system depression resulting in general anaesthesia; • Tachypnea; • Many types of cardiac arrhythmias; • Cranial nerve dysfunction; and • Occasionally facial numbness	Potential health and safety hazard	Possible	Site	Moderate
		Potential exposures to radiation form weightometers and measuring flasks at skips may occur.	Potential health and safety hazard	Possible	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
		Storage and handling of Beryllium x-rays. The dangers to health which can arise from beryllium are mainly due to inhaling the substance. Inhaling dust or fumes containing beryllium may cause serious, chronic lung disease called Chronic Beryllium Disease (CBD). Soluble salts of beryllium may present additional ingestive, eye and skin hazards	Health hazard	Possible	Site	Moderate
Maintenance facilities; Workshops	Maintenance activities underground; Welding and gas cutting; Fire suppression; Washbay operations; Servicing of Equipment; Batching Plant operations (underground)	The incorrect use of any hazardous materials during maintenance activities underground may cause hydrocarbon and other hazardous chemical spillages. This includes oil, paint, grease, etc.	Potential groundwater pollution	Possible	Local	Moderate
		The generation of fumes and gases from this activity underground may be a safety risk.	Potential air pollution	Possible	Local	Moderate
Maintenance facilities; Workshops	Maintenance activities underground; Welding and gas cutting; Fire suppression; Washbay operations; Servicing of Equipment; Batching Plant operations (underground)	The inadequate maintenance of machinery underground may cause spillages of hydrocarbons.	Potential groundwater pollution	Possible	Local	Moderate
		The washing of contaminated parts, lack of maintenance of the sumps, inadequate or damaged bunding, ineffective operation, and uncontrolled water drainage at the wash bay underground may cause hydrocarbon and other hazardous chemical leaching.	Potential water pollution	Possible	Local	Moderate
		Pollutants in batching plant wastewater include cement, sand, aggregates and petroleum products. These substances can affect the water pH	Underground water pollution	Possible	Local	Moderate
	Maintenance activities above ground		Potential groundwater pollution	Possible	Local	Moderate
		The incorrect use of any hazardous materials during maintenance activities above ground may	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
		cause hydrocarbon and other hazardous chemical spillages. This includes oil, paint, grease, etc.	Groundwater pollution	Possible	Local	Moderate
		The ineffective use of surface water at the workshops and other maintenance facilities and the evaporation of water from the wash bay above ground may lead to a depletion of the water resource (water from VG pipeline).	Loss of surface water	Possible	Local	Moderate
Maintenance facilities; Workshops	Maintenance activities above ground	The inadequate maintenance of vehicles and machinery above ground may cause spillages of hydrocarbons.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		The washing of contaminated parts, lack of maintenance of the sumps, inadequate or damaged bunding, ineffective operation (e.g. WAP machine broken), and uncontrolled water drainage at the wash bay above ground may cause hydrocarbon and other hazardous chemical spillage.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		Inadequate maintenance of the pumping system, the 2 000l storage tanks, and the bunding of the storage tank from the lube bay above ground may result in leakages or spillages of oil.	Soil pollution	Possible	Site	High
			Surface water pollution	Possible	Local	High
			Groundwater pollution	Possible	Local	High
Maintenance facilities; Workshops	Maintenance activities underground	Welding and gas cutting as well as the generation of fumes and gases from this activity underground may be a safety risk. This impact is increased if mine employees are not adequately trained, not wearing correct PPE or if fire extinguishers are not in place and correctly working.	Potential safety hazard	Possible	Site	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
		Fires occurring underground due to burning of waste tyres.	Potential safety hazard	Possible	Site	Moderate
		The generation of fumes and gases underground may be a safety risk.	Potential safety hazard	Possible	Site	Moderate
	Maintenance activities above ground	Noise generation at above ground workshops may occur during carpentry operations.	Nuisance to workers	Possible	Site	Moderate
		Welding and gas cutting as well as the generation of fumes and gases from this activity above ground may be a safety risk. This impact is increased if mine employees are not adequately trained, not wearing correct PPE or if fire extinguishers are not in place and correctly working.	Potential safety hazard	Possible	Site	Moderate
Administration and other buildings	Use of water	The ineffective use of surface and groundwater or damaged water pipes and taps at any of these building may lead to a depletion of the water resource (water from VG pipeline).	Loss of surface water	Possible	Local	Moderate
		Overdosing of wash water with soaps and detergents for cleaning purposes and the use of acid based cleaning reagents in the change houses.	Soil pollution	Possible	Site	Low
			Surface water pollution	Possible	Local	Low
			Groundwater pollution	Possible	Local	Low
	Paper usage	The inefficient recycling of paper.	Loss of natural resource (vegetation)	Possible	Site	Moderate
Administration and other buildings	Paper usage	The storage of large quantities of paper creates a fire risk.	Potential air pollution	Possible	Local	Moderate
	Operation of air-con units	The lack of maintenance, servicing, storage and repairs of air-conditioning units, ineffective cleaning of filters or the recharging air cooling systems with Freon gas and storage of Freon gas cylinders and redundant equipment.	Potential air pollution	Possible	Local	Moderate

SECTION	ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Activities at change houses	Uncontrolled water usage for showers, leaks of pipes, etc at change houses may lead to a depletion of the water resource (water from VG pipeline).	Loss of surface water	Possible	Local	Moderate
		Leakage of dirty water and sewage from pipes or change house during changing activities or cleaning of change houses may occur.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		Use of detergents and cleaning materials	Pollution of the water	Possible	Local	Moderate
		Use of electricity; Purchased electricity	Climate change	Probable	National	Moderate
Housing recreation and other employee activities	Use of water	The ineffective use of surface and groundwater at the mine residences and other employee facilities (water from VG pipeline).	Loss of surface water	Possible	Local	Moderate
		Leakage of dirty water and sewage from pipes at houses.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
Support services contractors	Contractor activities	Supplier vehicles leaking oil or diesel as well as suppliers and contractors that contravene Environmental legislation such as hazardous substances transportation, delivery and store, waste disposal.	Soil pollution	Possible	Site	Moderate
			Surface water pollution	Possible	Local	Moderate
			Groundwater pollution	Possible	Local	Moderate
		The ineffective use of surface and groundwater by services contractors (water from VG pipeline).	Loss of surface water	Possible	Local	Moderate

7.1.3 Decommissioning phase

ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
Rehabilitation of FRDs, CRDs and	Lack of stormwater control on the newly top-dressed slopes.	Loss of topsoil and soil erosion	Possible	Site	Moderate
		Soil erosion.	Possible	Site	Moderate

ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
WRDs	Insufficient quantity and quality of growing medium applied to profiled slopes	Potential decrease in vegetation growth.	Possible	Site	Moderate
	Increased surface water run-off due to decrease water infiltration as a result of soil compaction causes siltation. Siltation will increase as a result of soil erosion.	Surface water siltation could result in an increase in suspended solids concentration in runoff water	Possible	Local	Moderate
	Siltation of drainage channels.	Disturbance of vegetation and animal life.	Possible	Site	Moderate
	Incorrect profiling of the rehabilitation areas will result in the deviation from the natural topography.	Visual aspect	Possible	Local	Moderate
	Placement of soil containing alien vegetation.	Invasive plant might be established.	Possible	Site	Moderate
	Ponding of water due to incorrect profiling of rehabilitation areas.	Change in normal surface water flow patterns may affect the surface water quantity of the area.	Possible	Local	Moderate
	Increased surface water runoff due to incorrect placement of stormwater control structures e.g. contours or drains around the FRDs, CRDs and WRDs.	Siltation of surface water and erosion of side walls.	Possible	Local	Moderate
	Leakages or spillages may occur from earthmoving and construction vehicles during the dismantling and removal of the shaft and plant and associated infrastructure.	Soil pollution, surface water pollution, groundwater pollution	Possible	Local	Moderate
Rehabilitation of earth dams	Incorrect disposal of silt and liner that may contain pollutants from the process water.	Soil pollution, surface water pollution, groundwater pollution	Possible	Local	Moderate
	Incorrect sloping of the earth dam walls leading to surface water runoff.	Surface water siltation could result in an increase in suspended solids concentration in runoff water and aquatic habitats further downstream.	Possible	Local	Moderate
	Siltation of drainage channels.	Disturbance of aquatic vegetation and animal life	Probable	Local	Moderate
	Infertile soil being used for rehabilitation.	Inhibiting the growth of vegetation	Possible	Site	Moderate
Open pit	Surface water runoff into the pit in the event of incorrect construction of stormwater berms.	Loss of surface water	Possible	Local	Moderate
Open pit	Inappropriate closure and prevention of access to the haul roads	Safety hazard	Possible	Site	Moderate
	Unauthorised access to open pit if a security fence or Enviro berm is not erected around the pit or not correctly erected around the pit.	Safety hazard to community	Possible	Site	Moderate

ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
Soil replacement	Removal of topsoil from the topsoil stockpiles may cause the liberation of soil. A total of 60,000m³ topsoil will be removed from the stockpile west of the infill dam. The topsoil on the stockpile east of the infill dam has already been used for the rehabilitation of the northern slope of No. 3 FRD. A total of 22,500m³ topsoil will be removed from the stockpile north of the WRD.	Soil erosion.	Possible	Site	Moderate
	Surface water runoff on the topsoil stockpile may occur during the liberation of the soil, which may lead to siltation of drainage channels downslope from the stockpiles.	Siltation of surface water and additional water resources.	Possible	Local	Moderate
	Siltation of drainage channels.	Disturbance of aquatic vegetation and animal life	Probable	Local	Moderate
	Dust may be generated at the topsoil stockpile during removal of the soil.	Air pollution	Possible	Local	Moderate
	Leakages or spillages may occur from earthmoving and construction vehicles and machinery used for the removal of soil from the stockpiles.	Soil pollution	Possible	Site	Moderate
		Surface water pollution	Possible	Local	Moderate
		Groundwater pollution	Possible	Local	Moderate
Additional borrow pits	The additional borrow pits will lead to a void in the topography.	Visual impact	Definite	Local	Low
	Removal of topsoil will take place for the additional borrow pit. A total of 1 037 500m³ soil will be removed.	Loss of soil	Definite	Site	Moderate
		Loss of land capability	Definite	Site	Moderate
		Loss of vegetation	Definite	Site	Moderate
	The borrow pits construction will lead to a total void of 1 037 500m³ for surface water to flow into.	Loss of surface water	Definite	Site	Moderate
General surface rehabilitation	Inadequate placement of topsoil in slopes or the placement of topsoil creating a catena.	Loss of topsoil and soil erosion	Possible	Site	Moderate
	Incorrect placement of topsoil on rehabilitation areas may lead to soil compaction	Compacted soil may lead to the decrease of water infiltration therefore leading to soil erosion.	Possible	Local	Moderate

ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
General surface rehabilitation	Incorrect placement of topsoil on rehabilitation areas may lead to soil compaction	Potential decrease in vegetation growth. The effect of compaction on plant growth and yield depends on the type of vegetation and the environmental conditions that is encountered. In general, under dry conditions some compaction is beneficial, but under wet conditions compaction decreases vegetation.	Possible	Site	Moderate
		Surface areas that have been compacted due to the construction activities, may lead to localized increased runoff conditions.	Possible	Site	Moderate
	Increased surface water run-off due or decrease water infiltration from soil compaction leading to siltation. Siltation can be increased by soil erosion.	Surface water siltation could result in an increase in suspended solids concentration in runoff water and aquatic habitats further downstream.	Possible	Local	Moderate
	Siltation of drainage channels.	Disturbance of aquatic vegetation and animal life.	Probable	Local	Moderate
	Inadequate or no application of fertiliser and/or organic material into the soil used for rehabilitation. The existing topsoil stockpiles may have been leached due to rain, etc.	Inhibiting the growth of vegetation.	Possible	Site	Moderate
	Leaching of minerals due to incorrect application of fertilisers into topsoil used for rehabilitation of disturbed areas.	Groundwater pollution	Possible	Local	Moderate
	Incorrect sloping of the rehabilitation areas will result in the topography remaining changed from natural topography.	Visual aspect	Possible	Local	Moderate

ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
General surface rehabilitation	Placement of soil containing alien vegetation. It is possible that the topsoil on the stockpiles contains seeds of alien vegetation or is already infested with alien vegetation which will then be placed on rehabilitation areas with the topsoil.	Invasive plant might be established. This may lead to: • Displacement of indigenous vegetation. • Change in plant species composition. • Change in vegetation composition and structure. • Competition for sunlight and 'living space' will increase between indigenous and alien species. • Competition for water and minerals between alien and indigenous vegetation. • Change in plant-pollinator composition. • Loss of habitat • Change in flammability of existing vegetation structure – pending the introduction of the alien species. • The spread of alien vegetation in areas previously free from such species causing a change in biodiversity.	Possible	Site	Moderate
	Ponding of water due to incorrect sloping of rehabilitation areas.	Change in normal surface water flow patterns may affect the surface water quantity of the area.	Possible	Local	Moderate
	Increased surface water runoff due to incorrect placement of stormwater control structures around the rehabilitation areas.	Siltation of surface water and additional water resources	Possible	Local	Moderate
	Siltation of drainage channels may lead to change in aquatic habitats.	Disturbance of aquatic vegetation and animal life.	Probable	Local	Moderate
	Inadequate removal of heaps of excess material from rehabilitation areas.	Visual aspect	Possible	Local	Moderate
Re-establishment of Biodiversity	Replacement of species not adapted to the local conditions.	Biodiversity will be poor	Possible	Local	Moderate
	Replacement of species not adapted to the local conditions may lead to bare areas.	Soil erosion	Possible	Site	Moderate

ACTIVITY	ASPECT	IMPACT DESCRIPTION	LIKELIHOOD	EXTENT	SEVERITY
	Potential spillages of herbicides used for alien vegetation.	Potential soil, surface and groundwater pollution.	Possible	Site	Moderate
Dismantling of the shafts, Plant areas, associated infrastructure and additional buildings / infrastructure	The inadequate dismantling of steel structures from the shaft and plant.	Visual aspect.	Possible	Local	Moderate
	Incorrect disposal of building rubble removed from demolition of buildings and related structures.	Depletion of landfill space	Possible	Site	Low
	Dust may be generated during the dismantling and removal of the shaft and plant and associated infrastructure	Air pollution	Possible	Local	Moderate
Dismantling of the shafts, plant, and associated infrastructure and additional buildings / infrastructure	The inadequate dismantling of steel structures from the shaft and plant.	Safety to community	Possible	Site	Moderate
	Incorrect identification of risks whilst dismantling steel structures from the shaft and plant.	Safety of workers dismantling the shaft	Possible	Site	Moderate
	Incorrect sealing/plugging of the shaft.	Safety hazard to community	Possible	Site	Moderate
	Noise generated during the dismantling and removal of the shaft and plant and associated infrastructure.	Nuisance to workers and community	Possible	Site	Moderate
Rehabilitation of disturbed areas by profiling, ripping and topdressing& overseeding where necessary	Noise generation f By earthmoving equipment	Nuisance to workers and community	Possible	Site	Moderate
	Dust generated by rehabilitation earthworks	Air pollution and health hazard	Possible	Site	Moderate

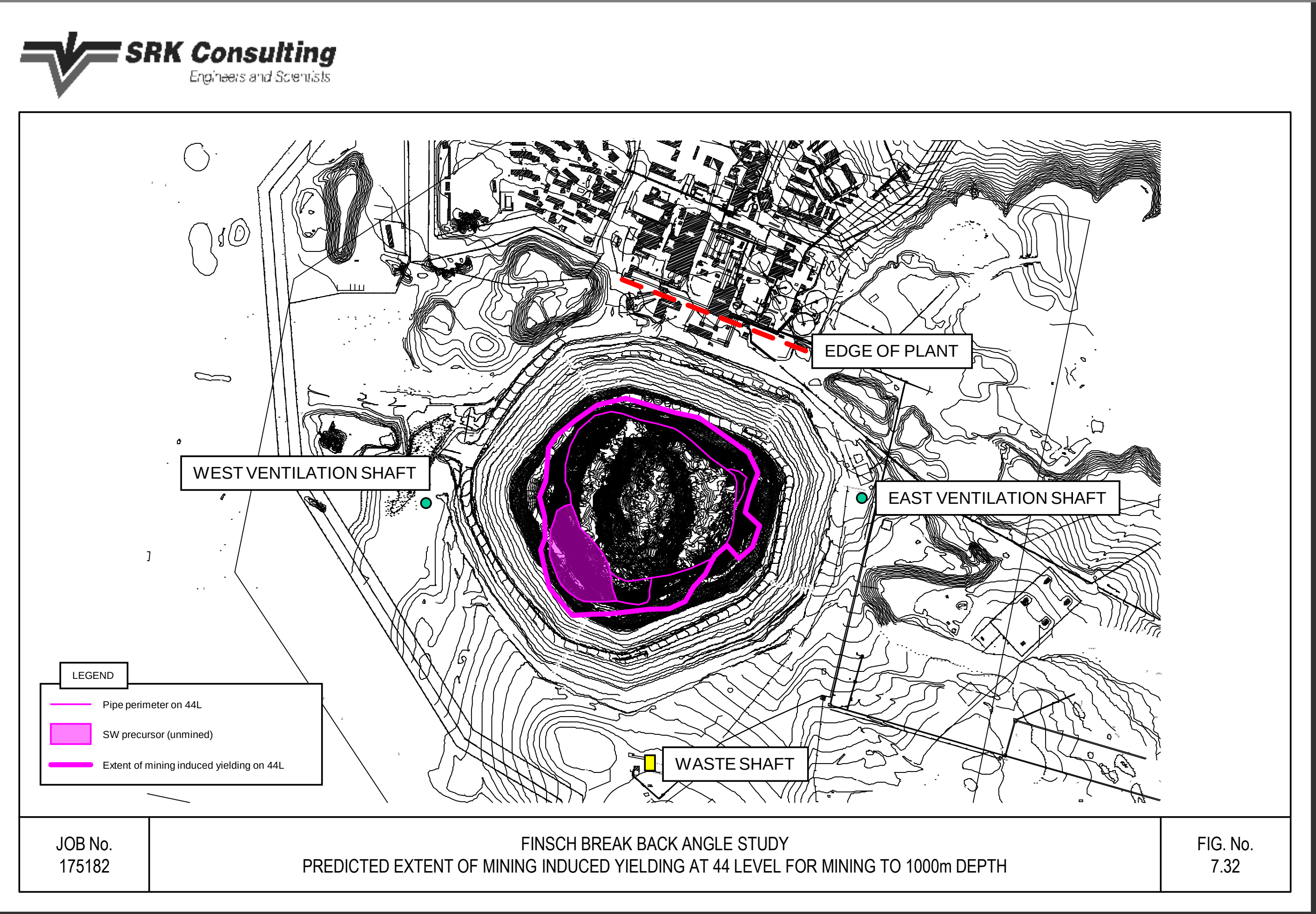

Figure 13: Predicted extent of mining induced yielding at 44 level for mining to 1000m depth

Client: Petra Diamonds, Finsch Mine

Project: EMP Amendment

Date: May 2012

SHANGONI Management Services (Pty) Ltd

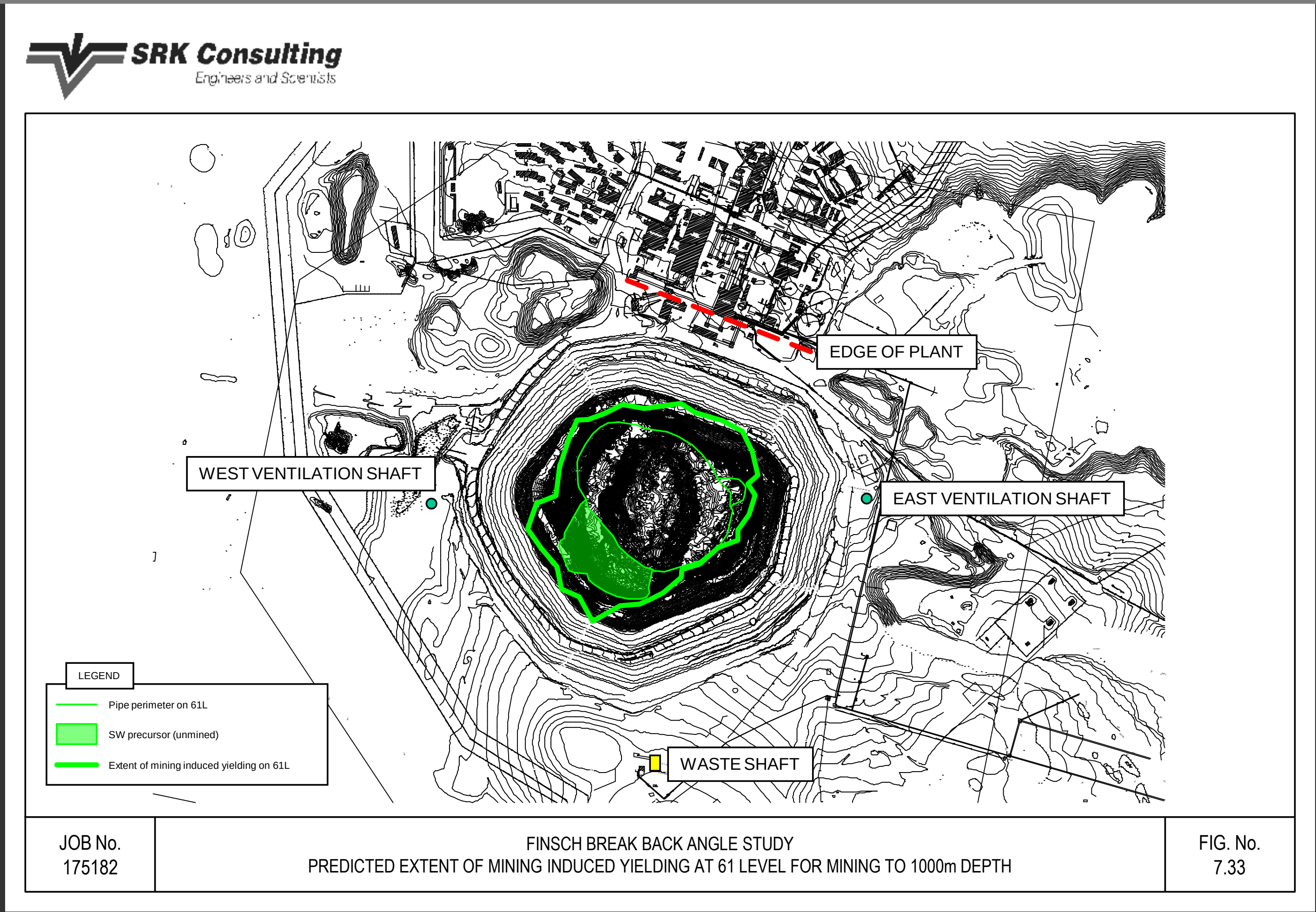

Figure 14: Predicted extent of mining induced yielding at 61 level for mining to 1000m depth

Client: Petra Diamonds, Finsch Mine

Project: EMP Amendment

Date: May 2012

7.2 Concomitant impact rating for each potential impact listed in paragraph 7.1 above in terms of its nature, extent, duration, probability and significance

7.2.1. Definitions for rating

SANS ISO 14001

The international standard specifying the requirements of an EMS, to enable an organisation to formulate a policy and objectives, taking into account legislative requirements and information about significant environmental impacts. It applies to environmental aspects of the organisation on the environment.

Environmental Aspect

The element of an organization's activity, product or service that can interact with the environment be it positive or negative.

Environmental Impact

Any changes to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's environmental aspects.

EMS

The part of an organization's management system used to develop and implement its environmental policy and manage its environmental aspects.

NOTE 1: A management system is a set of interrelated elements used to establish policy and objectives and to achieve those objectives.

NOTE 2: A management system includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources.

Likelihood

The likelihood of the impact occurring, taking into account existing management measures. (Current Controls)

Extent

The area (volume) over which the impact will be expressed.

Severity

Severity of the Environmental impact (actual: potential; positive or negative) and Risk to the operation / company.

Compliance

Extent of compliance of activity / aspect to relevant legislation and permit conditions, under normal and abnormal operating conditions.

Improvement

Opportunity for reducing severity / extent / likelihood of impact by appropriate management or enhancing positive impacts.

As Low As Reasonably Practicable (ALARP)

Applied to aspects that are still rated high even when all practicable control measures have been implemented.

7.2.2 Identification of environmental aspects

The mine is divided into a number of areas of responsibility. This is done on the basis of the existing management structure of the mine.

The following structure forms the basis for the aspect register and organises all environmental information relevant to the EMPs of the System:

- Department
- Section
- Area
- Activity Description
- Aspect
- Impact

Each aspect is described in detail adding information regarding volumes, current mitigation and potential emergency conditions. The relevant Section Head / Mine Overseer are present when the aspects are described to ensure accuracy and reliability.

The environmental aspects are identified or updated based on:

- The description of the activities in each area
- The known impacts of the activities
- Information contained in the EMP
- EIAs and risk assessments conducted for a new process
- Legal requirements obtained from the legal register
- Re-occurrence of incidents or non-conformances relating to an area, activity or product
- Known environmental factors such as neighbouring environmental hotspots

The environmental aspects associated with activities, products and services are documented in the aspect register. The potential impacts arising from the environmental aspect are also captured in the aspect register. An aspect may lead to more than one impact.

7.2.3 Prioritisation of environmental aspects

In order to determine the significance rating of the environmental aspects, the following assessment is used:

Table 48: Likelihood (negative impacts)

DESCRIPTION	DEFINITION
Definite	It is certain that the impact will materialize regardless of any preventive measure
Probable	The likelihood that the impact will materialize exceeds 10%
Possible	The likelihood of the impact materializing < 10%
Low	Possibility of impact materializing is very low either because of design or historic experience (likelihood < 1%)

Table 49:(Positive impacts)

DESCRIPTION	DEFINITION
Definite	It is certain that the impact will materialize under current practise and controls
Probable	The likelihood that the impact will materialize exceeds 10%
Possible	The likelihood of the impact materializing < 10%
Low	Possibility of impact materializing is very low due to the circumstances occurring on an ADHOC basis.

Table 50: Extent (negative impacts)

DESCRIPTION	DEFINITION
International	Impact on a scale beyond country boundaries
National	Impact on a scale within country boundaries
Regional	Impact on a regional scale
Local	Impact extends locally: the site and its surroundings
Site	Impact is confined to the site only
Immediate	Impact is confined to the immediate vicinity of the activity itself

Table 51: (Positive impacts)

DESCRIPTION	DEFINITION
International	Impact on a scale beyond country boundaries
National	Impact on a scale within country boundaries
Regional	Impact on a regional scale
Local	Impact extends locally the site and its surroundings
Site	Impact is confined to the site only
Immediate	Impact is confined to the immediate vicinity of the activity itself

Table 52: Severity (negative impacts)

DESCRIPTION	DEFINITION
Very High	Environment: There is a total disruption of natural, social and cultural functions or processes to the extent that these functions would permanently cease. Risk: Workforce fatality, Complete

	disruption of operational integrity, Loss of company credibility, with key stakeholders, Non-compliance with likelihood of prosecution, Premature close of operations
High	Environment: There is a total disruption of natural, social and cultural functions or processes to the extent that these cease functioning for the duration of the activity but resume functioning after the operation has been terminated. Risk: Workforce reportable or disabling injury or illness, Substantial disruption of operational integrity, Negative public perception, Non-compliance with low likelihood of prosecution, Required to position operation for imminent closure, Could have wider corporate implications
Moderate	Environment: The natural, social and cultural functions or processes are notably altered but continue (albeit in a modified way). The effect is reversible within the lifetime of the operation. Risk: Minor injury, Required to position the operation for closure, Required to position the operation for impending legislation
Low	Environment: The natural, social and cultural functions or processes are minimally affected (often only just measurable). Such effects are felt only during the life of the operation. Risk: Incident
No Effect	No effect e.g. a small oil spill in a bund wall

Table 53: Severity (positive impacts)

DESCRIPTION	DEFINITION
Very High	All Products; Services and Activities will function independently with long-term sustainability.
High	All Products; Services and Activities will function with sustainability after closure of the mine with limited company controls.
Moderate	All Products; Services and Activities are sustainable during the life of the mine under controlled conditions with increased resource investment.
Low	The natural, social and cultural functions or processes are minimally improved (only just measurable). Such effects are felt only during the life of the operation. Risk: Limited investment of resources.
No Effect	No positive effect

Table 54: Compliance (negative impact)

DESCRIPTION	DEFINITION
Not Compliant	Operation is currently not compliant under normal operating conditions
Occasionally Not Compliant	Operation is generally compliant but there is occasional non-compliance under normal operating conditions
Potentially Not Compliant	Operation is generally compliant but there is potential non-compliance under abnormal operating conditions
Compliant / n/a	Operation is compliant under normal AND abnormal operating conditions OR Compliance is NOT APPLICABLE to this impact
Positive	The Operation adds value by leading by example

Table 55: Compliance (positive impact)

DESCRIPTION	DEFINITION
Not Compliant	Operation is currently not compliant under normal operating conditions

DESCRIPTION	DEFINITION
Occasionally Not Compliant	Operation is generally compliant but there is occasional non-compliance under normal operating conditions
Potentially Not Compliant	Operation is generally compliant but there is potential non-compliance under abnormal operating conditions
Compliant / n/a	Operation is compliant under normal AND abnormal operating conditions OR Compliance is NOT APPLICABLE to this impact
Positive	The Operation adds value by leading by example

Table 56: Improvement (negative impact)

DESCRIPTION	DEFINITION
High	Strong opportunity to improve management to reduce or eliminate impact.
Medium	Management measures are in place to manage impact. Improved management could further reduce or eliminate impact.
Low	The activity/ aspect is currently well managed. There is little or no scope for improving current management to further reduce impact.
Not Required	No management is required

Table 57: Improvement (Positive impact)

DESCRIPTION	DEFINITION
High	Strong opportunity to improve management to enhance the positive impact.
Medium	Management measures are in place to sustain the positive the positive improvement. Improved management could enhance the positive impact.
Low	The Activity, Products and Services are currently well managed. There is little or no scope for further improvement.
Not Required	No management is required

Table 58: Training Required (Negative Impact)

DESCRIPTION	DEFINITION
Yes	Training is required for the aspect under review. Training will mitigate the severity of the Impact.
No	Training is not required for the aspect.

Table 59: Training required (positive impact)

DESCRIPTION	DEFINITION
Yes	Training is required for further improvement
No	Training is not required for the aspect.

Table 60: Emergency (negative impact)

DESCRIPTION	DEFINITION
Yes	The activity and related aspects could lead to an environmental emergency taking place.
No	The activity and aspect cannot lead to an environmental emergency situation.

Table 61: Emergency (positive impact)

DESCRIPTION	DEFINITION
Yes	The activity and related aspects could lead to an environmental emergency taking place.
No	The activity and aspect cannot lead to an environmental emergency situation.

Every aspect is evaluated according to the criteria listed above. Only the most suitable class of each criterion will be selected taking note of normal, abnormal and emergency situations. All aspects are rated taking into consideration current mitigation in place in the area under investigation i.e. the residual risk will be determined.

The type and effectiveness of mitigation that should be considered are, amongst others:

- Suitably competent personnel;
- Monitoring and management process and procedures in place;
- Physical barriers and controls to prevent or minimize the impacts;
- Emergency procedures and systems in place where applicable. The rating of aspects will be done in conjunction with the responsible person of the area under investigation.

7.3 Indication of the phases and estimated time frames in relation to the potential impacts rated

7.3.1. Implementation

The mine is already operating since 1967.

7.3.2. Operational phase

The current anticipated LoM is 2028 for underground workings.

7.3.3. Decommissioning phase

At the current production rate the mine can be operational for multiple years. At the end of the period the project will be re-evaluated and a decision to extend the mining right will depend on this outcome. The LoM is 2028 but this can extend based on potential block 6 activities.

Regulation 50 (d)

8 Identification of the alternative land uses which will be impacted upon

Full mining production commenced in 1967. Most of the mining activities currently take place on the original Brits Farm. The farm does not have water, and was therefore not suitable for agriculture, apart from some grazing for cattle.

9 Listed results of a specialist comparative land use assessment

The mining site was previously mined; therefore no alternative land uses can occur on this site.

Regulation 50 (e)

10 List of all the significant impacts as identified in the assessment conducted in terms of Regulation 50 (c)

Significant impacts are any impact identified in paragraph 7.1 of section 1 (EIA) which have two of the following rating:

- Definite or probable likelihood;
- International, national or regional extent; and
- Very high or high severity.

These significant impacts are highlighted as dark pink in paragraph 7 of section 1 (EIA).

10.1 Construction phase

Mining production commenced in 1967. The construction of the Brits FRD was completed in 2007 and the facility was commissioned in 2008. The economic LoM under the curatorship of De Beers was planned until 2014, but with the sale to Petra Diamonds on 14 September 2011 the LoM planning was extended by approximately another 20 years. In the case of any other activity taking place that requires an EIA, an impact assessment screening process will be followed.

10.2 Operational phase

The operational phase is divided into four sections. These sections are mining activities, ore processing activities, support services and general. Each section is divided into the different activities that currently take place as part of the operational phase. Please note, all impacts related to waste for all sections, transport and hazardous substances will be dealt with under the support services section.

10.2.1 Mining activities

Refer to paragraph 7.1.2.1 of section 1 (EIA) for the complete impact and aspect register, highlighting the significant impacts.

10.2.2 Ore processing activities

Refer to paragraph 7.1.2.2 of section 1 (EIA) for the complete impact and aspect register, highlighting the significant impacts.

10.2.3 Support services

Refer to paragraph 7.1.2.3 of section 1 (EIA) for the complete impact and aspect register, highlighting the significant impacts.

10.3 Decommissioning phase

Refer to paragraph 7.1.3 of section 1 (EIA) for the complete impact and aspect register, highlighting the significant impacts.

Regulation 50 (f)

11 Identification of interested and affected parties

11.1 Introduction

Various public participations and liaisons with interested and affected parties (I&APs) and stakeholders have taken place at the mine.

1. In 2006, a public participation was done for the EIA for a NEW FRD at the mine conducted by Golder Associates;
2. In 2007 a public participation was done for the EIA for a new explosives magazine conducted by Shangoni Management Services;
3. In 2009 a stakeholder liaisons was held for the closure plan of the mine, conducted by Redco;
4. In 2011 a stakeholder engagement was held for the SLP conducted by the HR department of the mine; and
5. In 2011/2012 a public participation was done for the update of the EMP (this EMP) conducted by Shangoni Management Services.

11.2 Interested and affected parties database

Below is a combined I&AP database for all five projects as mentioned in paragraph 11.1 of section 1 (EIA):

Table 62: Interested and affected parties database

NAME	DESIGNATION / ORGANISATION
Mr. Raisrve Fekepane	DMR - Director: Mineral Development
Mr. Sam Dywili	DWA
Mr. Glen Stenekamp	DWA
Sonkhile Mudaweni	DWA
Lorraine Nobela	DWA
Mr. Hendrik Potas	S.A. Police Service
Mr. W.V.D. Mothibi	Dept of Agriculture- Agricultural extension Officer
Mr. J.J. Lambrechts	Neighbour - Farms Strathmore &Wildspan
Mr. R.J. Lombaard	Neighbour - Farm Rocky Flats
Mr. R.J. Lombaard	Neighbour - Farm Bergplaas
Mr. H. Meyer	Neighbour - PPC Lime Acres Mine & Factory
Mr. Johan Classes	PPC Lime Acres
Mr. Gestav von Mollendorf	KLM
Mr. Bernie Ferreira	SDM
Mr. Risible Sekepane	DMR
J Frank	Leclovo cc
M Dzivhani	PPC Lime
C Schoombie	PPC Lime
J Lambrechts	Kolomela Mine
T Molefe	DENC (Department of Environment and Nature Conservation)
S Mbanjwe	DENC
M Motete	DRDLR (Department: Rural Development and Land Reform)
T Tau	DRDLR

12 The details of the engagement process

12.1 Engagement process for new fine residue deposit facility

The opportunity for stakeholders to participate in the environmental assessment process, with specific regard to the Next Best Option, was announced as follows:

- Several copies of a background letter describing the use of the NBO FRD site were distributed to stakeholders in the area during July 2006 as a first step to announce the opportunity for comment;
- Site notices were placed at the mine during October 2006, providing background information to the proposed project;
- More than 50 telephone calls to key stakeholders in the area were made;
- An newspaper advertisement;
- An Authorities Meeting was held at the mine on Thursday, 7 September 2006;
- A Public Meeting was held in the afternoon of Thursday, 7 September 2006 in Lime Acres, to discuss any comments and issues raised by the Public, with regard to the Draft Scoping Report; and
- An Authorities Meeting and Public Meeting/Focus Group were held on Thursday, 30 November 2006 to discuss issues surrounding the Draft EIA/EMP Report which was in the Public domain for review.

During the initial consultation period, stakeholders had the opportunity to raise issues either in writing, by e-mail or during telephonic consultation with key groups.

A period of three weeks was made available for public comment on the Revised Draft Scoping Report. The availability of the Revised Draft Scoping Report was announced by way of a letter announcing the availability of the Revised Draft Scoping Report. The report was distributed by mail to those who requested a copy and leaving it in the following public places:

- Beaconsfield Library
- Lime Acres Library
- Galeshewe Library
- Kimberley City Library
- Finsch Diamond
- Golder Associates Africa, Midrand

Public review of the Revised Draft Scoping Report was by the following methods:

- Written comment, including e-mail. A comment sheet asking stakeholders to respond to particular questions accompanied the report; further written submissions were encouraged;
- Verbal comment during telephonic consultation; and
- At a Public Meeting, held in Lime Acres on Thursday, 7 September 2006.

A Public Meeting was held on Thursday, 7 September, 2006 in Lime Acres, to discuss comments and issues raised by the Public, regarding the Revised Draft Scoping Report. In addition, another Public Meeting was held on Thursday, 30 November, 2006 (also in Lime Acres) to discuss possible concerns raised regarding the Draft EIA/EMP Report Amendment. The content of the Revised Draft Scoping Report together with other relevant information was displayed at the September meeting, and the content of the Draft EIA/EMP Report was also displayed during the November meeting. Copies of relevant documents and reference material are also made available for stakeholders that attended the meetings to take away.

A Draft EIA/EMP Report Amendment was prepared after the public review period of the Revised Draft Scoping Report (end of October 2006). The availability of the Draft EIA/EMP Report was advertised in the Diamond fields Advertiser on 29 November 2006 and a Public Meeting was held on 30 November 2006. Stakeholders were invited to the meeting telephonically and in writing. Stakeholders were also invited to comment on the Draft EIA/EMP Report in writing and a comment sheet was included in the letter to ensure that all stakeholders had the opportunity to comment on the report. The public meeting was held and stakeholders indicated that they were satisfied with the process. A copy of the groundwater study, which elicited the most issues during the process, was handed to stakeholders to study at their leisure. The Draft EIA/EMP Report was updated with comments by the stakeholders. The final EIA/EMP Report (this report) will be submitted to the lead authority, the DME, on Monday, 11 December 2006, for a decision.

12.2 Engagement process for new explosives magazine

A block advert of (150mm x 95mm), according to the EIA Regulations, 2006, was placed in the local newspaper, Kuruman Bulletin 14 June 2007. The Department requested to re-advertise the project as the previous advert was done in the old Regulations. The advert appeared in the Kuruman Bulletin on the 31 January 2008.The Kuruman Bulletin distributes approximately 12,000 copies per week to Kuruman, Kathu, Danielskuil, Lime Acres, Postmasburg, Olifantshoek, Beeshoek, Mines and Municipalities in distribution area.

Notices according to the NEMA, were displayed at the Mine. Notices were placed at the following locations:

- At the exit 1 and 2
- At the entrance 1 to the mine
- At the entrance 2 to the mine
- At the entrance 3 to the mine

These notices were displayed from 1 June 2007 for a period of 30 days. The site notices were re-displayed in the new EIA Regulations and displayed at the Mine.

12.3 Engagement process for the closure plan

Consultation with I&APs did not form part of the scope of work for this Preliminary Closure Plan; its aim was to *identify* all relevant stakeholders which would facilitate the planning of a stakeholder engagement strategy for closure.

12.4 Engagement process for the social and labour plan

The LEDP for the mine was put together in conjunction with the relevant officials from the KLM and SDM. Since the approval of the mine's mining right and the associated SLP, the management of the mine has actively sought to engage with the key stakeholders in the region.

Stakeholder engagement forums / meetings were convened in the period under review, and were specifically aimed at informing stakeholders regarding the implementation of the Local Economic Development Plan (LEDP). Important milestones were:

- Jan 2011 –Three learner ship candidates continue on the job training at the mine
- April 2011 -Handover of the sanitation project as well as the electrification project of Idwala and PPC Lime
- June 2011 - Draft MOU between municipality and the mines
- September 2011 – Draft Local Economic Development (LED) strategy between the mines and the municipality

The implementation of LED is managed by the KLM LED Steering Committee with the municipality chairing the meetings. The Chairperson is the Mayor or an appointed representative from the Local Council. The working groups deal with day to day activities of execution and include municipality officials, the mine technical experts and where applicable, community representatives.

The collaborative nature of the SLP necessitates that external and internal stakeholders are kept abreast and consulted at all times. External forums and steering committees include:

- KLM LED Steering Committee with the mine, Idwala Lime and PPC Lime (Mayor, councillors and MM)
- Work Group Meetings (LM and DM Officials and FM employees)
- SDM LED Forum
- Quarterly meetings with DMR Provincial office representatives
- The Internal structures include the following:
- SLP Committee (Management, representative bodies and responsible employees, projects) are represented in this committee that meets on a quarterly basis.
- Future Forum is constituted by members of Management and the representative bodies (NUM and Solidarity).
- Ad hoc meetings with relevant other stakeholders

Additional meetings are convened when needed and the input from a wide range of relevant persons is used.

12.5 Engagement process for the EMP update

The advertisement was published in the Diamond Fields Advertiser on 30 January 2012.Public notices referring to the proposed activities and the public meeting were put up in Lime Acres. A public meeting was held on the 13th of February 2012 at the Recreation Club Lime Acres at 17h30.

A stakeholders meeting was held on the 14 February 2012, whereby officials from DENC and DRDLR attended the meeting.

A third stakeholders meeting was held on the 19 June 2012 at the DWA offices in Kimberley. Officials from DWA attended the meeting.

13 Details regarding the manner in which the issues raised were addressed

13.1 Issues raised for the new fine residue deposit facility

All the comments provided at the September meeting were captured in the format of a Draft Issues and Responses Report and distributed to people who requested copies. The comments were added to the Issues and Responses Report which accompanies this EIA/EMP Report Amendment.

13.2 Issues raised for the new explosives magazine

No persons registered as I&APs in terms of the advertising of the project.

13.3 Issue raised for the closure plan

No issue were raised during this process.

13.4 Issues raised for the social and labour plan

All issues raised were included in the SLP.

13.5 Issue raised for the EMP update

The following issued were raised at the meetings:

Table 63: Issue at the public meeting on 13 of February 2012

NAME	COMMENT	RESPONSE
S. Sparks	S. Sparks enquired what the proposal was with regards to the accommodation provided to the proposed contractors.	L. Rode indicated that at this stage no final decision had been made with regards to the accommodation. He did indicate that a large number of houses were available for use from the previous expansion projects done at the mine. He did indicate that this will receive careful thought

Table 64: Comments at the stakeholder meeting on 14 February 2012

NAME	COMMENT	RESPONSE
M Motete (MM)	MM enquired whether there is any additional prospecting on the surrounding farms.	J Nel (JN) indicated that as far as he is aware there has been prospecting done by De Beers in the past in and around the mining area. Currently no prospecting is taking place. He did however say that he cannot say whether any future prospecting is planned around the current mining area.
MM	Enquired whether the mine is	JN indicated that the four additional activities namely,

NAME	COMMENT	RESPONSE
	the only place where the mentioned activities are planned.	road upgrade, pipeline upgrade, air field/ runway upgrade and proclamation of the town fall outside the mining area. The other activities are all in the mining area.
T Molefe (TM)	TM indicated that water for agricultural purposes is very important. He enquired whether additional water will be required and whether dumping happens inside the mining area.	JN indicated that the mine has an existing water license. He mentioned that the changes would not require additional water. This is based on the current information. He also stated that dumping of coarse residue and fines is planned to take place inside the current mining area.
TM	TM enquired whether the mine may be moving towards the town and demolish the town in future.	JN indicated that according to him this is definitely not part of future developments.
JN	JN indicated that the current identified activities on the mine do not trigger any BA or EIA requirements at this stage. This is based on the current information received from the mine.	Those present agreed on the comment. It was however mentioned that the additional activities outside the mine need to be assessed against the listed activities and conformation must be obtained of the technical information to determine whether a BA or EIA may be required.
S Mbanjwe (SM)	SM enquired whether there is any proposal to extend the mine towards the town or in the direction of the mine.	JN indicated that the resource is currently mined in the pipe and the mine direction cannot change. At this stage there is no indication of any movement towards the town. Deposition of waste is limited to the current mining area and the extension of the CRD towards the south and the FRD (Brits dam) to extend to the north onto PPC property.

Table 65: Comments at the stakeholder meeting on 19 June 2012

NAME	COMMENT	RESPONSE
Lorraine Nobela (LN)	The water use licences you have, for what is it?	GS responded that the mine operated under a registration and not authorisation. The water use licence was issued last year. He mentioned what water activities have been licensed.
Glen Stenekamp (GS)	How does Sedibeng water forms part of the mine's water activities?	The mine buys water form Sedibeng. The mine uses only a small amount of water, much less than per license. The mine does

NAME	COMMENT	RESPONSE
		not use Bonza water at present.
GS	He saw an e-mail regarding above-mentioned matter.	SS replied that the new license forms included the old information from 2006.
GS	DWA does not bill Sedibeng water; however Sedibeng water billed De Beers in the past and now Petra.	LN stated that the mine must submit the arrangement between Sedibeng water and the mine to DWA.
GS	Will Sara Sparks (SS) take this matter up?	SS responded she will.
SS	Must the IWULA then be amended?	GS stated that the IWULA must be amended.
Sonkhile Mudaweni (SM)	The EMP states that no water is taken form Bonza quarry.	SS stated this is not entirely true. In the past the mine used water from PPC that was pumped into Bonza quarry. Sedibeng said this may not be done. Then the mine started using water allocated from the VG pipeline.
LN	The IWULA must be amended	SS confirmed this. She also said that the mine only got authorisation of their WULA last year.
SS	Should the WULA include the water from the VG pipeline?	LN confirmed this. This will enable DWA to relook in the DWA register.
SS	The use of VG water is a registered use.	GS confirmed and stated this registration was under De Beers.
SM	The mine will be billed for taking water from Bonza quarry.	SS stated that the mine is already being billed for this water.
SM	DWA will also bill the mine for seepage and the S21A water use.	SS stated the mine is at presently not billed for this.
SM	License conditions should be part of Tshiping Water User Association. It must clarify water use changes and include agreement. The mine will get 2 invoices, one from DWA and one form the water association.	SS stated the mine has only paid from Sep 2011 when the mine changed from De Beers to Petra.
SM	For the payment of the water resource management, is the name change through?	GS stated that depending on the state of title deeds only need to change name.
SM	Does the mine have an IWWMP?	SS confirmed that in 2010 the IWWMP was submitted to DWA. This document may be reviewed. Nothing has changed

NAME	COMMENT	RESPONSE
		except water use volumes. Brits Dam is part of current licence.
SM	The IWWMP may need an update?	SS confirmed that this must be done to update names, sizes of dams etc. The WULA must also be updated.
SM	With the amendment of the IWULA the IWWMP must also be amended.	GS stated that the name change must be done before the amendment.
GS	A meter must be put in at Bonza quarry to measure amount of water used.	SS stated that there is such a meter.
GS	Then the actual readings must be submitted to DWA.	SS asked where these meter reading results must be submitted.
GS	The meter readings results must be submitted at Sidney Lindhorst. This will also help with the billing.	
SS	If the mine wants to take water from PPC how do the mine go about to get this legal?	
GS	Does PPC have enough water to give to the mine?	SS confirmed this and asked how to approach this.
GS	Does PPC also fall under Sedibeng?	SS said no.
GS	Have not seen PPC license yet.	SS stated they have applied. PPC does not put water in or take water out of quarry 4. The water has slightly high nitrates.
SM	The quantities of the water uses must be cleared. The license differs from the draft EMP. Need to amend the license accordingly.	SS stated this will be done.
SS	What must be done to make the taking of water form quarry 4 legal? What steps must be taken to start the process? Must the WULA be amended?	GS stated that if PPC gives consent they must amend their WULA as well.
SS	Must this water use be put on the mine WULA and be paid by the mine?	SM stated that it must be cleared on how much will be use and when. It is up for discussion on steps to be followed.
SM	Has any new specialist study been done for the update of the EMP?	SS stated the mine is busy with a groundwater study. This study is basically finished and must be commented on by the mine.

NAME	COMMENT	RESPONSE
SM	In terms of monitoring volumes of dewatering, are you monitoring?	SS confirmed this.
SM	Do you use all the water taken from dewatering?	SS confirmed this.
SM	The reason why asking, needs to look at model regarding volumes pumped out especially when going deeper.	SS confirmed that the mine is busy with these assessments.
SM	According to the EMP the dewatering cone does not fall outside the property.	SS stated that the mine owns quite a lot of land. The groundwater is also in compartments. Some are dewatered and some are not. There are boreholes everywhere. The mine has a groundwater model for dewatering.
SM	The EMP states that the dewatering influences and area of 5-10km. Has there been any complaints from neighbours?	The only complaints are form a farmer and this is on water quality. The mine addresses this issue.
SM	You are looking at recommissioning the FRDs?	SS confirmed this. The mine is busy with a study on this.
SM	Parts of the mine is located on dolomite, what about sinkholes?	SS stated there is a sinkhole on the paddocks. This sinkhole was filled up previously but has stared collapsing again.
SM	Most of the comments will come after receiving the complete draft EMP.	
LN	Does the mine send its monitor reports to DWA?	SS asked which monitoring reports.
SM	Need the S21J effluent monitoring reports.	LN included that the first year monitoring reports on boreholes must be submitted to DWA.
SS	Groundwater reports are done every 6 months.	
SM	The mine must submit groundwater reports within 3 months of licensing.	SS confirmed this was done and included in the IWWMP.
SS	What does DWA do with the monitoring results?	LN stated that DWA also checks it as well as the IWWMP each year. This is to see if there is an impact on the groundwater.
SM	More communication is needed between the mine and DWA.	

Regulation 50 (g)

14 The appropriate mitigatory measures for each significant impact of the proposed mining operation

14.1 Adequacy of predictive methods utilised

All predictive methods are based on historical experience, visual assessments, specialist reports, internationally acceptable standards and proven mitigation.

14.2 Adequacy of underlying assumptions

Assumption are supported by the specialist studies and monitoring information obtained from the mine.

14.3 Uncertainties in the information provided

- No noise monitoring taken at the boundaries of the plant is available.
- The most recent bacteriological, surface water chemical results and groundwater chemical results were not available.
- There is no PM10 or pm2.5 monitoring results at present.
- Three months dust fall-out results in 2012 were not available.
- There was no noise monitoring results after April 2012.
- There is no available data on the capacity to manage and rehabilitate the environment.

REGULATION 50 (h)

15 Arrangements for monitoring and management of environmental impacts

15.1 List of identified impacts which will require monitoring programmes

Some monitoring requires comparison with specified limits or standards to ensure compliance with legislation. Other monitoring is carried out for the tracking of operational/environmental objectives and targets. All the relevant monitoring data is reported on in the annual environmental performance report. Non-conformances are recorded in the EMS database and the required corrective and preventative action taken. Refer to Table 68 for a list of commitment that will be monitored.

15.2 Functional requirements for the said monitoring programmes

1 Calibration of all measuring equipment shall be carried out according to the Original Equipment Manufacturer (OEM) instructions.
2 The instructions shall include the frequency, specifications and standards required for equipment calibration.
3 Calibration can also be done through comparisons between different measuring equipment.
4 The section responsible for the instrument or equipment used shall maintain the calibration records on file.

15.3 Roles and responsibilities for the execution of the monitoring programmes

The responsible person shall receive an e-mail notification with the details of the incident and corrective actions which must be completed before the due date specified. Once the action has been taken, a progress report shall be completed on the EMS electronic database. Refer to Table 68 showing the roles and responsibilities for the execution of the monitoring programmes.

15.4 Time frames for monitoring and reporting

Refer to Table 60 showing the timeframes for the execution of the monitoring programmes.

Table 66: Monitoring of environmental impacts

SECTION 15.1	SECTION 15.2	SECTION 15.3	SECTION 15.4
MONITORING	**FUNCTIONAL REQUIREMENTS**	**ROLES AND RESPONSIBILITY**	**TIMEFRAMES**
Water quality monitoring	The water monitoring programme is aligned with the requirements of the NWA and MPRDA. The water monitoring programme will include: • Borehole Water level measurement using an electronic dipmeter • Multi- parameter logging ○ In-situ measurement of conductivity ○ The position of fractures is identified in order to determine sampling depth • Water quality sampling • Analysis of the samples, including organic analysis for the oily water separators The sources and potential sources of water pollution on surface and underground which require monitoring are: • Leaching of wastes at the waste disposal sites; • Fuel and oil spills/leaks during unloading, storage, use and disposal; • Spills/leaks of other hazardous substances during storage and use; • Leaching from FRDs; • Spills and potential leaching from sewerage lines, portable toilets, the Honey Sucker and Sewage Treatment Plant; • Floods; • Fires; • Bonza Quarry Water – this practice is deemed illegal until the PPC and Finsch WUL are amended, return from Earth dam and fine residue return; • Earth Dam; • Five Mission Dam; • Laundry facility at Change Houses; • Silt/mud removed from wash bays and hydrocarbon storage sumps.	Environmental specialist Occupational hygienist External water specialist	Every 6 months Monthly inspections Monthly Monthly 6 monthly

SECTION 15.1	SECTION 15.2	SECTION 15.3	SECTION 15.4
MONITORING	**FUNCTIONAL REQUIREMENTS**	**ROLES AND RESPONSIBILITY**	**TIMEFRAMES**
Water quality monitoring	**Method of sampling** Borehole The method of sampling boreholes shall be done according to the latest hydrogeological Guidelines for borehole water sampling and profiling; All water sample analyses shall be carried out by a SABS registered laboratory. Borehole equipped with a pump and dispensing point 1 Clean 500ml plastic or glass bottles obtained from the specified laboratory shall be used for chemical analysis only. 2 500ml glass bottles shall be used for hydrocarbon analysis and 100ml glass sterilised bottles for bacteriological analysis. 3 Bottle shall not be rinsed. 4 Nearest tap/outlet shall be found to take the sample. 5 The tap/outlet shall run for at least 3 minutes. 6 After 3 minutes sample bottle shall be opened 7 For bacteriological sampling the tap outlet shall be sterilized with a flame using a small portable gas burner 8 Bottle shall be filled with water and the cap shall immediately be replaced. 9 Sample bottle shall be placed in a cooler box directly after collection. 10 Cooled container shall be kept dust free and out of any direct sunlight. 11 Samples shall be analyzed as soon as possible. 12 A 1litre sample shall be required for analysing.	External water specialist	Monthly
	Sampling of borehole water without a pump 1 It is recommended that purging of boreholes is done at least once every two to three years. 2 .it is essential that samples are taken at the same depth to obtain a uniform estimation of true water quality 3 The clean baler (vol. ±1litre) shall be lowered into the borehole until it becomes submerged into the water.	External water specialist	Every 2 years

SECTION 15.1	SECTION 15.2	SECTION 15.3	SECTION 15.4
MONITORING	**FUNCTIONAL REQUIREMENTS**	**ROLES AND RESPONSIBILITY**	**TIMEFRAMES**
Water quality monitoring	4 The baler is cleaned with deionised water before each sample is taken. 5 The inner surface of cap and neck of sample bottle shall not be contaminated with hands. 6 The bottle shall not be rinsed. 7 The bottle shall be correctly labelled with date of collection and sampling point location. 8 The water shall be transferred into the clean 500ml container (plastic or glass) and the cap shall be put on immediately. 9 Air space shall be left in the bottle (at least 2.5cm) to facilitate mixing by shaking. 10 Sample bottle shall be placed in cooler box with ice bricks directly after collection. 11 Cooler box shall be kept dust free and out of any direct sunlight. 12 Cooler box shall be taken to the Lime Acres hospital and liaise with hospital staff to ensure that water samples are stored in the refrigerator. 13 Cooler box shall be stored in close proximity to refrigerator. 14 Cooler box with ice bricks and samples shall be transported to ESKOM laboratory in Kimberley by mine transport. 15 The samples shall be kept cool at all times.		
	Surface non potable water sources 1 500ml plastic bottles shall be used for chemical analysis. 2 500ml glass bottle shall be used for hydrocarbon analysis. 3 100ml sterilized glass bottles shall be used for bacteriological analysis. 4 All sample bottles shall be obtained from the specified laboratory. 5 Bottle shall not be rinsed. 6 Sample bottle shall be submerged in the water. 7 The sample bottle shall then be filled. 8 For bacteriological and hydrocarbon analysis the bottle shall be filled to the top. 9 For chemical analysis the bottle shall not be filled completely, 2.5cm airspace shall be left for mixing purposes. 10 The cap shall be replaced without touching the inner side of cap or neck of the bottle with hands. 11 Sample bottle shall be placed in a cooler box container.	External water specialist	Monthly

SECTION 15.1	SECTION 15.2	SECTION 15.3	SECTION 15.4
MONITORING	**FUNCTIONAL REQUIREMENTS**	**ROLES AND RESPONSIBILITY**	**TIMEFRAMES**
Water quality monitoring	12 Cooler box shall be kept dust free and out of any direct sunlight. 13 A 1liter sample shall be required for analyzing, therefore 2x500ml samples shall be taken for each sampling point. 14 Samples shall be analysed within 24 hours of collection. 15 Cooler box shall be kept dust free and out of any direct sunlight. 16 Samples shall be analysed within 24 hours of collection. 17 A 1liter sample shall be required for analyzing, therefore 2x500ml samples shall be taken for each sampling point.		
	Bacteriological sampling 1 100ml sterilized glass bottles obtained from the specified laboratory shall be used. 2 Bottle shall not be rinsed. 3 Tap outlet shall be opened and the water shall be allowed to run for 1-2 minutes. 4 The tap shall be closed and a hand held burner shall be used to sterilize the tap outlet. 5 Sampler shall wear sterile surgical gloves or wash his/her hands thoroughly before taking each sample. 6 Sample bottle shall be filled and without touching inside of cap the cap shall be replaced immediately. 7 Samples shall be kept on ice in a cooler box. 8 Each sample shall be labelled clearly. 9 The sample shall arrive at the laboratory within 24 hours of collection. 10 If no laboratory sample bottles are available, 1litre glass cold drink bottle that has been thoroughly washed and rinsed well in boiled drinking water shall be used General 1 Each sample shall have a clearly identifiable label and shall be accompanied by the documentation required by the laboratory. 2 SABS registered laboratories shall be used for all water analyses. .	External water specialist	Monthly

SECTION 15.1 MONITORING	SECTION 15.2 FUNCTIONAL REQUIREMENTS	SECTION 15.3 ROLES AND RESPONSIBILITY	SECTION 15.4 TIMEFRAMES
Water quality monitoring	**Sample Points and sampling frequency** Bacteriological analysis These tests shall be conducted to determine the presence of: • Total Coli forms; • Typical Faecal Coli forms; and • Total Viable Organisms.	External water specialist	Monthly
	On a monthly basis samples for bacteriological sampling shall be taken from: 1 Potable Water Sources: • Lime Acres village reservoir; • Five Mission village water reservoir; • Bottom Dam – Mine Potable water supply reservoir; • Norfin village water reservoir; and • Vaal Gamagara inflow 2 Non Potable Water Sources: • Final sewerage effluent; • Shaft service water – header tank; • Earth Dam; and • FRD (Fine residue) return of all operational facilities	External water specialist	Monthly
	Chemical analysis 1 A standard Inorganic chemical analysis for macro and micro-parameters shall be carried out on all samples and organic analysis will be done for specified samples bi- annually. 2 New sample applications shall be analysed every two months so that a baseline of results is established. 3 Thereafter bi-annual sampling shall take place.	External water specialist	Biannual

SECTION 15.1	SECTION 15.2	SECTION 15.3	SECTION 15.4
MONITORING	**FUNCTIONAL REQUIREMENTS**	**ROLES AND RESPONSIBILITY**	**TIMEFRAMES**
Water quality monitoring	4 Designated points shall be: • All groundwater monitoring boreholes are sampled for environmental management purposes by an external groundwater specialist); • Earth dam • Thickener • Brits return water • FRD seepage • Potable water tap		
	Hydrocarbon analysis 1 Hydrocarbon pollution of water shall be monitored by taking samples for hydrocarbon analysis bi annually from existing designated sites. 2 New sample applications shall be analysed every two months to obtain baseline data. 3 Thereafter sampling shall be carried out bi-annually. 4 Designated sites shall be: • Earthmoving workshop oil separator; • Outside services workshop separator; • 51 l workshop oil separator; • 68 L Settlers before and after flocculation; • 63 L workshop oil separator; • WAMY oil separator; and • Specified boreholes	External water specialist	Biannual
	Special samples 1 Special samples shall be taken for analysis when complains are received. 2 This shall done at the discretion of the Occupational Hygienist or Environmental Specialist	External water specialist	Ad hoc

SECTION 15.1	SECTION 15.2	SECTION 15.3	SECTION 15.4
MONITORING	**FUNCTIONAL REQUIREMENTS**	**ROLES AND RESPONSIBILITY**	**TIMEFRAMES**
Water quantity monitoring	**Section A: drinking and process water** 1 Water readings shall be taken monthly as per the schedule below. 2 A Sedibeng representative shall be responsible for taking the water readings on water meters VGC 35 to VGC 40.	Services clerk	Monthly
	Section B: Plant Process Water 1 Flow data from the major dams shall be supplied to the plant by outside services. 2 Within the plant monitoring shall be undertaken to ensure that the process operates at optimum efficiency with respect to both production and water usage. 3 This monitoring shall be by means of flow meters, drop tests and observations. 4 The data shall collected in the following areas: • SCMS – flow meter data captured manually or digitally. • DMS to Thickeners - flow not measured, water released to balance system. • DMS to Thickener G - drop tests with results being recorded and held on file by the Plant Metallurgist • DMS to CRDs - Average moisture content is calculated in the laboratory everyday with the results being stored on M: /Plant/laboratory/lab results. • Process water to G from thickener overflow Limited, erratic and not measured. • G Thickener – to other thickeners – no measurement, used to balance system. • Thickeners to Fine residue – Deistometers and flow rate by drop test, plus records of hours pumped. Data is stored in M: /Plant/laboratory/systems.	Services engineer	Monthly
	Section C: Groundwater 1 Regional groundwater levels shall be monitored via surface boreholes, using a dip meter, so as to ascertain any significant changes that may occur. 2 The information can be divided into three groups: • Boreholes around the mine, monitored by the mine personnel on a monthly basis. • Boreholes around PPC, monitored by PPC personnel on a three monthly basis. • Boreholes on surrounding farms, monitored by the mine personnel on a six monthly basis.	Geotechnical officers	Monthly/quarterly

SECTION 15.1	SECTION 15.2	SECTION 15.3	SECTION 15.4
MONITORING	**FUNCTIONAL REQUIREMENTS**	**ROLES AND RESPONSIBILITY**	**TIMEFRAMES**
Water quantity monitoring	3 In the case of the latter group the information is for general trends only as the Mine has no power to ensure that the farmers do not over pump their wells. 4 The Geotechnical Manager shall do trend analysis/comparison with local rainfall patterns 5 The data shall be taken into consideration in the construction of the three dimensional models used to assess the risk of groundwater inflow into the mining operations and the effect of the associated de-watering on the region.		
Fallout dust monitoring	There are currently four fixed monitoring points that are being used to collect two-weekly samples in order to measure fall-out dust. Two of the dust buckets are located downwind of potential pollution sources in consideration of the major seasonal wind directions. One bucket is placed upwind of the mining operations in order to collect base information. There is also one mobile monitoring point used to measure dust fall-out in specific areas on an ad hoc basis. **Monitoring general** 1 Sampling activities shall always reflect the method as described in the Standard Test Method for Collection and Measurement of Dustfall (Settleable Particulate Matter) D 1739-98 used internationally to determine fallout dust concentrations. 2 Containers of a standard size and shape shall be prepared and sealed in a laboratory and then opened and set up at appropriate chosen sites so as that particulate matter can settle into them for periods of about 30 days. 3 The containers shall then be closed and returned to the laboratory. 4 The masses of the water-soluble and –insoluble components of the material collected shall be determined. 5 The results shall be reported as grams per square meter per day, ($g/m^2/day$). **Site location** 1 The site shall be in an open area, free of structures higher than 1m within a 20m radius from the container stand. 2 The site shall be away from objects that could affect the settling of particulate matter e.g. trees, air exhausts and intakes.	Environmental officer	

SECTION 15.1	SECTION 15.2	SECTION 15.3	SECTION 15.4
MONITORING	**FUNCTIONAL REQUIREMENTS**	**ROLES AND RESPONSIBILITY**	**TIMEFRAMES**
Fallout dust monitoring	3 Elevations to higher objects within 20m shall not exceed 30º from the horizontal. 4 Sampling points shall be identified to cover contribution from the identified point sources, (dumps, stacks etc) down-wind from source taking the predominant wind direction into account. 5 Control points shall also be identified in living areas, (e.g. village) to confirm dust load from mining operations as well as upwind to determine contribution from surrounding environment. 6 The bucket shall be positioned on a stand at a height of between 1.2 to 3.0m. 7 To ensure collecting fall-out dust from a specific source the sampling point shall be located within a 2km radius from that source. 8 A file for each site shall be maintained containing the following: • A site map clearly indicating the sampling point positions in relation to the site activities. • Map co-ordinates of sampling points. • Description of site. • Unusual activities such as fires, construction and demolition work. **Sampling** 1 The containers shall be thoroughly cleaned, filled with distilled water as per standard (ASTM D 1739-98) requirement, sealed with their lids, labelled with identification numbers and transported to the site. 2 The buckets shall be filled with a 3rd from the bottom with the distilled water. 3 An algaecide, (e.g. Jik / Milton) shall be used if algae growth is a problem especially in summer. 4 Containers shall be set out at identified sites. 5 Date time and identification numbers shall be recorded on the prescribed processing log sheet for each container. 6 The sampling period shall be one calendar month, (± 2 days) 7 Removal of the sampling buckets shall be recorded on the log sheet for each bucket. 8 The samples shall be capped, (closed) at the sampling point. 9 The samples shall then be transported to the laboratory for processing and analysis. 10 For blank filter preparation a blank filter paper shall be marked that corresponds to the respective collected field sample to be analysed. 11 This filter shall be dried for at least one hour in drying oven, (105 °C).		

SECTION 15.1	SECTION 15.2	SECTION 15.3	SECTION 15.4
MONITORING	**FUNCTIONAL REQUIREMENTS**	**ROLES AND RESPONSIBILITY**	**TIMEFRAMES**
Fallout dust monitoring	12 The filter shall be weighed to the nearest 0.1 mg. 13 The mass shall be recorded as the acclimatised reference mass, (tare) mass on the log sheet. 14 The contents of collected bucket shall be filtered from sampling point bucket through a no 18, (1 mm) sieve to remove large particulates been deposited in the sampling bucket and that is not classified as fallout dust. 15 Contents retained in sieve shall be discarded. 16 The sides and bottom of the bucket shall be rinsed with distilled water to ensure that settled particulates are in suspension. 17 Pre-weighted filter shall be positioned, (fast filtering type) in filtration unit. 18 Collected contents shall be filtered through the vacuum filter unit on the filter paper. 19 The filter paper shall be dried in the drying oven, (105°C) for at least 90 minutes. 20 The dried filter shall be weighed to within 0.1mg. 21 The drying procedure shall be repeated until a constant mass is obtained. 22 The net mass of the material shall be calculated by subtracting the acclimatized reference mass, (tare) determined during blank filter preparation and weighing. 23 The deposition rate D shall be calculated, in grams/square meter/30 day period, g/(m²/30days): 24 The data shall be reported and processed in the format as stipulated in the attached processing log sheet. 25 The processing log sheets used to record and process data shall be kept in the site files of the respective sampling points. 26 The analytical balance used to weigh the filter paper with a precision of ±0.1g shall be adequately calibrated. 27 Analytical glassware shall be checked for calibration accuracy, (±5ml).		
Fossil fuel consumption monitoring – electricity usage	1 Electricity usage shall be monitored on a monthly basis and compared with production figures to determine whether any wastage may have occurred. 2 This shall be discussed at the monthly environmental meeting and production meetings.	Supply chain Electrical engineering section	Monthly
Rehabilitation monitoring	1 Rehabilitation areas and all areas where alien vegetation is or becomes established shall be monitored on a quarterly basis during normal site visits. 2 Any deviations identified such as erosion, alien invader growth, illegal disturbance of ecosystems shall be actioned on the EMS database. 3 Contours on the MRDs shall be inspected before the rainy season.		

SECTION 15.1	SECTION 15.2	SECTION 15.3	SECTION 15.4
MONITORING	**FUNCTIONAL REQUIREMENTS**	**ROLES AND RESPONSIBILITY**	**TIMEFRAMES**
Rehabilitation monitoring	4 When a potential environmental problem is identified, an environmental incident shall be logged as per procedure. 5 Thereafter corrective and/or preventive measures shall be taken. 6 In addition, contours shall be inspected after each heavy rainstorm. 7 The same reporting and actions as per above bullet shall be followed. 8 Root cause of the incident shall always be established to formulate effective corrective and preventive actions 9 Photo monitoring of vegetation establishment shall be done on fixed points. 10 This shall be done quarterly as well as monthly during the growing season of vegetation. 11 In areas where alien and invasive plant eradication has taken place, the re-growth of the plants shall be assessed on an annual basis. 12 The areas where eradication has not yet taken place shall be monitored on an annual basis to assess the increase in population densities of the targeted species in order to reassess the project priorities. 13 The density of the plant cover over rehabilitated areas shall be assessed on a quarterly basis in order to evaluate rehabilitation success. 14 Photos shall be used when the effectiveness of rehabilitation is monitored. 15 Comparisons shall be made between rehabilitate areas from year to year to monitor progress made and determine effectiveness of rehabilitation. 16 The parameters used during the monitoring shall include: • Comparison between grass types in rehabilitated and natural areas; • Tree growth; and • Basal cover	Environmental specialist	Quarterly
Bioremediation	Bioremediation is monitored by changes in the colour and the smell of the material and by chemical analysis of the material.	WAMY supervisor Environmental officer	Every two weeks
Consumption of hazardous materials			

SECTION 15.1	SECTION 15.2	SECTION 15.3	SECTION 15.4
MONITORING	**FUNCTIONAL REQUIREMENTS**	**ROLES AND RESPONSIBILITY**	**TIMEFRAMES**
Non-conformances analysis as per environmental management review	1 All incidents shall be reported to the environmental management section in one of the following ways: in writing, on the EMS database, e-mail, or telephonically as soon as the incident is observed. 2 The incident shall be captured on the electronic database. 3 Corrective actions shall then be taken. 4 A progress report shall be completed. 5 Actions overdue for an unreasonable period shall be escalated to the immediate supervisor. 6 Monitoring records shall be evaluated to determine trends to take the necessary precautionary steps.	All employees Supervisors Section heads Environmental management personnel Safety personnel Occupational hygienist Ventilation personnel	Throughout
Visual monitoring	1 The visual aspects of the MRDs shall be monitored on an annual basis. 2 This shall be done by the survey section. 3 The points used for monitoring shall be the Lime Acres turn-off from the National road and the Lime Acres town turn-off from the Silverstream road. 4 The horizon of MRDs compared to the surrounding landscape shall be used to assess the visual impact.	Survey section	Annual
Environmental noise monitoring	1 Noise audits which will include monitoring, control and suppression systems shall be conducted yearly as may be determined by the potential risk involved and by legislation. 2 Primary amongst these shall be the potential high environmental noise risk that may result in health problems. 3 Monitoring shall target all areas inside and around the mine that may be affected by noise originating from mine activities. 4 The Environmental Section shall initiate the monitoring which will be conducted at identified areas around the mine. 5 This shall include nearby villages and accommodation facilities. 6 In addition impact monitoring for nearby farms and publicly accessible areas shall be carried out.		
Monitoring of waste volumes	1 The volumes of waste recycled shall be recorded. 2 Hazardous waste volumes shall also be measured and recorded.		

SECTION 15.1	SECTION 15.2	SECTION 15.3	SECTION 15.4
MONITORING	**FUNCTIONAL REQUIREMENTS**	**ROLES AND RESPONSIBILITY**	**TIMEFRAMES**
Pit rim stability	1 Monitoring of dedicated accessible areas such as haul road, pit perimeter and plant shall be done. 2 Monitoring and early detection of sidewall movement shall be done in order to predict potential failure, measurement of waste dilution and establishment of pit bottom profiles at regular intervals to monitor behaviour of the cave to ensure correct draw control.		
Asbestos occurrence	All RTM2 sampling filters shall be ordered from the analysis laboratory as pre-prepared. The sampling train shall be prepared as per the acceptable air quality monitoring procedures. Pre-identified areas shall be monitored. Only on special occasions shall personal sampling be done. All samples shall be sent to an accredited body for analysis. All reports received shall be circulated to all sections affected and copies shall be sent to the Environmental Management and Medical Sections for records.		Air quality analyst
Plant residue facilities	1 The moisture control of the residue is monitored to ensure stability of the outer face. 2 A topographical survey must be undertaken for each CRD on an annual basis. 3 The following aspects shall be inspected: • Deposition station: safety, operating procedures, • Side slopes: Rat holes, Seepage, Sloughing, Movement (Cracking subsidence, bulging), Berm penstocks, Freeboard on berms, Erosion • Day walls: Operating procedure, Available deposition capacity, Freeboard • Penstock: Safety, Access, Operating procedures, Pool size and position, Alignment • Catchment paddocks: Freeboard, Overtopping, Water volume, Vegetation growth, Flow capacity • Solution trenches: Vegetation growth, Flow capacity, Freeboard • Return water dam: Capacity, Freeboard, Outlet, Outer wall condition, Pump system • General: Fencing and gates, Warning signs, Access Roads, Piezometric levels, Deposition rates, Freeboard Measurements, Drain Flow Readings, Slurry Density, Particles and distribution	Professional engineer Ore processing leader Ore processing foreman Operating contractor Area manager Site manager	Weekly, quarterly, annually

Regulation 50 (i)

16 Technical and supporting information

Refer to addendum 3 (specialist studies) for all specialist studies attached to this EMP. The measures contained in the specialist reports are only recommendations which have been incorporated into this EMP.

Section 2: Environmental management programme

Regulation 51 (a)

1 Description of environmental objectives and specific goals for mine closure

1.1 Environmental aspects that describe the pre-mining environment

1.1.1 Pre-mining environment

Refer to Section 1 (EIA), Regulation 50(a), 1 – Description of the baseline environment for a complete description of the pre-mining environment.

1.1.2 Residual impacts on environment

1.1.2.1 Mining activities

Refer to Table 61 below for all the residual impacts associated with the mining activities.

Table 67: Residual impacts for mining activities

ACTIVITY	IMPACT DESCRIPTION	PROBABILITY
Underground mining	Considering the fact that the mining of the diamonds goes hand in hand with extraction of the ore body the impact on the geology (mineral wise) will be permanent.	Definite
	Ground water inflow (at approx. 32 l/s) into the working will eventually fill up the workings with water and then use the decline shafts as preferential flow pathways to the surface. If the shafts are sealed there could be a build up of hydraulic head which will encourage seepage along the slope shared by the shafts. It is possible that seepage decant could occur. Due to the non-aquifer nature of the Bushveld Aquifer, with its low permeability, the escape of mine water to ground water sources from the flooded workings will be reduced. With the workings full of water, remaining exposed sulphides are unlikely to be oxidised and this should minimise the risk of acid/sulphate generation.	Possible
Open cast mining	Considering the fact that the mining of the diamonds goes hand in hand with extraction of the ore body the impact on the geology (mineral wise) will be permanent.	Definite
	The land capability where the open cast pit is situated will not be returned to grazing.	Definite
	Animals grazing in the open pit area could fall into the pit.	Possible
Mine residue	All WRDs will have a permanent impact on the topography and therefore visual impact. This will be reduced through rehabilitation.	Definite
	If stormwater runoff is not managed then erosion from the WRDs can occur along drainage systems.	Possible
	The land capability where the WRDs are situated will not be returned to grazing.	Definite
	Alien invasive vegetation could occur on the WRDs due to the disturbed nature of these dumps. These dumps will be rehabilitated, reducing the probability of alien invasive occurring.	Possible
	The exposure of animals to asbestos fibres is at the WRDs could be a possibility.	Possible
	Surface water runoff from the WRDs could lead to siltation of drainage areas.	Possible
	Seepage of the WRDs may occur. Rehabilitation of the WRD will help minimise rainfall infiltration and assist in getting water off the dump as quickly as possible, with less chance	Probable

ACTIVITY	IMPACT DESCRIPTION	PROBABILITY
	of picking up contaminants.	
	In the event of inadequate rehabilitation leading to areas not revegetated, dust generation may still occur.	Possible
	The exposure of humans to asbestos fibres may occur.	Possible

1.1.2.2 Ore processing activities

Refer to Table 62 below for all the residual impacts associated with the ore processing activities.

Table 68: Residual impacts for ore processing activities

ACTIVITY	IMPACT DESCRIPTION	PROBABILITY
Fine residue deposit	All FRDs will have a permanent impact on the topography and therefore visual impact. This will be reduced through rehabilitation.	Definite
	If stormwater runoff is not managed then erosion from the FRDs can occur along drainage systems.	Possible
	The land capability where the FRDs are situated will not be returned to grazing.	Definite
	Alien invasive vegetation could occur on the FRDs due to the disturbed nature of these FRDs. These FRDs will be rehabilitated, reducing the probability of alien invasive occurring.	Possible
	Surface water runoff from the FRDs could lead to siltation of drainage areas.	Possible
	Seepage of the FRDs may occur. According to the groundwater investigation, which included geochemical modelling, it is clear that about 70 % of the mass released from the FRD will be intercepted within 60 years. The remainder of the mass will still be in storage in the aquifer. The increase in concentration of sulphate, sodium and chloride will be in the order of 40mg/l, 20mg/l and 5mg/l. This is considered to be a very limited impact, and will not create conditions favourable for AMD. Initial predictions indicate that pollution is unlikely to move more than 2km down-gradient of the FRDs.	Probable
	In the event of inadequate rehabilitation leading to areas not revegetated, dust generation may still occur.	Possible
	The destruction of pans by the new FRD will be permanent.	Definite
CRDs	All CRDs will have a permanent impact on the topography and therefore visual impact. This will be reduced through rehabilitation.	Definite
	If stormwater runoff is not managed then erosion from the CRDs can occur along drainage systems.	Possible
	The land capability where the CRDs are situated will not be returned to grazing.	Definite
	Alien invasive vegetation could occur on the CRDs due to the disturbed nature of these CRDs. These CRDs will be rehabilitated, reducing the probability of alien invasive occurring.	Possible
	Surface water runoff from the CRDs could lead to siltation of drainage areas.	Possible
	Seepage of the CRDs may occur. Initial predictions indicate that pollution is unlikely to move more than 2km down-gradient of the CRDs.	Probable
	In the event of inadequate rehabilitation leading to areas not revegetated, dust generation may still occur.	Possible

1.1.2.3 Support services

Refer to Table 63 below for all the residual impacts associated with the support services activities.

Table 69: Residual impacts for support services

ACTIVITY	IMPACT DESCRIPTION	PROBABILITY
Waste management facilities	Leaching may also be generated from the landfill site at the WAMY.	Possible
Water management	Seepage of the rehabilitated FRDs will still be diverted to the RWD. Spillages of this dam may occur, leading to surface water pollution.	Possible
	Seepage from the RWD may impact the groundwater.	Probable
	Groundwater contamination due to seepage from the Earth and Overspill dams may also occur.	Probable
Transport and conveyance	If stormwater runoff is not managed then erosion from the roads can occur along drainage systems.	Possible
Housing recreation and other employee activities	There is the risk that Lime Acres may not be a sustainable settlement after closure due to its remoteness from economic hubs and lack of diversified economic base. This will also have a reputational risk if the town degrades. There is a risk that Lime Acres may not be incorporated into one of the neighbouring municipalities.	Possible

1.2 Measures required to contain or remedy any causes of pollution or degradation or the migration of pollutants, both for closure of the mine and post-closure

1.2.1 Closure objectives

The following are closure objectives from the closure plan, dated February 2009, to attain through implementing the specific criteria:

1. Rehabilitate disturbed areas to their pre-mining land capability and use potentials. The rehabilitation of disturbed land will be to the extent that it is within compliance of current national environmental quality objectives;
2. Limit the short and longer term impacts of pollution on surface and groundwater and related biodiversity;
3. Control the further generation of dust;
4. Minimise the visual impact of the permanent features at the mine e.g. CRDs and FRDs;
5. Ensure that people and animals are not harmed by falling off or into hazardous excavations or off steep slopes. The management objectives for these are to minimise safety risks to the public and livestock;
6. Limit the impact on staff whose positions become redundant on closure of the mine;
7. Keep relevant authorities informed of the progress of the decommissioning phase;
8. Submit monitoring data to the relevant authorities; and
9. Build and maintain meaningful relations with all stakeholders (I&APs).

The following are specific reclamation objectives for *restorable and non-restorable land* respectively:

10. Objectives for Restorable land (Land which can be returned to its pre-mining land capability):
    - The land must be left in a safe condition
    - The land must be chemically, physically and ecologically stable

- Waste will be managed responsibly and in line with legal requirements
- All infrastructure not required for the post-mining end land use must be removed
- A suitable growth medium and sustainable indigenous vegetation must be established and
- The land should be returned to the pre-mining capability.

11. Objectives for Non-restorable land (Land which cannot be returned to its pre-mining land capability):

- The land must be left in a safe condition
- The land must be chemically, physically and ecologically stable
- Waste will be managed responsibly and in line with legal requirements; and
- A suitable growth medium and sustainable indigenous vegetation layer must be established.

12. Determine a post closure surface water plan, with plans to minimise the pollution of the surface water resource.
13. Ensure that post closure maintenance of vegetation cover includes comment on air quality vis-à-vis dust generation on mine residue sites.

1.2.2 Final land use options

1.2.2.1 Integration of the town into one of the adjacent municipalities

The neighbouring municipalities of Tsantsabane and KLM would probably only consider incorporation if they were convinced that a bigger economic driver would ensure private investment in the town. For this, the feasibility of any of the other options / scenarios would need to be proven or certain enough to make an economic case to the municipality concerned.

1.2.2.2 Light industrial

The economic and physical viability of manufacturing bricks or tiles from the fine residue deposits has been established, according to the mine; but transport cost and distance to markets will be a limiting factor. The uncertainties related to the required transportation links to make this option feasible, render this option too insignificant as meaningful contributor to the sustainability of Lime Acres.

1.2.2.3 Retirement village and golf estate

The option of a retirement village, possibly combined with a golf theme, was not given serious consideration due to limitations placed on the secluded position of the town in connection with other attractions in the direct vicinity.

1.2.2.4 Intensive agriculture

Factors that need to be considered or investigated are the quality of the groundwater, soil (hydroponics should be considered) and climate on the feasibility of intensive agriculture in view of very high capital costs, and are therefore not weighed up.

1.2.2.5 Algae bio-fuels

Another alternative use proposed was the manufacturing of bio-fuel from algae. The cheapest way to grow algae is an open-pond system, but open pond systems can be hard to sustain because they are subject to wide ranges of temperature and pH and can also be forced to compete with other invasive algae and bacteria. Algae grown in greenhouses or in sealed tubes can be very expensive, especially since the facilities to make a profitable amount of algae would have to be vast. The current delay caused by uncertainty of both government policy and legislation in relation to bio-fuels was also seen as one of the constraints that could inhibit the bio-fuel idea, as well as the proximity to markets.

1.2.2.6 Vocational training centre for skills needed for new development

The utilisation of existing process plant and office facilities, and perhaps even some of the underground shafts as a vocational training centre, was also presented as an option. The possibility of further mining training – for example block-caving techniques – could also be done here. It was, however, later ruled out because of the limited use (only three mines in South Africa) of this technique. Using the shafts would also disqualify closure: the mine would remain operational and therefore be at odds with De Beers' closure objective. The option of the vocational training centre would probably be too small in its own right to provide a real reason for the houses in Lime Acres to remain.

1.2.2.7 Heavy industrial (smelter relocation from proposed Postmasburg / Sishen South)

This option was seen as a valid opportunity– but it appears from the discussion that the relevant mining houses have already applied for this facility to be erected at Postmasburg.

1.2.2.8 Grazing (excluding mine residue sites, which will be wilderness)

Grazing, whether for cattle or game, was seen as a real option. This was also the pre-mining use, and in the absence of other economic factors or drivers, it is probably the only certain end-use which is not dependent on a chain of favourable events and linkages to happen. It is perhaps the only option that has no dependence on Lime Acres being incorporated into an adjacent municipality, or on the establishment of a new economic activity.

1.2.3 Land use of immediately adjacent land

Consideration of the land use of adjacent land contributed to the determination of the end land use and closure vision for the mining area. Prior to mining, the land was mainly used for grazing and this use has remained largely the same, with the addition of mining activities. The current land surrounding the mine is therefore used for livestock and game farming (which includes grazing), subsistence farming and the PPC mining operations.

1.2.4 Final (post-mining) land uses of the project area

The final land use was therefore determined as grazing, with the residue sites excluded. These would be returned to wilderness. The town of Lime Acres would therefore likewise be rehabilitated to its former status of grazing, unless the town becomes integrated into a local municipality in the interim. This outcome is seen as a potential project, but the end (post closure) land use will remain as grazing until a different outcome for the town is assured. For the purposes of this Preliminary Closure Plan the end land use is therefore grazing (these are the end land uses that the mine can commit to).

The main rehabilitation and closure objective is to restore the pre-mining potential of the land as far as possible (in this case a grazing potential). Final land uses must however still be discussed in general with the land owners and other stake holders.

1.2.5 Rehabilitation

The rehabilitation measures as outlined below were taken from the preliminary closure plan of 2009 as well as the rehabilitation plan compiled in 2011. Below is a summary of these measures.

1.2.5.1 Fine residue deposits

1.2.5.1.1 Brits fine residue deposit

1. Reshape the top of the facility if the overall gradient to the west must be increased.
2. Reshape the northern slope to 18°.
3. Cover the top and all contaminated areas with a single layer of growth medium of 300mm depth.
4. Cover the areas that may contain some exposed asbestos fibres with a clean cover layer up to a depth of 100mm.
5. Construct contour drains on the covered top level to reduce the slope length and reduce concentration of runoff in unwanted drainage lines.
6. Construct a collector drain to the west of the covered area. The collector drain must flow south to discharge on a stable area south of the southern starter wall.
7. Construct contour drains on the reshaped western slope of the WRD.
8. Construct paddocks at the foot of the starter walls to contain contaminated seepage and separate clean and dirty water.

1.2.5.1.2 Fine residue deposits 1, 2 & 3

1. Reshape all the slopes to fill existing erosion gullies and reduce the concentration of surface runoff in unwanted drainage patterns. Use additional material from WRD or Bonza quarry for filling of dongas.
2. Reshape slopes to a gradient that is ecologically stable.
3. The lower bench must be maintained and upgraded to serve as water control structures.
4. Ensure natural vegetation remains ecologically stable at the southern side of the FRD footprints or clean the entire polluted area by grading off about 200mm on average depending on the depth of contamination.
5. Cover all reshaped and final slopes with a primary layer of 200mm and a secondary layer of 100mm.
6. Implement measures to dry out the top of the FRDs.
7. Water controls on the FRDs will be managed by either, maintaining and cleaning the current bench penstocks, constructing cross paddock walls or making the benches free draining.
8. Maintain and monitor the Piezometric water levels inside the FRDs.
9. Construct a diversion drain to the west of FRD1 once the CRD has been rehabilitated. Divert runoff north and around FRD1 to drain along the natural drainage line past the Earth Dam to be collected by the main drain north of the Old Paddocks.
10. Remove and rehabilitate the existing PCD on the north eastern corner of FRD1 (Sump 1) by removing all accumulated fine residue and contaminated material, backfilling and reshaping to make the area free draining.
11. Construct collector drains to the east of FRD1 draining alternatively north and south.
12. Join the drain on top of the Infill Dam and from the waterway through the eastern starter wall of the Infill Dam with the above mentioned collector drain.
13. Construct a diversion drain west of FRD2 to divert runoff from the hillside and protect the rehabilitated area.
14. Construct a wide low level drift with concrete base where the diverted stormwater and runoff from the top of FRD2 crosses the access road to the neighbouring property.

1.2.5.1.3 Old FRD paddock

1. Reshape the remaining old paddock starter walls to a maximum gradient of 18°.
2. Cover all bare areas (i.e. areas with poor vegetation establishment or compacted areas) with a primary layer of 200mm and a secondary layer of 100mm as growth medium.
3. Fill the existing sinkholes up to well above (about 5m high) the current ground level (CGL) and about 10m outside the edge of the sinkhole with waste rock material from Bonza dump.
4. Fill low lying areas that cannot be made free draining with the proposed water control structures to prevent ponding of water.
5. Construct the indicated drains on the existing “drainage lines” on the old paddock area.
6. On the western side of the paddocks stormwater runoff from the CRD and FRD areas must be diverted north and around the Old Paddocks.

7. A main collector drain is proposed north of and around the Old Paddocks.
8. Spillages from the Earth and Five Missions Dams must be isolated or separated from this collector drain when the dams are still in operation as dirty water control return dams.
9. The excavated and disturbed low lying areas north of the Old Paddocks must be reshaped to make it free draining and allow the main collector drain to drain freely to the east.
10. Divert all runoff from directly above the sinkhole around this area to the proposed drains.

1.2.5.2 Coarse residue deposit

1.2.5.2.1 Pre-1979 coarse residue deposit

1. The stripped footprint of the Pre79 CRD must be covered with a 300mm primary cover layer and a 100mm secondary cover layer.
2. Make the low lying points free draining by excavating drains to nearby drainage lines where this is plausible.
3. Fill the low lying areas above the surrounding ground level by reshaping material from higher lying points around it or import fill material.
4. Remove those dams that are close to the faults or dykes. Rehabilitate the areas by removing contaminated material and covering it with the proposed cover material. Ensure that the areas are free draining.
5. The dams that will remain must be upgraded.

1.2.5.2.2 Post-97 coarse residue deposit

1 Reshape the CRD to a maximum gradient of 18° on all slopes.

2 Construct 5m wide benches and paddocks on the slopes at horizontal intervals of 25m to control runoff.

3 Construct paddocks on the top area of the CRD and contain all runoff.

4 Construct crest berm walls 40m inside the current crest to provide interim stability during operation.

5 Cover the entire reshaped CRD with a cover layer and growth medium of 300mm thick, consisting of weathered banded ironstone.

6 Cover the reshaped slope with a 200mm primary and a 100mm secondary growth medium layer.

7 Construct benches during deposition. Once the 3rd lift is being deposited and the 2nd slope is reshaped, the 1st bench can be completed.

8 Construct contour walls on the reshaped slope to further reduce the slope length to about 30m.

9 Construct crest paddock walls on the bench above the reshaped slope, immediately after reshaping and covering of the slope.

10 Some of the lower benches can be made free draining if the future CRD is being deposited against the natural ground slope of the hills.

11 Keep the drainage line to the south of the new facility clean to serve as major stormwater structure.

1.2.5.3 Waste rock dumps

1.2.5.3.1. Waste rock dump with overburden

1 WRD contour must be landscaped down to 18º.

2 Construct surface water control structures on the top areas, crests and slopes of the WRD.

3 Contain the runoff on the top area at more than one position to prevent the containment of runoff on one position to provide greater stability in case of failure of one of the structures.

4 The embankment towards the pit side must be stabilised by compaction and sealing.

5 Emergency spillways must be provided for each attenuation pond to protect the embankment in case of extreme floods.

6 The water control structures on the slopes will be contour walls / drains.

7 Excavated drains and crest drains will be installed.

1.2.5.3.2 Additional waste rock dumps

Refer to paragraph 1.2.5.13 of section 2 (EMP) for the revegetation of these WRDs.

1.2.5.4 Main Bonza drain

1 The drain will be constructed by partial excavation where possible and construction of a typical contour wall on the downstream side.

2 The lower part of the drain will be constructed next to the proposed borrow pit east of the Old Paddocks and FRD3 and have an acceptable gradient to the discharge position in the natural drainage line.

1.2.5.5 Bonza area

1.2.5.5.1 Bonza dump

1 Shape the material to side slopes to well below 18°.

2 Cover all coarse areas with a secondary layer up to 100mm, unless sufficient fines are present in the dump.

3 Construct crest walls and paddocks on the top low gradient area. Use the available material from the dump.

4 Construct contour walls on the slopes of the reshaped dump by excavating or dozing material in place along the indicated alignment.

1.2.5.5.2 Bonza quarry

1 Reshape all slopes except the western solid highwall to a maximum gradient of 18° in a balanced cut and fill operation up to the existing water level.

2 Cover all coarse areas with a secondary layer up to 100mm, unless sufficient fines are present in the backfilled material.
3 Construct a crest or perimeter berm wall around the reshaped quarry.

1.2.5.6 Waste management yard

1 Remove all waste and contaminated material from the area and dump in the licensed areas.
2 The landfill site within this area is licensed to be used to receive general or inert solid waste.
3 Hazardous waste must be removed according to the relevant policies and protocol.
4 Soil and other material contaminated with hydrocarbons can be treated at the bio-remediation facility.
5 Reshape the steep inner slopes of the landfill site in a balanced cut and fill operation where the stability of the filled material allows.
6 Cover the reshaped landfill slopes with a 200mm layer of compacted clayey material to reduce infiltration.
7 Rip (bulldozer) all compacted areas 500mm deep and with a tine spacing of maximum 500mm.
8 Cover bare areas or areas that are too coarse to a depth of 100mm with a single layer with enough fines.
9 Construct surface water control structures on the top areas, crests and slopes of the WAMY area.

1.2.5.6 Shafts

1 Steel structures will be dismantled and the material will be removed.
2 Buildings and related structures, as well as reinforced concrete must be demolished.
3 The building rubble will be disposed of lawfully.
4 The shafts and inclines will be sealed or pluggedin consultation with the respective mining rights holders and authorities.
5 General surface rehabilitation including the establishment of vegetation, as already described.

1.2.5.7 Earth dams

1 Allow the water to evaporate.
2 Remove the silt in the dam basin if it contains pollutants and dump on a registered site or on residue dumps if the chemistry is similar.
3 In the case of a lined dam, remove the liner and dispose of in the indicated manner.
4 Doze and spread the earth walls back over the footprint of the dam, then shape the area to be smooth and free draining without any steep slopes.
5 Fill the basin to well above the surrounding ground level to allow for consolidation of the material.

1.2.5.8 Processing plant

1 Steel structures will be dismantled and the material will be removed.
2 Buildings and related structures, as well as reinforced concrete must be demolished.
3 The building rubble will be disposed of lawfully.

1.2.5.9 Residential areas

1 Buildings and related structures will be demolished.
2 Infrastructure such as roads, electrical, water, stormwater and sewage reticulation shall be removed and the area rehabilitated.
3 Where only portions of the residential areas are to be demolished and rehabilitated, demountable (pre-fabricated) structures should be demolished first.
4 As far as possible, the remaining town must be contiguous, i.e. the area of Lime Acres closest to PPCs properties should remain; furthermore if possible the social/business infrastructure should remain (shops, schools, churches).

1.2.5.10 Open pit and surrounding areas

1 Steel structures will be dismantled and the material will be removed.
2 Buildings and related structures, as well as reinforced concrete must be demolished.
3 The building rubble will be disposed of lawfully.
4 The haul road entering the open pit will be closed off and safety measures will be implemented to prevent access.
5 Construction of an Enviro-berm around the pit - 2m high, 2m wide at top, with a slope of 1:3, an area of 16m^{2}and 3000m long, around the pit.
6 Construct safety game fence around the pit – 1.8m high and 3500m long around pit.
7 Open pit will be left to fill from the recharge of groundwater.

1.2.5.11 Other Infrastructure and areas

1.2.5.11.1 Roads and airstrip area

1 Reshape all areas to avoid concentration of surface water along the roads and prevent the roads from intercepting surface runoff from higher lying areas.
2 Remove culverts and other obstructions in natural watercourses where the roads are being removed.
3 Construct cut-off side drains at frequent intervals in the windrow or shoulder of the roads to discharge runoff from the road surface at low peak floods.
4 Rip all compacted areas up to a minimum of 300mm with a maximum tine spacing of 500mm.
5 Ameliorate to the recommended levels with organic material and inorganic fertilizer and establish indigenous vegetation.

1.2.5.11.2 Power lines and fencing

1 Remove the current fencing but the non-restorable areas will be needed to be re-fenced.
2 The fence and access gate will need to be removed depending on the condition of the material it will either be used elsewhere or sent to the WAMY.

1.2.5.12 Soil replacement

A detailed soil balance was developed to optimise the use of available material and calculate the need from additional sources. Although shallow, the soils of the area are suitable for topsoil. Both soils of the Hutton and Mispah form may be used. Soil of the Hutton form can be excavated deeper and will yield more topsoil. The use of soils with high rock/gravel content will also promote slope stability because these are less susceptible for erosion. The rocky soil is well suited for rehabilitation and will enhance slope stability. The topsoil has a low CEC and nutrient status; therefore the soil fertility needs to be improved with fertilisers and organic material. Soil chemical analysis indicated that the fine residue and coarse residue are not suited for rehabilitation without proper amelioration and improvement of the soil fertility. Specific problems are the alkaline nature of the waste materials, high sodium concentrations and low soil fertility.

1.2.5.12.1 Available topsoil

1 The best quality growth medium should be earmarked for the areas that will need the most input to establish sustainable vegetation, e.g. residue deposits.
2 All future development should be done with the intention that the maximum amount of growth medium is stripped and stockpiled.
3 As far as possible, this should be used only for rehabilitation purposes.
4 An annual fertilisation program based on soil chemical analyses of the topsoil is recommended to ensure that nutrient imbalances that may develop during the first three years be alleviated.

1.2.5.12.2 Additional borrow pits

1 Additional sources or borrow pit areas for cover material is required.
2 The Bonza Game Farm borrow pit will have a large amount of material.
3 Material with a high sand component must not be used on slopes. These areas were however considered the last option on account of the pristine condition, sensitivity to bio-diversity and visual impact.

1.2.5.12.3 Topsoil from borrow pits

1 The cover material from the different potential borrow pit areas shall be utilised in such a way that it limits the double handling of material, reduce haul distances, ensure timely stripping in advance of extending residue facilities and implement concurrent rehabilitation.
2 The “best” material must be reserved for the construction of critical water control structures, notably the paddocks and crest walls on the FRD and CRD benches.
3 Leave strips or banks of material behind when cover material is excavated.

1.2.5.12.4 Rehabilitation of borrow pits

1 The proposed borrow pits must be rehabilitated to the same specifications as for the rest of the terrain.

2 The banks can be positioned down the slope in the case where the slope lengths are within limits for erosion to avoid the unnecessary interference with surface runoff.

3 Where the borrow pits are large and the slope lengths need to be reduced during rehabilitation, the banks can be left close to the contour to be used as contour walls.

4 The banks can then be reshaped to cover the floor of the borrow pit, which may be bare and hard, very coarse or with poor quality soil to serve as growth medium.

5 All borrow pits must be reshaped such that it will be free draining as far as possible. Standing water on dolomitic area or geological features (dyke, faults, etc.) must be avoided.

6 The borrow pits must be ameliorated and vegetated similar to the other rehabilitated areas.

1.2.5.13 Revegetation

1 Eradicate all invaders on the western slope of the WRD and other areas where control was ineffective.

2 Ameliorate the growth medium with the proposed organic and inorganic fertilisers.

3 Work the ameliorants into the top 100mm of growth medium.

4 The ameliorants can also be spread before ripping or cultivation, which can then perform the cultivation function to some extent.

5 Seed the recommended indigenous grass species at an application rate of 23 kg/ha.

6 Spread the grass seeds by hand ensuring always a good mixture of the different types of seeds.

7 Fix the seed by rolling or light harrowing (a heavy branch or chains can also be used for this).

8 Some shrub and tree species can be established on the top area of the rehabilitated area.

9 Large trees must not be allowed to establish on the starter walls.

1.2.5.14 Asbestos contaminated areas

1. The major access roads to and from the construction site will be constructed.
2. All slopes of the dump steeper than 18° will be reduced to a maximum slope of 18°.
3. Reshape the slopes by dozing material down in a balanced cut and fill operation.
4. The existing bench must be shaped to slope towards the foot of the upper embankment.
5. No vehicles must be allowed to travel on a contaminated surface.
6. Asbestos contaminated service road must be covered on the southern side of the WRD embankment, by dumping suitable cover material at the entrance point to the contaminated road.
7. Reshaped and polluted area must be covered with suitable erosion resistant cover material.
8. The final depth of the cover material must be a minimum of 100mm.
9. A stormwater berm must be constructed above the rehabilitated slope.

10. The contour walls are constructed along the shaped slopes of a dump to protect the slope against erosion, where slope lengths exceed the designed maximum or where concentrated runoff needs to be managed.
11. The channel should be graded on the inside after it has been constructed, aligned and compacted to remove all localised obstructions.

2 Description of environmental objectives and specific goals for the management of identified environmental impacts emanating from the proposed mining operation

2.1 List of identified impacts which will require monitoring programmes

Refer to paragraph 15 of Section 1 (EIA), for a complete description of the monitoring for the mine.

2.2 List of the source activities that are the cause of the impacts which require to be managed

Refer to paragraph 2 of Section 1 (EIA), for a complete description of the source activities that are the cause of the impacts that need to be required and paragraph 3, 6, 7 and 10 of Section 1 (EIA), for a complete description of the impacts.

2.3 Management activities which, where applicable, will be conducted daily, weekly, monthly, quarterly, annually or periodically as the case may be in order to control any action, activity or process which causes pollution or environmental degradation

Refer to paragraph 5.2 of section 2 (EMP) for the timeframes for the execution of the monitoring and management programmes.

2.4 The roles and responsibilities for the execution of the monitoring and management programmes

Refer to paragraph 5.2 of section 2 (EMP) for the roles and responsibilities for the execution of the monitoring and management programmes.

3 Description of environmental objectives and specific goals for the socio-economic conditions as identified in the social and labour plan

This section was compiled in consideration of the SLP as developed for the mine, dated June 2011.

3.1 Human resources development programme

Socio-economic objective:

1. To implement the human resources development programme.

Achieved goals:

1. The mine currently employs 743 employees, including 4 Foreign Nationals.
2. The mine has implemented Learner ships and Skills Programmes in the Ore Processing, Mining and Engineering Support Departments to enhance current operational training.
3. The mine has developed a training programme tailored to fill hard to fill vacancies.
4. In Ore Processing skills programmes have been developed for assistant operators to progress to operators and Artirator programme for operators to become semi-skilled.
5. The Mine has a Learner Plant Foreman programmes for operators to become Section Foreman.
6. The scholarship scheme has been developed for the children of the mine's employees and children from the local labour sending areas i.e. KLM and John Taolo Gaetsewe. This scholarship is aimed at meeting future organisational needs as well as contributing to the sustainable development of the region.
7. Petra Diamonds SA has established a bursary scheme, which aims at the development of suitable students who, once they have completed their studies, may be afforded professional career opportunities within the broader Petra Diamonds Group.
8. The mine is currently offering practical training to the Groups bursars' vacation work and graduate trainees.
9. Coaching and Mentorship is being offered at the mine through career discussions during the O&C process, Graduate/Trainees programme, Women in Mining Learnership programme and Supervisory Learnership.

Socio-economic planned goals:

1. The mine aims to achieve an equitable representation of designated groups in all levels in the workplace through the Employment Equity Committee.
2. The mine is committed to complying fully with the spirit and requirements of government and industry agreements to ensure non-discrimination against foreign migrant labour.

3.2 Local economic development plan

Socio-economic objective:

1. To effectively implement the LEDP.
2. To effectively implement Community development programmes.
3. To effectively execute Poverty Eradication projects in efforts to generate alternative livelihoods in the KLM.

Socio-economic planned goals:

1. The infrastructure projects identified by the KLM aims to address the immediate needs of communities as identified by the KLM:
    - Skills training for identified projects.
    - Alignment with district and provincial job creation initiatives.
    - Partnerships with government, private sector and communities groups.
    - Assisting with sourcing seed money
2. Effective management Community Bursary Scheme to meet Technical requirements at LM
3. Intake of two interns per annum at discretion of LM
4. Upgrade of Resource Learning Centre:

3.3 Measures to address housing and living conditions

Socio-economic objective:

1. To implement measures addressing housing and living conditions.

Achieved goals:

1. The mine has 1193 units of housing that are allocated to Mine employees.

Socio-economic planned goals:

1. Bi monthly Health Screening is done on different department whereby the Blood pressure, blood glucose, cholesterol and body mass index are done.
2. Scheduled health and hygiene inspections are done at the Canteen by the Occupational Health Clinic staffers in order to ensure that the meals are prepared and served in a spotless environment.
3. Chefs and food handlers are annually medical investigated for health and hygiene purposes and this is done on the mine by the Occupational Health Clinic staffers.
4. The Blood pressure, blood glucose, cholesterol as well body mass index of chronic patients are done on weekly basis at the Lime Acres Day Care centre and the Occupational Health Clinic.

3.4 Procurement progression plan

Socio-economic objective

1. Implementation of procurement progression plan.

Socio-economic planned goals:

1. The mine contributes to supplier development and empowerment on some of the ad-hoc projects.
2. The mine's procurement team assists a number of potential suppliers during tender processes and also advised unsuccessful tenderers on where they need to improve for possible future tenders.

4 Description of environmental objectives and specific goals for historical and cultural aspects

4.1 Environmental objectives and goals in respect of historical and cultural aspects identified in specialist studies conducted during the EIA phase

1. To compile an inventory of all heritage and cultural aspects as identified in the HIA.
2. To include all heritage and cultural aspects as identified in the HIA into a heritage management plan.
3. To preserve all heritage and cultural aspects as identified in the HIA.

Regulation 51 (b)

5 Appropriate technical and management options chosen for each environmental impact, socio-economic condition and historical and cultural aspect in each phase of the mining operation

5.1 Actions, activities or processes, including any NEMA EIA regulation listed activities, which cause pollution or environmental degradation

Refer to paragraph 3, 6, 7 and 10 of Section 1 (EIA), for a complete description of the actions, activities or processes; including any NEMA EIA regulation listed activities, which cause pollution or environmental degradation.

5.2 Concomitant list of appropriate technical or management options chosen to modify, remedy, control or stop any action, activity, or process which will cause significant impacts on the environment, socio-economic conditions and historical and cultural aspects as identified

5.2.1 Soil management

Operational Objectives:

1. To conserve topsoil resources;
2. To prevent spillage or leakage of hazardous chemicals onto soils or into surrounding soils (contamination of soil);
3. To prevent erosion; and
4. To prevent contamination of soils.

Management:

5.2.1.1 Soil stripping and stockpiling

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Prior to the commencement of any top and subsoil stripping, all vegetation, in particular invasive plants shall be removed, in consultation with the environmental manager.						X	Environmental department, all employees
Stripping shall only occur where soils are to be disturbed and when an end-use for the stripped soil has been identified.						X	
Topsoil shall not be stripped when saturated, as this will exacerbate the damage to the soil structure.						X	
Wherever possible, stripped topsoil shall be placed directly onto an area being rehabilitated. • This avoids stockpiling and double handling of the soil. • Topsoil placed directly onto rehabilitation areas contains viable seed, nutrients and microbes that allow it to re-vegetate more rapidly than topsoil that has been stockpiled for longer periods.						X	
The stripped topsoils and subsoils shall be transported to the designated stockpile areas.						X	
Topsoil shall be stockpiled separately from any subsoil and rock.						X	
Suitable stockpiling areas shall be identified, preferably in close proximity to the source of the topsoil. • The areas shall be calculated on the basis of the expected soil volume.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Stockpiles shall be established within the bounds of stormwater management infrastructure.						X	
Soil stockpiles shall be clearly identified as such.						X	
To avoid compaction and consequent damage to the soils, equipment movement on the stockpiles shall be limited.						X	
The stockpiled topsoils and subsoils are not to exceed 1m in height, and shall not be compacted.						X	
Rapid growth of vegetation on the stockpiles shall be promoted.			X	X	X	X	
No waste shall be disposed of at the stockpiled areas.	X						
Samples of stripped soils shall be analysed to determine the nutrient status. • Fertilisers and seeding will be applied if/ as required.						X	
Erosion control measures shall be implemented to ensure that the topsoil is not washed away and erosion gullies do not develop in the arable land.	X						
Topsoil shall not be sold as a mineral nor mixed with sterile soils.	X						

5.2.1.2 Soil erosion control

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Indigenous vegetation shall not be removed. Projects shall be advised to cut vegetation off at ground level rather than bulldozing and clearing everything to prevent wind erosion.	X						Environmental department, all employees
Plant cover especially grass shall be maintained.	X						
If natural vegetation fails to establish within one growing season the area shall be re-vegetated.				X	X		
Unseasonal veld fires shall be controlled.						X	
Stormwater drainage shall be established on all waste rock dumps and rehabilitated areas to prevent erosion which includes the constructions of berms, contours and water channels.	X						
In the event of erosion occurring: • The extent and rate of change of soil erosion shall be monitored on all rehabilitation areas. • The FRDs shall be monitored quarterly for erosion through photos, and to be reported in minutes of meetings. • Erosion gullies shall be stabilised with infill material.				X		X	

5.2.1.3 Soil pollution prevention

Refer to paragraph 5.2.7 of section 2 (EMP) for soil pollution prevention measures.

5.2.1.4 Soil compaction

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Vehicles shall only drive on designated roads.	X						All employees

5.2.2 Water management

Operational objectives:

1. To ensure compliance with the GN 704 Regulations and conditions of approval of water use license;
2. To minimise the alteration of drainage patterns in the mine area;
3. To remedy the effects of any disturbance to the bed and banks of a watercourse;
4. To prevent discharges of contaminated water to the environment;
5. To prevent contaminated soil adversely affecting water courses;
6. To ensure that the mine's use of water does not impact on the availability of water to lawful water users;
7. To optimise surface rehabilitation of FRDs, CRDs and WRDs in order to minimise adverse groundwater impacts as a result of seepage;
8. To comply with any prescribed waste standard or management practice; and
9. To prepare and evaluate the water balance as and when necessary or as determined by the relevant authorities.

Management measures:

5.2.2.1 General management measures

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
No FRD, CRD, WRD or dam together with any associated structure or any other facility shall be located or placed within the 1:100 year flood-line or within a horizontal distance of 100m from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked excluding if the mine has exemption.						X	Environmental department, all employees
No mining or any other operation or activity shall be carried out within the 1:50 year flood-line or within a horizontal distance of 100m from any watercourse or estuary excluding if the mine has exemption.						X	
An annual report on water balance shall be submitted to DWA. This will provide information on the status of the water balance in the wet season and the dry season and under conditions of extreme rainfall.					X		
All water system shall be kept free from any matter or obstruction which may affect the efficiency thereof.	X						
All pipes shall be kept in a good condition to prevent leaks.	X						
All leaks shall be reported and remediate as soon as possible.	X						
Maintenance of water taps shall take place on an ongoing basis.	X						
Instalment of meters stolen shall be ongoing.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Reclamation and recycling of process or mining water shall be undertaken as far as possible.	X						Plant manager, mining manager, environmental manager
Volumes of affected water abstracted for mining and beneficiation purposes and re-used shall be monitored on a frequent basis.						X	Environmental department, all employees
All water systems and MRDs shall be designed, located and maintained to restrict the possibility of damage to the riparian or in-stream habitat through erosion or sedimentation, or the disturbance of vegetation, or the alteration of flow characteristics.	X					X	
Erosion control measures shall be implemented at all MRDs and dams.	X						
Sidewalls of MRDs and dams shall be revegetated with indigenous plants.						X	
Alien vegetation shall be eradicated from the MRDs and dams.						X	
Security measure shall be put into place to prevent theft / vandalism from taking place.	X						
Maintenance of access control and warning signage shall take place.	X						

5.2.2.2 Management of water quality

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
No residue or substance which causes or is likely to cause pollution of a water resource shall be placed or disposed of in any excavation.	X						Environmental department, all employees
No residue or substance which causes or is likely to cause pollution of a water resource shall be used for construction of any infrastructure.						X	
No fuel or hazardous substance storage which causes or is likely to cause pollution of a water resource may be located or used within the 1:50 year flood-line of any watercourse or wetland.						X	
Waste water from cleaning shall be diverted to the waste water system.						X	
All impoundments or dams containing any hazardous substance shall be effectively fenced-off so as to restrict access thereto, and warning notice boards shall be erected at prominent locations so as to warn persons of the hazardous contents thereof.						X	
There shall be no discharges of dirty water from the mine site unless there is an extreme storm event, with a recurrence interval exceeding 1:50 years.						X	
Environmental conditions shall be included in construction contracts, thereby making contractors aware of the necessity to prevent accidental spillages by the implementation of good housekeeping practices.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The water balance for the mine shall be refined on an ongoing basis during the LoM. The water balance shall be used to check on an ongoing basis that the capacity of the dirty water holding facilities is adequate, taking the operational distribution and use of water into account.						X	
Major spillage incidents shall be reported to the DMR, DWA, Northern Cape Department of Environment and Nature Conservation and the DA. Appropriate remedial measures will be implemented in consultation with these regulatory authorities.						X	
All unpolluted water shall be confined to a clean water system, away from any dirty area using infrastructure such as drains, trenches and berms.						X	
All dirty/process water shall be contained within the dirty water system.						X	
The infrastructure such as drains, trenches and berms shall be assessed to examine whether it has adequate capacity for water flow.						X	
The infrastructure such as drains, trenches and berms shall be maintained to keep out all vegetation and blockage that may prevent water flow maintained so as to ensure the system can handle the 1:100 year storm event.		X					

5.2.2.1 Wastewater care works

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Screens							
The screens shall be cleaned continuously during the shift with equipment provided to ensure the free passage of raw sewage inflow at all times.	X						Outside service engineer, sewage plant personnel, services foreman, services electrician, sewerage works consultants
Screenings shall be allowed to dry on the drainage plate every morning before incineration takes place.	X						
When the incinerator is out of operation the dry screenings shall be stored in a closed container or in a suitable location where it will be of no nuisance.						X	
Lime shall be sprinkled over the dry screenings to prevent the attraction of flies.						X	
Ash from incinerator shall be sent to the WAMY when containers are full.						X	
Number of containers sent to the WAMY shall be recorded.							
Grit removal							
One grit channel shall always be in operation to make certain that provision is made for manual de-gritting of the isolated channel.	X						Outside service engineer, sewage plant personnel, services foreman, services electrician, sewerage works
The grit channel shall be cleaned at least once a week, consistent with the nature of the influent.		X					
The sluice gates shall be placed at the upstream and downstream positions of the grit channel to ensure that the channel earmark for cleaning is isolated.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The grit shall be removed using a shovel once the channel has been drained.						X	consultants
The remaining channel shall be commissioned for the rest of the week.		X					
The grit shall be allowed to dry with wet sludge in the dry bed or, it shall be spread evenly on the concrete slab adjacent to the drying bed to dry.		X					
Lime shall be sprinkled over the grit to prevent the attraction of flies.		X					
The grit shall be removed with the sludge.		X					
<u>Raw sewage flow meter</u>							
The flow reading shall be taken each day at the same time (usually 08h00) and jotted in a logbook, which should be kept at the plant.	X						Outside service engineer, sewage plant personnel, services foreman, services electrician, sewerage works consultants
<u>Raw sewage pumps</u>							
The switches for both the pumps shall be set to ‘automatic’.							
In the event of pumps not working the responsible person shall be contacted.						X	Outside service engineer, sewage

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The operation of the pumps shall be checked						X	plant personnel, services foreman, services electrician, sewerage works consultants
Anoxic reactor							
The mixer shall be operational at all times.	X						Outside service engineer, sewage plant personnel, services foreman, services electrician, sewerage works consultants
The mixer shall be maintained regularly. Maintenance shall include de-energise and lock out of the mixer to check the gearbox oil level and to fill it up when necessary.						X	
Maintenance checks shall be done.		X					
The grease shall be replaced.					X		
The rags that have accumulated around the shaft shall be removed.						X	
All the floating debris shall be removed and incinerated with the screenings.						X	
The recycling of the sludge shall take place from both the clarifier and the aerobic reactor.						X	
Aerobic reactor							
The reactor shall be checked for unusual noises and reported if the case.						X	Outside service engineer, sewage plant personnel, services foreman,
Aerator shall be checked if they are running according to the pre-selected time settings.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The reactor shall be maintained regularly. Maintenance shall include de-energise and lock out of the mixer to check the gearbox oil level and to fill it up when necessary.						X	services electrician, sewerage works consultants
It shall be topped up when necessary.						X	
Oil levels shall be checked.		X					
The bearings shall be greased according the original engineering maintenance schedule.						X	
The outlet pipe shall be checked that it is not blocked						X	
All the floating debris shall be removed and incinerated with the screenings.						X	
Excessive foaming shall be controlled by spraying down with a hosepipe.						X	
It shall be ensured that both of the mixed liquor suspended solids are operating by checking the outlet to the anoxic reactor.	X						
Half-hour settlement tests shall be conducted twice per day.	X						
Settlements tests shall be done.						X	
Sludge wastage							
At least two sludge drying beds shall be empty in case more sludge needs to be wasted than normal. Decant sluice that empty drying bed shall be closed.	X						Outside service engineer, sewage plant personnel, services foreman, services
Valve shall be monitored continually to ensure that no treated effluent is being discharged with the waste sludge.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Valve shall be throttled to allow the sludge in the clarifier to become thick again.						X	electrician, sewerage works consultants
Bed shall be filled to a depth of 300mm and the discharge valve at the bed shall be closed.						X	
Decant sluice shall be opened to allow the water layer on the top of the wet sludge to run off. This will shorten the drying time.						X	
The drying bed shall be dry within six days under normal drying conditions.		X					
Removal of dry sludge							
Dry sludge shall be removed in order to make room for the waste activated sludge.						X	Outside service engineer, sewage plant personnel, services foreman, services electrician, sewerage works consultants
Sludge shall be ready to be removed when it takes on a dry, hard cracked flaky appearance.						X	
Dry sludge shall be lifted with a spade and piled on the concrete slab adjacent to the dry beds.						X	
Dry sludge shall be transferred to the prescribed dumping point.						X	
Care shall be taken not to remove excess sand from the drying beds, and the lost can be replaced and levelled with a short tooth rake.						X	
Clarifier							
The drive and trail wheels on the scraper mechanism shall be checked for uneven ware or damage.						X	Outside service engineer, sewage plant personnel,
Tops of the clarifier walls shall be clean and free of grease.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Drive gearbox shall have no oil leaks.	X						services foreman, services electrician, sewerage works consultants
Maintenance shall include de-energize and lock out the motor to check the oil level and top-up if necessary.						X	
Services co-ordinator shall immediate be contacted when the switch is on and the bridge is not rotating.						X	
Bearing shall be greased monthly.			X				
Gearbox oil shall be replaced once every year.					X		
Motor of a drive unit shall be monitored for any strange noises.						X	
There shall be no sum build-up in the central stilling chamber. If excessive scum build-up has occurred, it shall either be washed out or physically removed and thrown in the sludge drying bed.						X	
Clarifier surface shall be monitored for excess scum build-up.						X	
Algae growth shall be removed within the overflow launders every two weeks.		X					
Strainer to the effluent discharge pipe shall be kept clean at all times.	X						
Sludge withdrawal shall be checked that it is sludge and not supernatant liquid.						X	
<u>Return activated sludge pumps</u>							
When return activated sludge pump No.5 is in operation, its corresponding valve shall also be open, and that No. 6 valve shall be closed.						X	Outside service engineer, sewage plant personnel,

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
When return activated sludge pump No.6 is in operation, its corresponding valve shall also be open, and that No. 5 valve shall be closed.						X	services foreman, services electrician, sewerage works consultants
Sludge shall be discharged out of the return activator sludge pipeline into the anoxic reactor.	X						
Chlorine dosage							
Cylinder shall be checked for any chlorine gas leaks by using the ammonium squeegee bottle provided.						X	Outside service engineer, sewage plant personnel, services foreman, services electrician, sewerage works consultants
Main valve on the cylinder shall be closed.	X						
Hexagonal bolt shall be loosened on measuring and removal of gauge.						X	
New lead washer shall be placed between measuring gauge and full chlorine gas cylinder's valve.						X	
Measuring gauge shall be placed on full chlorine gas cylinder and hexagonal bolt shall be tightened on measuring gauge.						X	
The main valve on cylinder shall be opened and the ball shall be adjusted for a residual chlorine concentration of 0, 4 mg/l (usually at 0, 2 kg/h) above the end of the measuring gauge.						X	
Test for any leaks shall be performed using ammonium squeegee bottle.						X	
Blockages the in-line filter located at the venture shall be removed and cleaned of all alien materials which may have found entry to this point.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Final effluent pumps							
The pumps shall be checked to ensure one pump is on duty and the others on standby.						X	Outside service engineer, sewage plant personnel, services foreman, services electrician, sewerage works consultants
Both inlet and outlet valves to both pumps shall be checked that they are open at all times.						X	
The emergency discharge valve shall be opened in the event of a power failure.						X	
Final effluent flow meter							
The flow device shall be checked that it is displaying a flow rate and total flow on the front cover of the instrument.						X	Outside service engineer, sewage plant personnel, services foreman, services electrician, sewerage works consultants

5.2.3 Biodiversity management

Operational Objectives:

1. To prevent the loss of vegetation and if not possible minimise the area of disturbance.
2. To replant and rehabilitate disturbed land to a stable physical state.

3. To control and eradicate all listed invasive species by means of methods that are appropriate for the species concerned and the environment in which it occurs.
4. To conserve animals and prevent disturbance of animal habitats.
5. To maintain the diversity of species.
6. To avoid disturbance of sensitive habitats.
7. To protect watercourses and prevent alteration of these habitats directly and indirectly through sedimentation and pollution.

Management:

5.2.3.1 Vegetation conservation

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
All areas of natural, indigenous vegetation shall be identified and mapped.					X		Environmental department, all employees
Surface disturbance shall be kept to a minimum by concentrating activities at the already disturbed mining infrastructure area. Human and vehicular activity shall be restricted to operational sites.	X						
Human and vehicular activity shall be restricted to the access roads and operational areas.	X						
Dirty water from mine surface infrastructure areas shall be retained within the mine's stormwater control system and prevented from flowing into these habitats.	X						
Erosion shall be prevented or controlled where vegetation has been disturbed. Refer to paragraph 5.2.1.2 of section 2 of this EMP for soil erosion control management measures.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Indiscriminate disposal of waste in these habitats shall be prevented.	X						
Mine staff shall not be allowed to remove plant species for any activities such as firewood.	X						
A red data study to identify any red data vegetation species shall be undertaken on all areas earmarked for development in the future.						X	
All red data species identified shall be relocated to designated areas and monitored for success of establishment.						X	
Seeds from all red data species shall be collected prior to relocation and stored in a seedbank for future planting.						X	

5.2.3.2 Vegetation re-establishment

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Topsoil and young/small vegetation shall be stripped together on all areas earmarked for new development to ensure the seedbed is maintained to facilitate with rehabilitation.						X	Environmental department, all employees
An approved seed-mix of indigenous plants shall be used in all new rehabilitation programmes on the mine.						X	
Consecutive rehabilitation shall be undertaken on areas impacted where rehabilitation has taken place.						X	

5.2.3.3 Vegetation Invader Control

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
General control							
Alien invasive vegetation shall be removed according to area and not species. Ranking shall be considered according to legislation: • Category 1 (prohibited plants) • Category 2 (allowed under permitted conditions) • Category 3 (ornamentally used plants)						X	Environmental department, all employees
A document plan shall be in place and implemented to remove category 1 plants in strategic areas of responsibility.						X	
Any category 1 plants that occur on any land or inland water surface shall be controlled.						X	
There shall be no establishment, multiplication, maintenance or propagation of category 1 plants.						X	
Propagating material of category 1 plants or any category 1 plant shall not be imported, sold or acquired.						X	
Category 2 or 3 plants shall be restricted to demarcated areas or a biological control reserve.						X	
Propagating material of category 2 or 3 plants or any category 2 or 3 plants shall not be sold to another person unless such other person is a land user of a demarcated area or of a biological control reserve.						X	
Any category 2 or 3 plants that occur on any land or inland water surface within the mine's property shall be controlled.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Methods of control shall include: • Uprooting, felling, cutting or burning. These methods shall coincide with the life cycle of invaders to prevent the plants from forming seeds or re-establishment in any manner. • Treatment with herbicide that is registered for use in connection with such plants in accordance with the directions for the use of such herbicide. • Biological control carried out in accordance with the stipulations of the Agricultural Pests Act, 1983 (Act No. 36 of 1983), the NEMBA and any other applicable legislation. • A combination of the above methods shall be employed to control weeds or invaders. • Regular follow-up operations shall become mandatory to allow achieving the appropriate combating levels. This shall also give an indication of the success of the control method employed. • The services of a biological expert shall be called upon to assess the success of a biological control agent. • Actions taken in the combating of weeds and invaders shall be done in such a fashion that it will cause the least harm to the environment.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Communities of indicator plants that occur in natural vegetation shall follow practices to prevent the deterioration of the natural resources.						X	
Bush encroachment shall be combated.						X	
Information and actions taken on combating of weeds and invader plants shall be reported.						X	
<u>Specific control</u>							
Fountain grass (*Pennisetum setaceum*): • The plants shall be left as is for the time being as they are helping to stabilise the CRDs, and shall be removed when Finsch starts with the retreatment of the dumps. • The grass shall be manually removed. • The coarse residue shall be monitored during and after rehabilitation to ensure the grass does not invade the area again.						X	Environmental department, all employees

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Wild tobacco (*Nicotiana glauca*): • The plants shall be left as is for the time being as they are helping to stabilise the CRDs, and shall be removed when Finsch starts with the retreatment of the dumps. • The herbicide Garlon 4 shall be used to remove wild tobacco. • The wild tobacco shall also be manually removed. • In order to prevent coppice and re-growth the whole plant together with its roots, shall be removed.						X	
Honey mesquite (*Prosopis glandulosa*): • The stumps of trees shall be cut. • Herbicide can be used. • Bio control in the form of seed feeders can be used.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Sweet prickly pear (*Opuntia ficus-indica*): • The plant shall be dug out and burned. • There are various biological control agents available for this species that can be used: *Archlagocheirus funestus* – a stem borer with substantial degree of control and trivial damage to weed. *Cactoblastis cactorum* - a stem borer with substantial degree of control and extensive damage to weed. *Dactylopius opuntiae* - a sap sucker with substantial degree of control and extensive damage to weed. *Metamasius spinolae* - a stem borer with substantial degree of control and extensive damage to weed. • Registered herbicide that can be used is Agromate with the active ingredient MSMA, Roundup, MSMA 720 SL, Touchdown, Touchdown Plus, Agromate						X	
<u>Chemical management</u>							
All measures shall be taken to ensure operators safety and label recommendations regarding safety are strictly observed.	X						Environmental department, all employees
Operators shall receives training on the basic pesticide awareness; safe handling of concentrates and spray mixtures, toxicity of the pesticides, protective clothing and safe disposal; application techniques to prevent waste; and are of equipments – cleaning and disposal of washings.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The label shall always be read to determine what specific PPE is required for handling and application of a product. The minimum requirement when handling pesticides are adequate eye protection, goggles or a full-face shield; rubber gloves and boots; aprons to protect working clothes; head protection; and respirator or face-mask.						X	
Only pesticides with least environmental impact shall be used.	X						
Precaution shall be taken to ensure that these products are safely stored, handled, applied and disposed.						X	
During the application, damage to indigenous or other desirable vegetation product shall be observed.						X	
Care shall be taken to prevent contamination of water bodies.						X	
Strict precautions shall be applied when handling pesticides and the personnel handling the product shall be fully aware of the precautions observed.						X	
Absorbent materials shall be available during the process to handle accidental spillages.						X	
In case of spillage, the spill shall be contained immediately with absorbent.						X	
The contaminated material shall then be disposed of as hazardous waste.						X	
Concentrates and mixtures shall never be decanted into or be mixed in drinking bottles or other food containers.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
All containers into which pesticides are decanted shall be clearly marked and a copy of the original label secured to the container.						X	
Pesticides empty containers shall be treated as hazardous waste and correctly and safely disposed.						X	
All contaminated material shall be paled in a sealable container marked with the following words e.g. “Pesticide/Toxic”.	X						
Contaminated soil shall be dug up and placed into a suitable container and sealed.						X	
The container shall be stored in a designated area, along with all other hazardous waste.						X	

5.2.3.4 Animals and habitat conservation

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Mine staff shall not be allowed to hunt, trap, kill or disturb any animal species, with the exception of hunting if permitted in the game farm.	X						Environmental department, all employees
Killing of animals that are perceived as dangerous, such as snakes, shall be discouraged.	X						
Surface disturbance shall be kept to a minimum by concentrating activities at the already disturbed mining infrastructure area. Human and vehicular activity shall be restricted to operational sites.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Fire breaks management is described in sub-section 5.2.3.6 of section 2 of this EMP.							
Conservation-orientated clauses shall be built into contracts for personnel, complete with penalty clauses for non-compliance.						X	
A red data study to identify any red data animal species shall be undertaken on all areas earmarked for development in the future.						X	
All red data species identified shall be relocated to designated areas and monitored for success of establishment.						X	

5.2.3.5 Conservation of sensitive habitats

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
No new development shall be undertaken in sensitive areas.						X	Environmental department, all employees
Clean and dirty water shall be separated to ensure that all clean water areas are allowed to freely drain into the natural drainage features. Refer to paragraph 5.2.2 of section 2 of this EMP for water management.							
Refer to paragraph 5.2.7 of section 2 of this EMP for management of hazardous substance.							

5.2.3.6 Fire breaks

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
20m fire breaks are currently established around the town and around the game farms and shall be maintained.						X	Environmental department, all employees

5.2.4 Air quality management

Air quality includes: noise; blasting and vibration management and control.

Operational Objectives:

1. To ensure that the mine remains compliant with air quality legislation.
2. To maintain dust prevention systems and equipment in good working condition so as to keep respirable dust levels as low as is reasonably achievable and within the recommended standards.
3. To supply to the work-force, free of charge, personal dust respirators to be worn as protection where workers are exposed to short term dust levels which are not covered by permanent dust control measures.
4. To control wind erosion and eliminate nuisance and health problems;
5. To limit public exposure to unacceptable dust risks and noise disturbance.
6. Provide hearing protection where noise cannot be reduced.

Management:

5.2.4.1 Dust management measures

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Removal of vegetation cover shall be kept to a minimum.	X						Occupational hygienist Hygiene staff Environmental monitor Mining manager / surface manager/all employees
Open areas shall be kept to a minimum.	X						
Temporary vegetation shall be established on the stockpiles, where possible, to prevent wind-blown erosion.						X	
In the case of project-related areas, such areas shall be re-vegetated as soon as is practically possible to reduce the amount of open areas exposed to wind erosion.						X	
If dust pollution levels exceed the relevant requirements as described under the NEMAQA and the Mine Health and Safety Act, dust shall be managed by means of a water bowser and the implementation of lower speed limits on the mine's roads.						X	
Strict speed limits shall be implemented. This includes speed signs on mine as well as the training of drivers.	X						
Trucks transporting light/ wind- dispersible materials shall be covered.	X						
If there are any complaints with regards to dust pollution, dust samples shall be taken to assess the intensity of such an impact on the applicable complainants' land or residences.						X	
Dust suppression as mist spraying shall take place, especially during dryer periods on the FRDs.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Dust suppression methods for the WRDs shall be undertaken if required.						X	

5.2.4.2 Emissions management measures

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
All machinery shall be kept in a good working order and serviced regularly to reduce emissions.	X						Occupational hygienist Hygiene staff Environmental monitor Mining manager / surface manager/all employees
All diesel driven vehicles operating on public roads shall be listed.						X	
Service / maintenance data / annual roadworthy inspections of all vehicles shall be reflected.						X	
Visual inspections on vehicles for black smoke shall be undertaken.						X	
Vehicles shall be prioritized from oldest vehicles to newest.						X	
Vehicles shall be submitted for vehicle emission testing as per GN R 1651 of 20 September 1974.						X	
Contractors undertaking transporting on behalf of the mine shall be requested to provide evidence of their vehicle emission levels compliance to the maximum levels set out in GN R1651 of 20 September 1974 or at least proper maintenance on their vehicles.						X	
Burning of conveyor belts, cables or waste shall be prevented.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The prohibition of above shall be communicated to all contractors operating on site.						X	

5.2.4.3 Noise management measures

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Diesel powered vehicles shall be regularly maintained. • Monitoring shall be done, and included on a monitoring schedule.						X	Occupational hygienist Hygiene staff Environmental monitor Mining manager / surface manager/all employees
Any obvious increase in the noisiness of any vehicles shall result in that it being scheduled for a maintenance check. • Reports as well as monitoring data shall be kept and analyzed.						X	
A good maintenance management scheme shall be implemented to ensure that vehicles are properly maintained thus reducing the occurrence of excessive emissions.						X	
If significant increases in noise levels are identified technological alternatives such as silencers shall be considered.						X	
All vehicles owned by the mine, operating on public roads shall be submitted for vehicle noise testing as per Noise Control Regulation 3 of GN R154 of 10 January 1992 – Noise Control Regulations.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
All contractors undertaking transportation on behalf of the mine shall be requested to provide evidence of their vehicles' noise levels compliance with the Noise Control Regulations 3 as per GN R154 of 10 January 1992.						X	
If complaints of any noise pollution are made, noise levels at the applicable sites shall be measured to assess the intensity of the alleged impact. • These noise levels shall then be interpreted relative to the baseline information already gathered to indicate whether steps would be necessary.						X	
Blasting activities shall only be undertaken during daylight working hours on weekdays only.						X	

5.2.4.4 Vibrations management measures

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Monitoring of the pit rim stability shall continue.						X	Mine manager
Long term forecasts shall be made by the mine of possible effects regarding the stability of the pit.						X	
The forecasts shall be reviewed on an ongoing basis.						X	
The pit area shall be fenced off.	X						
The use of an accurate initiation system shall continue.						X	

5.2.5 General waste management

Operational Objectives:

1. Avoid as far as possible the generation and production of waste.
2. Where the generation and production of waste cannot altogether be avoided, it must be minimized, re-used or recycled. When recycling or re-use:
   - Uses less natural resources than disposal of such waste; and
   - To the extent that it is possible, is less harmful to the environment than the disposal of such waste.
3. Where possible, dispose waste in a responsible and sustainable manner – environmentally sound manner.
4. Disposal of any waste, liquid or solid, must be done at an approved demarcated site.
5. Investigate, assess and evaluate the impact of the waste in question on health or the environment;
6. Manage the waste in such a manner that it does not endanger health or the environment or cause a nuisance through noise, odour or visual impacts.
7. Cease, modify or control any act or process causing the pollution, environmental degradation or harm to health.
8. Eliminate any source of pollution or environmental degradation.
9. Remedy the effects of the pollution or environmental degradation.
10. Prevent the waste from being used for an unauthorised purpose;
11. Comply with any norm or standard or prescribed management practice;
12. Prevent any employee or any person under his or her supervision from contravening these management measures or any Act in this regard.

Management measures:

5.2.5.1 Waste separation and storage at source

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Waste on surface shall be separated into four categories namely hazardous waste, general waste, scrap metal and garden refuse.	X						Environmental department, all

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Hazardous waste shall be stored in black containers, general waste in grey containers, scrap metal in blue containers and garden refuse in green containers.	X						employees
Extra telecons shall be requested for any project on surface where significant quantities are generated.						X	
All working areas underground shall classify and separated their waste into hazardous waste and general waste which includes scrap metal.	X						
Hazardous waste shall be stored in black containers and general waste in grey or yellow containers.	X						
Extra cassettes for the removal of underground waste shall be requested.						X	
Hazardous waste shall not be mixed with general waste.	X						
Old oil filters shall be drained before they are placed into the hazardous waste telecom/cassette.						X	
Oil, diesel or grease contaminated soil/sludge; absorbent material (hazardous waste) shall not be mixed with other hazardous or general waste.	X						
Used products and containers shall be returned to the supplier for recycling if this is possible.						X	

5.2.5.2 Disposal of used oil

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
All the used oil on surface inside the mining area shall be drained into a container and emptied into 210 litre drums posted at various locations and clearly marked for this purpose.						X	Engineering foreman, workshop foreman, environmental department
All the used oil collected at the oil traps and sumps on surface inside the mining area shall be pumped into 210 litre drums marked for this purpose.						X	
When these drums are full, it shall be ensured that they are taken to the surface mechanical workshop and placed at the designated storage area in the lube bay to be pumped out.						X	
Empty drums shall replace the full drums that are removed from oil disposal points.						X	
All personnel shall be familiar with the old/used oil disposal system and shall know where the disposal points are situated.	X						
Empty drums that are not in use on surface inside the mining area shall not be stored at the hazardous storage area at the WAMY.						X	
All the used oil at the outside services workshop shall be drained into a container and pumped into the 2000 litre used oil storage tank.						X	
When the tank is 60% full, supply chain shall be notified, which in return shall notify the oil-recycling contractors who pump out the oil from the storage tank at Outside Services.						X	
No oil from the underground trackless workshops shall be allowed to run into any water drain.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
All oil drained underground from machines during maintenance shall be disposed of via the used oil system at 63 level workshops or shall be disposed of into 210 litre drums which report to surface.						X	
Oil spillage occurring during machine repairs and breakdowns in service bays underground shall be absorbed with fibre and the workshop floor shall be cleaned with a biological degreaser where possible.						X	
Oil underground shall not be deposited on the footwall or poured into the drains or water passes underground.	X						
Any vessel underground that contains old oil shall be sealed so that accidental spillage cannot occur if the container is disturbed.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
When the used oil storage tank underground is 60% full; the following procedure shall be adhered to: • An empty used oil cassette shall be sent to correct level. • The oil shall then be transferred from the used oil storage tank into the used oil cassette. Spillage shall be caught in a drip tray. • The cassette shall be transported to surface and placed at the designated area in the lube bay at the Surface Mechanical Workshop. • The old oil shall then be pumped to the oil storage tank outside the security fence. • When the cassette is empty it shall be returned to the designated site at the marshalling yard.						X	
If transformer oil has to be disposed of, sample shall be taken for PCB testing.						X	
If the results indicate that the oil is PCB free it shall be taken in 210 litre drums to a designated area at the surface mechanical workshop lube bay and pumped into the used oil storage tanks.						X	
If the transformer oil contains PCBs, i.e. if the levels exceed 50ppm it shall not be disposed of through the oil system.						X	
PCB contaminated oil shall be securely contained in labelled 210 litre drums and taken to the hazardous waste storage area at the WAMY.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The WAMY Supervisor shall be informed so that arrangements can be made for its safe disposal to Waste-tech.						X	
All spills shall be reported.						X	
The method used to clean up an oil spill depends on the type of surface that has been contaminated but shall be done in such a way to prevent the spreading of oil, recover oil where possible, clean up and if necessary rehabilitation the area.						X	
Personnel handling oil shall use gloves and eye protection.						X	
Personnel shall have training in spill management.						X	
Appropriate records shall be kept.						X	
Large spills on a concrete surface shall be contained using absorbent booms.						X	
Excess oil shall be pumped or scooped up into old oil containers.						X	
Small spills on a concrete surface shall be contained using loose fibre.						X	
The used fibre or booms shall be stored in a 20 litre drum marked for this purpose and reused where possible.						X	
The used fibre and fibre booms, together with oily rags shall be disposed of in a drum marked for this purpose and sent to the WAMY.						X	
Oil-contained fibre or other oil contaminated materials shall not be mixed with any other wastes.						X	
Concrete floors shall be washed with biological degreaser.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Spills on land shall be contained as quickly as possible with earth walls or absorbent booms.						X	
Excess oil shall be deflected onto plastic sheeting to minimise infiltration into the ground. Contaminated soil shall be removed and placed in 210 litre drums and removed to the designated bioremediation site at the WAMY.						X	

5.2.5.3 Waste transportation

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
All telecons containing general and/or hazardous waste from the outside areas, namely outside training centre, single-quarters, hospitals and FRDs, shall either be transported to the demarcated inside areas or taken to the PPC general landfill site.						X	Engineering – transport section
If a security escort is available, the waste shall be transported directly to the WAMY.						X	
All telecons containing general and/or hazardous waste in the inside areas shall be transported to the WAMY.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Special transport shall be arranged for the following items: • Items heavier than 50 Kg; • Items of dimensions> 1 m³; • Electrical cable; • Hoist cable; • Conveyor belting; • Batteries; and • Fluorescent tubes- which must be crushed in a closed 210L drum at the relevant workshops prior to being sent to the WAMY.						X	
Waste shall not be spilled while the telecom or cassette is in transit or in the process of being offloaded or tipped.						X	
The transportation of waste to the WAMY shall take place during normal day shift, working hours.						X	
When weekend work is carried out where waste must be disposed of to the WAMY, the project owner shall make prior arrangements with the WAMY Supervisor to arrange for access and the appropriate off loading of the waste.						X	
Waste shall be safely offloaded at the WAMY.						X	
Equipment and/or material, identified for salvage purposes shall be safely offloaded to minimise the damage thereof.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Cassettes shall be collected and transported from underground to the marshalling yard.						X	
Any non-compliance with regards to waste separation in the cassettes from underground shall be reported						X	
Cassettes shall be transported from the marshalling yard to the WAMY.						X	
The cassettes shall be off loaded and tipped at a designated place after the content has been inspected.						X	
Contaminated waste shall be placed in a 210 litre drum, marked for that purpose, before being placed in a cassette or telecom or on a bakkie for transportation to the WAMY.						X	
Arrangements shall be made to transport hazardous waste from the marshalling yard separately to the WAMY where possible.						X	
If there are large quantities of polluted soil, a telecom or cassette shall be requested and transported to the WAMY.						X	
All batteries (dry cell and acid/lead batteries) shall be transported separately to the WAMY as hazardous waste. They shall not be placed in a telecom or cassette with any other waste types. Incorrect transport of batteries can lead to short circuits which may result in explosions and/or fires or the chemicals of wet cell batteries may leak out and contaminated the rest of the waste.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Waste from ladies change rooms shall be suitably contained in closed double plastic refused bags, and collected by the registered collection service provider from the change house.						X	
Old explosives shall not be delivered to the WAMY.	X						
Whenever any failed fluorescent tubes, mercury vapour, high-pressure sodium or incandescent lamps are replaced on mine the lamps shall transported intact to the electrical workshop where they will be disposed of by means of a tube crusher.						X	
The person crushing the tubes shall wear a dusk mask, full face eye protection and pig skin gloves.						X	
Light bulbs which do not fit in the tubes crusher shall be placed in dedicated drums at the electrical workshop.						X	
All this drums shall be sealed, labelled and transported to the WAMY for correct waste disposal when full.						X	
Incinerator ash shall be sampled.						X	
When test results indicate that the ash is not hazardous it shall be sent as general waste to the WAMY in a closed/sealed drum.						X	
When the test results indicate that the ash is hazardous it shall be sent directly to Waste Tech or to the WAMY until collected by Waste-tech.						X	
Salvageable equipment, where possible, shall be sent directly to the stores for sale and not to the WAMY.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
All vehicles, reusable containers and covers, where it is safe to do so, which have been in contact with HCS waste shall be cleaned in the wash bay so that they do not cause a hazard outside of the mine property						X	
The hazardous waste disposal contractor shall also comply with the HCS regulations	X						

5.2.5.4 Disposal at waste management yard

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The WAMY shall be locked and secured after hours and suitably manned during operated hours.	X						Registered person, supply chain practitioner, WAMY supervisor, environmental department
Waste received at the WAMY shall be sorted, stacked and stored.						X	
Storage shall be at demarcated areas for the specific type of waste.						X	
All WAMY personnel shall be adequately trained for the WAMY operation to include identification of the various hazardous and general waste streams and explosives.						X	
Waste shall not be stored or disposed of in front of the WAMY gates.	X						
Litter shall be prevented and where it is windblown against the fence it should be removed.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Record shall be kept of the general waste that is disposed of; quantities, dates and origins of hazardous and non-hazardous waste received, stored and leaving; waste materials recycled; waste material sales/or auctions; and incidents associated with the WAMY.						X	
General Waste shall not be stored for more than eighteen months from the date of generation.						X	
Scrap metal for cutting, salvage and/or auction purposes shall be identified and send to stores.						X	
Products and containers that are used shall be returned to the supplier for recycling, where practicable.						X	
Plastics, cardboard, wooden pallets, plastic pallets, polyurethane panels, scrap metals, conveyor belts and scrap metal shall be recovered for recycling.						X	
Garden waste shall be disposed of as a mulch or topdressing to the WRDs.						X	
Grass cuttings and leaves can be added to the bioremediation process of oil contaminated ground at the WAMY. The addition of organic material enhances the process.						X	
Tyres shall not be land filled as they cannot be compacted and tend to rise up through the waste.	X						
Tyres shall be stockpiled and recycled whenever possible.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
When handling and/or storing hazardous waste, special attention shall be given to the prevention of fires, explosions, burns, chemical fires, toxic fumes, chemical reactions, loss of life and damage to company property.						X	
Hazardous waste received in telecons, cassettes and by any other means shall be removed, sorted and stored under cover on a concrete bunded area.						X	
This storage area shall be designed and constructed to prevent pollution to the environment and kept lock.	X						
All hazardous wastes shall be removed and disposed of to a licensed hazardous site within 90 days.						X	
All chemicals waste shall be labelled and an MSDS shall be available on site.						X	
Drums shall be stored and labelled as per legal requirements.						X	
The washbay shall be used to steam clean all chemically contaminated drums, hydraulic hoses and other containers so that they can safely be reused, recycled or disposed of.						X	
The contaminated water from the wash bay shall report to an oil water separator sump whereby the oil is removed to a separate container for safe disposal and the clean water used on the bioremediation site.						X	
Spillages shall be prevented when decanting liquids from one container to another.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
In the event of a spillage or contamination at the incident shall be reported immediately to ensure prompt action.						X	
Contaminated soil shall be stored at the hazardous waste storage area or taken directly to the bioremediation site.						X	
Old oil shall be disposed of to an approved oil recycle company.						X	
Asbestos waste shall be placed in containers that will prevent the likelihood of exposure during handling.						X	
All vehicles, re-usable containers or any other similar articles which have been in contact with asbestos waste shall be cleaned and decontaminated after use in such a way that it does not cause a hazard inside or outside of the workplace.						X	
All asbestos waste shall be disposed of at a registered site.						X	
All persons working with asbestos waste shall wear PPE.						X	
Electronic waste shall be recycled as far as possible						X	
The dried sewerage sludge shall be disposed of through a controlled composting program.						X	
The final compost product shall be used as a top dressing material for WRD rehabilitation purposes.						X	
Lead/Acid batteries shall be returned to supplier.						X	
Batteries that cannot be recycled shall be disposed of to Waste-tech.						X	
In the event that they are any explosives at WAMY, this shall be reported.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
No medical or health care waste or pharmaceutical waste, animal carcasses, explosive waste, mining residue waste or sewerage waste may report to this site.	X						
Explosives shall be placed and locked in the relevant marked boxes.						X	
Detonators shall not be stored with other explosive components.						X	
The box containing the explosive shall be moved to a designated site away from the working area of the WAMY personnel and shall be collected by a designated person						X	
Waste from the emulsion silos shall be stored in marked drums; one for gassing solution and the other for emulsion within the locked Silos area. They shall be collected by AEL for safe disposal.						X	
Redundant chemicals, pesticides, incinerator ash, solvents, oily rags, oil filters, crushed fluorescent tubes and any other hazardous waste shall be dispatched to waste-tech every ninety days or when necessary.						X	
Any people conducting salvage operations at the WAMY shall be suitably trained and fall under the jurisdiction of the waste permit holder and or / employer.						X	
Ad hoc inspections shall be done on the WAMY to ensure compliance with the Specifications.						X	
The WAMY shall be measured in terms of audit findings, inspection recommendations and legal compliance in terms of waste management.						X	

5.2.5.5 Bioremediation at waste management yard

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
All polluted material shall be stored and remediated within the concreted area.						X	WAMY supervisor, section supervisor, foreman, environmental
Untreated material shall be separated from treated material and piled in windrows approximately 1m in height.						X	
The untreated material can be mixed with the Bobcat (or manually with shovels) to introduce air into the soil.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The mixing of the material shall be done as described below: • At the time of mixing one large spade/shovel of Bioremediation powder shall be added for every m³ of contaminated material or more if the material is heavily polluted. • Clean fresh soil, if available can also be added in order to dilute the degree of contamination and provide additional bacteria to the contaminated ground. • Organic material such as grass cuttings, leaves, small sticks, compost, shredded paper and/or wood chips can also be added to the contaminated ground. This organic material will help to maintain air in the mix, add nutrients will speed up bioremediation process. • The quantity of organic material added can be in the ratio of 1:1 if available. • Enough water shall be added to wet the mixture. • The mixture shall not be saturated.						X	department
The treated heaps shall be turned approximately every two weeks and water added to keep the mixture moist.		X					
Bioremediation shall be monitored by changes in the colour and smell of the material and by chemical analysis of the material.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The material shall be aerated (mixed) regularly and kept damp to keep the oil/diesel consuming bacteria alive and ensure that the process is successful.	X						
The bioremediation process shall be completed within 3 months.			X				
It shall be verify that bioremediation has been successful.						X	
The treated material shall not be disposed of into the landfill site if it contains kimberlite residues because of the polluting potential of kimberlite.	X						
Treated kimberlite sludge or residue shall be disposed of in the process via Boyo's Bin if the level of contamination is <1000ppm (Total heavy chain hydrocarbons)						X	
Treated soil or absorbent fibre that does not contain kimberlite shall be disposed of to the landfill or onto the WRD as top dressing if deemed clean enough <500ppm. (Total heavy chain hydrocarbon).						X	

5.2.5.6 Capital yard

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Only equipment with a valid proof of delivery certificate shall be allowed into the capital yard.	X						Mine overseer logistics, yard supervisor, environmental
The salvage equipment shall not leak oil.	X						
Salvage equipment that does leak shall be transported to the WAMY.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Second hand equipment shall be transported to the salvage yard (stores) to be sold.						X	department, all project managers, store 5 material manager, relevant contractors and contractor managers
Good housekeeping shall take place.	X						
The operations shall stay within the demarcated areas.	X						
All relevant environmental procedures shall be adhered to.	X						
All new construction work shall first be approved.						X	
An internal EIA shall be conducted and signed-off prior to the establishment of a new contractor site.						X	
A contract close-out checklist shall be completed and signed-off when doing site de-establishment.						X	

5.2.5.7 Incinerator

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The incinerator shall be cleaned out every morning before the operations start.	X						Registered person, supply chain practitioner, WAMY supervisor, environmental department
The grit arrestor shall be cleaned after incineration.	X						
After the last load of waste has been loaded, the timer shall be set for one hour so that the waste can be burnt out completely.	X						
If the waste is not completely burnt out, the timer shall be set for another hour and repeat process until all the waste has been burnt.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The electricity and diesel supplies shall be switched off before any work is carried out on the burner.	X						
The incinerator shall be maintained regularly.						X	
Used paraffin shall be disposed of as a hazardous liquid to the WAMY.						X	
The emissions shall be checked daily to ensure that any non-conformances are reported, if increasing Ash shall be remove daily and stored it in a sealed 210 litre drum.	X						
These drums shall be taken to the WAMY when they are full.						X	
The number of drums of ash and the dates on which they were sent to the WAMY shall be recorded.						X	

5.2.5.8 Disposal at landfill site

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Adequate facilities, equipment and suitably trained staff shall be in place to manage the site.	X						Registered person, supply chain practitioner, WAMY supervisor,
A small bulldozer or tractor and compactor shall be on site to compact and cover waste.	X						
Equipment shall be maintained in good working order.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The maintenance of the landfill or the supervision of the maintenance shall rest with the registered contractor and shall be carried out on a continuous basis.						X	environmental department
The landfill site shall be correctly stabilised at regular intervals.						X	
The water drainage from the landfill site shall be adequately constructed so that water is drained away from the landfill to prevent leachate from the waste. • A buffer zone shall be maintained around the waste disposal site at all times. • All runoff water arising on the land adjacent to the site shall be drained and diverted • Under flood conditions a freeboard of ½m shall be maintained • All runoff water which arises on the working site shall be drained and diverted						X	
Such runoff from coming into contact with any leachate from the site shall be prevented.	X						
The correct type of material / waste rock shall be used for land-filling.						X	
Record shall be kept of the general waste that is disposed of into the landfill; quantities, dates and origins of waste received.						X	
The maximum height of the site above ground shall not exceed 3m.	X						
There shall be adequate sanitation facilities on site.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Weather proof, durable and legible notices shall be displayed at the entrance to the site which prohibits unauthorized entry and includes hours of operation, name, address and telephone number of the registered person responsible for the operation of the site.	X						
The roads shall be maintained in a good condition						X	
All gates shall be locked outside of operational hours	X						
Illegal dumping outside the gates shall be reported						X	
If necessary, for special or emergency reasons after-hours access shall be provided for.						X	
The operator must ensure that no hazardous wastes, sludge's, liquid wastes or even sealed drums are disposed of into the landfill.	X						

5.2.5.9 Duty of care

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The generator shall retain the ultimate responsibility for ensuring that the waste is handled, stored, transported and disposed of according to the legislation and in an environmentally sound and responsible manner.							All mine personnel, environmental department
The illegal dumping of waste shall be prevented.							

5.2.6 Mine and plant residue management

Operational objectives:

1. Where possible, dispose mine residue in a responsible and sustainable manner – environmentally sound manner.
2. Waste material from any plant and / or beneficiation process must be disposed of at an approved demarcated site.
3. Investigate, assess and evaluate the impact of the waste in question on health or the environment;
4. Manage the waste in such a manner that it does not endanger health or the environment or cause a nuisance through noise, odour or visual impacts.
5. Cease, modify or control any act or process causing the pollution, environmental degradation or harm to health.
6. Eliminate any source of pollution or environmental degradation.
7. Remedy the effects of the pollution or environmental degradation.
8. Prevent the waste from being used for an unauthorised purpose;
9. Comply with any norm or standard or prescribed management practice;
10. Prevent any employee or any person under his or her supervision from contravening these management measures or any Act in this regard.
11. No sand dump or FRD shall be established on the bank of any water resource without permission from the Minister.
12. The mine's residue must be characterised according to its physical and chemical characteristics as well as mineral content.
13. All residue stockpiles and deposits must be classified into one or a combination of safety or environmental categories.

Management measures:

5.2.6.1 Operation of residue facilities

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Residue deposition							
Residue shall be deposited in a manner to ensure the stability of the outer face and to control the volume of water on the deposit.	X						General manager, production

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Deposits in which the outer wall is constructed using residue shall be operated using spigot to segregate the coarse and fine fraction on deposition so as to form a free draining outer wall zone.						X	manager, environmental coordinator, professional engineer, ore process section leader, specialist operating contractor, operating personnel
Deposition shall be controlled such that residue is only deposited in the demarcated operational footprint.	X						
The CRD shall be developed to the design profile.						X	
Water decant							
Supernatant water on FRDs shall decanted either by the gravity penstock system or barge such the volume of water stored in the deposit is kept to an absolute minimum and such that no solids are removed off the dam with the decanted water .	X						General manager, production manager, environmental

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The decanted water shall be returned to plant for reuse.	X						coordinator, professional engineer, ore process section leader, specialist operating contractor, operating personnel
Freeboard							
Adequate freeboard shall be maintained by correct deposition procedure.	X						General manager, production manager, environmental coordinator, professional engineer, ore process section leader, specialist operating contractor, operating personnel
The minimum vertical freeboard shall be 1m at all times regardless of the freeboard required in terms of NWA.	X						
The minimum total freeboard shall be maintained in excess of the required minimum freeboard which is determined on an annual basis.					X		

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Benches							
Benches shall be constructed at regular intervals on the outer wall to ensure a stable face and control water run-off and erosion						X	General manager, production manager, environmental coordinator, professional engineer, ore process section leader, specialist operating contractor, operating personnel
Water management							
Diversion trenches shall be provided uphill of the CRD to divert clean stormwater around the CRD to prevent contamination of the water.	X						General manager, production manager, environmental coordinator, professional engineer, ore process section
Temporary trenches shall be provided immediately uphill of the stripped portion of the footprint where the CRD is developed in an uphill direction.						X	
The top surface of the CRD shall be shaped and /or paddocked as far as practical to reduce the volume of water flowing over the crest to reduce the extent of erosion down the side slopes.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Stormwater flowing off the deposit shall be contained where the potential exists to contaminate the surrounding area, particularly clean water bodies.						X	leader, specialist operating contractor, operating personnel
<u>Footprint</u>							
Both the operational and final footprints shall be clearly demarcated in the field and updated as necessary.						X	General manager, production manager, environmental coordinator, professional engineer, ore process section leader, specialist operating contractor, operating personnel
Topsoil shall be stripped from the footprint ahead of the advancing toe and stockpiled in the designated area.						X	
<u>Re-profiling</u>							
The side slopes of the CRD shall be re-profiled to a slope of at least 1(v); 3(h) to enable capping and top soiling for closure.	X						General manager, production

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The operation shall be controlled to ensure the CRD remains within the confines of the demarcated final footprint.	X						manager, environmental coordinator, professional engineer, ore process section leader, specialist operating contractor, operating personnel
Maintenance and repair							
Stormwater control infrastructure including diversion trenches and down chutes (where provided) shall be maintained in an acceptable conditions such as that they conform to their design capacity at all times.						X	General manager, production manager, environmental coordinator, professional engineer, ore process section leader, specialist operating contractor,
Trenches shall be kept clear of vegetation, debris or silt that could impede flow.	X						
Any repairs to the infrastructure shall be carried out in accordance with the original design and construction specifications.						X	
Significant erosion down side slopes and particularly down re-profiled and capped slopes shall be repaired on identification using a suitable method to return the slope to at least to its original status.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The area shall also be upgraded to prevent re-occurrence or further deterioration.						X	operating personnel
Safety							
Sufficient and adequate safety equipments shall be provided on the deposit to ensure the safety of the operating personnel, employees and general public .Such equipment includes: • Personnel protective equipment; • Access catwalks and platforms; • Walkways; • Safety belts and • Warning signs	X						General manager, production manager, environmental coordinator, professional engineer, ore process section leader, specialist operating contractor, operating personnel
Access							
Access to the CRD shall be restricted to authorised personnel.	X						

5.2.6.2 Re-mining of residue facilities

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The angle of repose of the residue shall never be exceeded.	X						General manager, production
The maximum bench height of 3m shall not be exceeded.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Hollowing out (under cutting) of the face shall not take place.	X						manager, environmental coordinator, professional engineer, ore process section leader, specialist operating contractor, operating personnel
Bench widths shall be such that it enables the front-end loader creating the bench to work freely not closer than 3m from the outside edge of the bench.	X						
The necessary safety berms shall be constructed.						X	
Dozing shall be done to reclaim material and to minimise dilution where the cut off area between the original coarse residue conveyor belt pedding and coarse residue is reached.						X	
All vehicles travelling ways shall be kept clean and be well demarcated.						X	

5.2.6.3 Future deposits

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Candidate sites for any new deposit or a planned extension to an existing deposit shall be investigated in order to select the optimal site.						X	General manager, production manager, environmental coordinator,
The design of all new deposits and the extension of existing deposits must include the design criteria as per the COP.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Any modification carried out to existing deposits shall be in accordance with the requirements for a new deposit.						X	professional engineer, ore process section leader, specialist operating contractor, operating personnel

5.2.7 Hazardous substances management

Operational Objectives:

1. To cease, modify or control any act or process causing pollution.
2. To comply with any prescribed waste standard or management practice.
3. To contain or prevent the movement of pollutants.
4. To eliminate any source of the pollution.
5. To remedy the effects of pollution.
6. To remedy the effects of any disturbance to the bed and banks of a watercourse.

Management:

5.2.7.1 Transportation

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Pollution shall be prevented when transporting and offloading hazardous substances.						X	Engineering – transport section
Preventative measures shall include securing the closed containers on the vehicles as well as the use of drip trays and other spill corrective measures when transporting hazardous substances.						X	
All applicable procedures shall be followed when hazardous substances products are off-loaded in bulk or in small quantities.						X	
The necessary PPP shall be used when handling the product.						X	
Unloading of fuels shall be done according to the network instructions available at stores and bulk refuelling points.						X	
Any material or substances which can present threat to the safety and health of a person and which can be detrimental to the environment shall be evaluated.						X	

5.2.7.2 Storage

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Hazardous substances shall be stored in a well ventilated area.	X						Occupational hygienists, supply
The storage area shall be clearly labelled “Chemical Store”.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The types of items stored shall be indicated on a list at the entrance.	X						chain practitioner, environmental specialist, chief safety officer, standards officer, all employees at supply chain who deals with hazardous substances, all employees who deal with hazardous substances
All floors shall be sloped and bunded to contain any spills or leaks.	X						
Where items are stacked, adequate drip trays shall be made available to contain and confine any potential leaks.	X						
The drip trays shall aid in the cleaning-up of spills.						X	
Chemical compatibility shall be observed when storing chemicals.						X	
Corrosive liquids shall not be stored above eye level.	X						
Dry chemicals/powders shall be stored in one section and separated according to type i.e. oxidizing salts such as chlorine powder separated from other dry chemicals.	X						
Drain cleaners, acids and grease shall be stored separately.	X						
Flammable or combustible liquids (oils, solvents, paints) shall be stored separately or in a separate flammable store.	X						
Compressed gases shall be stored in a gas store and separated as follows; toxic gases, (chlorine); flammable gases, (LPG, Acetylene); oxidizing oxygen); inert gases (Neon, Freon); empty; full	X						
Store rooms containing hazardous substances shall be locked at all times. Only designated personnel shall have access to these areas.	X						

5.2.7.3 Specifications for bunded areas

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
All new bund shall have the following specifications and shall be big enough to contain the following: • Where there is one tank/transformer within the enclosed area, 110% of the capacity of the tank; • Where there are two tanks within the same enclosed area, 80% of the total capacity; • Where there are three or more tanks within the same enclosed area, 75% of their capacity; • For fuel and oil contained in drums, the bund shall contain 25% of the total volume of the stored products; and • Allowance shall be made to cope with maximum storm rainwater (100mm rainfall in 1 hour) and firewater.						X	Section leader, supply chain manager, all employees
The bund floor and walls shall be constructed of materials that are impervious to the contents of any tank or container within the bund.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The bunded area shall be capable of preventing the migration of any spillage or leakage to the surrounding environment and shall therefore be either: • Built of concrete; • Built of brick and then plastered with concrete and painted with an impervious paint; • Sealed with an impermeable liner; or • Constructed with steel.	X						
The area within the bund wall surrounding the tank or drums shall be kept entirely free and unoccupied and shall not be used as a storage area.							
No electric motor shall be placed where it can come in contact with the flammable liquid or its vapour, unless such motor is flameproof.							
Allowance shall be made for the trajectory/spurt of a leak from a full tank with an elevated point of leakage.							
High bund walls shall have steps for quick escape and/or to facilitate easy access from the outside.							
A collection sump shall be provided in the bund floor to make it easier to remove liquids.							
The floor shall be graded in such a way that liquid will collect in the sump. Spillage sumps shall be locked, preferably with "key-like" type devices to ensure availability of keys in case of emergency.							

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Bund drain valves/stopcocks shall be/have: • Leak proof; • Able to continue functioning in a fire; • Controls outside the bunded area; • Able to open manually; • Valves that must be kept locked in the closed position unless in use; and • The "open" and "closed" positions that must be indicated and obvious.	X						
If there are coupling in the bund, they shall be placed where leaks or spillage will be contained within the bund.						X	
Areas where fuel/oil is dispensed/refuelled (surface and underground) shall have bund type facilities to collect leaks or spills, and a means of collecting and disposing of these wastes in a way that will not cause soil or water pollution.	X						
If any new surface underground tanks must be constructed, the latest techniques in the way of jacketed tanks shall be investigated.						X	
The necessary certificate of registration for such a facility shall be obtained prior to it being used.						X	
The construction of the surface and underground tanks shall be according to the regulations relating to inflammable liquids and substances.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Every surface or underground tank shall have a 360cm high ventilating pipe with a diameter of 50mm.	X						
If an underground storage tank is to be abandoned, it shall either be removed or filled with sand or liquid concrete and will be confirmed by the environmental personnel.						X	
All underground storage facilities shall be tested on an annual basis to check for leakages and record kept.					X		
Warning signs that read "DANGER-FLAMMABLE LIQUID; NO SMOKING" and "NO NAKED FLAME" in letters 150mm high, shall be erected in prominent position at the entrance point of bulk storage areas.	X						
The appropriate symbols shall also be displayed.	X						
The capacity of tanks shall be indicated in letters 150mm high in an easily readable position.	X						

5.2.7.4 Operation

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Signs with regard to no naked flames shall be erected near the dispensing points.	X						Occupational hygienists, supply chain practitioner, environmental
Appropriate fire fighting devices shall be in place according to the required legislation.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
All employees working with the storage, use or disposal of hazardous substances shall be trained and briefed on the relevant procedures and potential environmental impacts of not adhering to these.						X	specialist, chief safety officer, standards officer, all employees at supply chain who deals with hazardous substances, all employees who deal with hazardous substances
No smoking shall be allowed within 10m of the operation.	X						
All fuel drawn from bulk storage points shall be recorded.						X	
All areas using fuel or oil, as far as practicably possible shall keep reconciliation records of fuel/oil used and disposed of on a monthly/quarterly basis.						X	
As a standard, no insulating oil containing PCB shall be used in transformers on mine.	X						
Spills or leaks encountered anywhere (including at refuelling points) shall be reported to the responsible supervisor of the area in which the spill occurs immediately.						X	
Arrangements shall be made for the clean up by the person/section that cause the spill and the supervisor of the area shall monitor the situation where necessary. The section that caused the spill shall be responsible for the cleanup costs.						X	
The spill management procedure shall be followed and appropriate disposal of contaminated material shall be ensured.						X	
Spillage of solid or liquid material within bunded areas shall be cleaned up as soon as possible.						X	
After rainfall, all bunds shall be emptied as soon as possible to maintain full capacity.						X	

5.2.7.5 Maintenance

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Surface and underground tanks shall be integrity tested on a regular basis (at least every two years) to ensure their competency.						X	Occupational hygienists, supply chain practitioner, environmental specialist, chief safety officer, standards officer, all employees at supply chain who deals with hazardous substances, all employees who deal with hazardous substances
All vehicles, machinery and equipment using fuel and oil shall be on a documented preventive maintenance schedule.						X	
Maintenance of bunded areas shall include checking the following: • That the drain valve is kept closed and locked; • Availability of the key to open or close when necessary; • That the bund wall is intact and is impervious to the liquids it must contain; and • That the pipe work, valves and other equipment in the bund are routinely maintained.						X	
Maintenance of concrete areas shall be done by using OT8 (or other biological degreaser) to wash down after mop-up operations.						X	
A qualified person shall examine all electrical earth connections every 2 months.			X				
Documented records of these inspections shall be kept according to the record keeping procedure.						X	

5.2.7.6 Disposal

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Contaminated waters or waste products shall be disposed of in a way that shall not pollute the environment. (e. g. Pump water through a portable oil separator before discarding the water, or use booms/cushions containing absorbent fibre to remove oil/diesel from the surface of the water)						X	Engineering foreman, workshop foreman
Appropriate facilities shall be made available to dispose of any wastes from the bund. This could be by drainage to an oil separator or having an emergency pump and emergency container readily available. Such a pump shall be on the maintenance scheduled and appropriate documentation available.						X	
Refer to section 5.2.5 for the disposal of all hazardous substances and spillages.						X	

5.2.7.7 Oil separator

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Contaminated water shall flow into the 1st compartment of the water tank.						X	Engineering foreman, Maintenance
This water shall then overflow into the 2nd and 3rd compartment.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The second compartment shall house the oil separator and the contaminated water shall be separated, allowing only clean water to flow into the third compartment.						X	planner, artisan
Water quality tests for hydrocarbon contents shall be conducted on the time schedules determined by the water quality monitoring procedure.						X	
The oil separator shall automatically pump the oil with a small amount of water into a separate container which shall be monitored and emptied when necessary and the old oil disposed of as per the storage, use and disposal of fuel and oil procedure.						X	
Silt traps shall be maintained as determined during daily inspections	X						
Silt shall be removed and treated at the bioremediation site at the WAMY.						X	
Contaminated water from the surface wash bay shall be directed to the oil separator.						X	Supervisors
It shall be ensured that no water contaminated with oil is allowed to flow into the stormwater drainage	X						

5.2.8 Health and safety

Operational Objectives:

1. To maintain a healthy and safe mine environment without risks to the labourers.
2. To identify the relevant hazards and assess the related risks to which persons who are not labourers may be exposed.

3. To ensure that persons who are not labourers, but who may be directly affected by the activities at the mine, are not exposed to any hazards to their health and safety.
4. To supply all necessary health and safety facilities and equipment to each labourer.
5. To maintain those facilities and that equipment in a serviceable and hygienic condition.
6. To ensure that sufficient quantities of all necessary PPE are available so that every labourer who is required to use that equipment is able to do so.

Management:

5.2.8.1 Welding, cutting and grinding

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Only trained persons shall use cutting equipment.						X	Supervisory staff, employees / contractors
No cutting shall take place in an unventilated area.						X	
Approved welding goggles shall be used by welder as well as any person assisting.						X	
In welding and cutting areas butane lighters shall not to be worn on a person or kept in the vicinity of such an area.						X	

5.2.8.2 Personal protective equipment

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The mine's employees, contractors and visitors, shall use the prescribed protective equipment / clothing when and where applicable.						X	Supervisory staff, foreman / shift boss, employees /

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
This equipment shall be supplied free of charge but shall remain the property of the mine.						X	contractors, stores supervisor, security contract personnel, line official, stores clerk
No short pants shall be allowed to be worn underground or in the process plant.						X	
The provided footwear shall be worn in designated areas.						X	
Employees shall take reasonable care to prevent injuries when wearing any other footwear in areas which are not designated safety footwear areas.						X	
When taking off the two piece jacket or when only wearing the overall trousers, employees working underground or working night shift on surface shall wear a shirt or T-shirt with reflective strips/reflective vest.						X	

5.2.8.3 Portable lamps

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
<u>Use of portable lamps</u>							
After removing the portable lamp from the charging rack, it shall be checked to see that it is in good working order.	X						Employees, lamp room staff, lamps man, underground engineer
Should a portable lamp be faulty, the complaint shall be entered in the defect book in the lamp room.						X	
Portable lamps shall not be switched on before it is necessary.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The portable lamp shall not be removed from the belt.	X						
On return to surface the portable lamp shall be returned to its place on the charging rack.	X						
All faulty portable lamps shall be placed in the repair bay and not on the charging frame.						X	
Each new employee that requires a portable lamp shall be allocated one by the lamp room attendant.						X	
Employees shall use their allocated portable lamps only.	X						
<u>Checks and tests</u>							
Each lamp room shift shall be responsible for checking one third of the lamps on the mine once every quarter.				X			Employees, lamp room staff, lamps man, underground engineer
Every 6 months a lamp room check shall be done.					X		
Weekly spot checks shall be done		X					
A burn down of all lamps shall be done at least twice per annum over a non-productive period.					X		
<u>Smoking</u>							
Smoking is prohibited within the lamp room.	X						Employees, lamp room staff, lamps man, underground engineer

5.2.8.4 Self-contained self-rescue packs

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Employees working underground shall receive full training.						X	Employees, lamp room staff, lamps man, underground engineer
Visitors shall only enter an underground section after watching the training video.						X	
Visitors shall at all times be accompanied underground by a fully trained mine employee.						X	
The retraining of employees shall take place every six months or if an employee has been absent from the mine for a continuous period of 30 days or more.				X			

5.2.8.5. Refuge bays

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
<u>Siting</u>							
The position of a refuge bay shall be determined by designated persons.						X	Underground personnel, supervisors (specific sections has specific refuge bays)
It shall be sited at an appropriate distance from the working places which it has to serve						X	
<u>Design and construction</u>							

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
A refuge bay shall be designed for the recommended number of persons in the section that it will serve, plus 10.						X	Underground personnel, supervisors (specific sections has specific refuge bays)
Service piping to the refuge bay shall be of fire resistant material or else be fire protected.						X	
The refuge bay shall be air leak proof so as to ensure a positive pressure inside the bay, once the compressed air is turned on.	X						
A steel access man door shall be provided.	X						
Seating to accommodate the maximum number of persons shall be provided.	X						
The refuge bay shall be clearly numbered both inside and outside for identification purposes.	X						
<u>Equipment and facilities</u>							
A supply of potable water shall be provided.	X						Underground personnel, supervisors (specific sections has specific refuge bays)
A telephone for communication between the refuge bay and surface shall be installed.	X						
A clearly visible reflective type "refuge bay" symbolic sign shall be displayed at the refuge bay entrance.	X						
An audible signalling device positioned outside the bay and activated from inside shall be installed.	X						
An amber flashing light with a reliable power supply placed in front of the refuge bay so as to indicate the location of the refuge bay shall be installed.	X						
Toilet facilities shall be installed.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
A first aid box and stretcher shall be available in the refuge bay.	X						
A notice board inside the refuge bay displaying the procedure to be followed during occupation in an emergency shall be installed.	X						
No smoking signs shall be displayed.	X						
A hand operated siren, to be operated from inside the refuge bay, shall be installed.	X						
The number of the refuge bay shall be displayed on both sides of the door.	X						
<u>Ventilation arrangements</u>							
A compressed air pipe shall be installed.	X						Underground personnel, supervisors (specific sections has specific refuge bays)
A hole shall be drilled through the gate valve for continues ventilation when not in use.	X						
<u>Maintenance and inspections</u>							
All equipment and facilities shall be inspected once per quarter and a written report submitted to the supervisors concerned.				X			Underground personnel, supervisors (specific sections has specific refuge bays)
Flushing and pressurisation tests shall be conducted on all refuge bays before being commissioned.						X	
Shift bosses shall carry out inspections on a weekly basis.		X					
<u>How to use the bay</u>							

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The first person arriving shall open the compressed air valve on the compressed air pipe.						X	Underground personnel, supervisors (specific sections has specific refuge bays)
The warning whistle and hand siren shall be activated.						X	
Door shall be kept closed during the entire occupation.						X	
The most senior person shall take charge and contact surface control.						X	
Details shall be given as to where the emergency was encountered, number of persons in the refuge bay, bay number and location.						X	
A record shall be kept of the names and company numbers of every person in the refuge bay.						X	
Employees shall remain calm and not move around unnecessarily.						X	
Cap lamps shall be conserved.						X	
Persons shall remain in bay until a senior official or the proto team arrives to escort the persons in the refuge bay to safety.						X	
Fire fighting drills and instruction							
This evacuation drill shall be done on a 6 monthly basis.			X				Underground personnel, supervisors (specific sections has specific refuge bays)
The findings of such a practise drill shall be recorded in the fire fighting drills			X				

5.2.8.6 Withdrawal from a dangerous place

When circumstances arise at the work place which appears, with reasonable justification, to pose a serious danger to the Health and safety of an employee or when a SHE Representative directs an employee to leave a working place, the following steps shall be taken:

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The employee shall withdraw from the workplace.						X	Head of departments (HODs), employees, SHE manager, chief safety officer, safety officer
The withdrawal shall be reported and incident shall be examined.						X	

5.2.8.7 Flammable gas

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
If the presence of flammable gas is detected, any other workings which may be affected shall be informed.						X	Supervisor, lamps man, assistant lamps man, miner / issued person, raisebore / sampling driller, hygiene section
Any occurrence of flammable gas shall be reported.						X	

5.2.8.8 Safety precautions related to all vehicles

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
All self propelled vehicles shall be kept in a good roadworthy condition at all times.	X						Engineering – transport section
Vehicles shall be registered as per traffic ordinance excluding earthmoving vehicles.						X	
All vehicles shall be equipped with fire extinguisher.	X						
All vehicles shall have a flashing amber light installed on top of the driver's cabin and shall be operational at all times.	X						
Vehicles shall be equipped with a reverse hooter /alarm to warn people working behind the vehicle.	X						
All vehicles drivers shall have a mine license to drive on mine property.	X						
All drivers shall have a valid driver's licence applicable to the class of the vehicle being driven and shall be authorised by the mine to drive that specific vehicle.	X						
Lowest gear shall be selected when driving down a steep slope with a fully loaded tipper truck;	X						
Speed limit shall be adhered to.	X						
When driving on public roads, all general road traffic rules shall be obeyed.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The 50m rule shall be observed by all drivers: The vehicles shall be stopped 50m away from any other vehicle eye contact obtained with the driver of the other vehicle and only proceed when given permission to do so.	X						
Reflective clothing shall be worn at all times.	X						

5.2.8.9 Additional measures

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Signage shall be put in site to regulate traffic on the mine.	X						All mine personnel
Traffic measures shall be put into place. This will include speed limits, etc.						X	
Security measures shall be implemented to prevent crime, loitering, etc.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Relocation of buildings and structures as and when required to maintain safety shall be undertaken through the operational phase of the mine.						X	

5.2.9 Explosives management

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Explosive waste such as cut off from ignition cords, detonators as well as old, excess or damaged stock shall be transported by a responsible person within the mine where it is destroyed by exploding the waste in an underground area during normal blasting processes.						X	
All explosives shall be stored in identifiable red, locked explosive boxes.	X						
Empty cardboard boxes that contained explosive packaging wastes shall be land filled.						X	
Old explosive shall not be delivered to the WAMY.	X						
In the event that they are, the appropriate person shall be notified.						X	
Explosives shall be placed and locked in relevant marked boxes.	X						
Detonators shall not be stored with other explosive components.	X						

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The boxes containing the explosives shall be moved to a designated site away from the working area of the WAMY personnel.						X	

5.2.10 Heritage and cultural management

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
Vehicles shall not drive over foundations of the farmhouse, outbuildings and labourers cottage.	X						Environmental department, all employees
Foundations of the farmhouses, outbuildings and labourers cottage shall not be disturbed or pillage.	X						
The pepper tree associated with heritage features shall be monitored so that it does not spread seedlings, or does not become a danger if it starts dying off.						X	
The grave shall either be completely fenced off or filled in.						X	
The cement blocks and other pieces that were originally on the top of the grave shall not be used for the infill, as they will indicate the presence of the grave on the landscape	X						
The graveyard shall be marked on mine maps, and indicated as a no-go area.						X	

DESCRIPTION	TIMEFRAME PARAGRAPH 2.3, SECTION 2						RESPONSIBILITY PARAGRAPH 2.4, SECTION 2
	Daily	Weekly	Monthly	Quarterly	Annually	Periodically	
The graveyard shall be checked annually to ensure that the fence is still in good condition and that there has been no vandalism to the graves.					X		
Archaeologist shall check the valley bottom soils when earth-moving commences in order to determine whether, as is probable, the artefacts in the sands have been washed in over time, or whether they were accumulated differently.						X	

6 Action plans to achieve the objectives and specific goals contemplated in Regulation 50 (a)

- Noise monitoring must be done to include the boundaries of the plant as well as results after April 2012.
- Dust fall-out monitoring must be done monthly.
- PM10 and pm 2.5 dust monitoring must commence.

7 Procedures for environmentally related emergencies and remediation

7.1 Fire management

1. If possible the fire shall be extinguished immediately.
2. The incident shall then be reported.
3. If the fire cannot be extinguished, a responsible person shall be contacted.
4. All persons shall be removed.
5. If an early warning device is available and indicates that the CO gas level is increasing or if discomfort from smoke is felt, the self rescuer shall be donned and persons shall proceed to the nearest refuge bay, or a place of safety.
6. Burning explosives shall never be extinguished; people shall be removed to safe place.
7. The event of an electrical fire, the relevant fire extinguisher supplied at the sub-station shall be used.
8. In the event of PVC cable burning, persons on the return side of the fire shall don the self rescuer and remove all persons to a safe place or refuge bay
9. In the event of an acetylene accident, the cylinder shall be removed to the open, the valve closed and regulator removed, the cylinder shall be opened fully and from a safe distance water shall be applied.

7.2 Spillages removal

1. Any oil, diesel, petrol or hazardous chemical spill shall be reported as an environmental incident by any employee.
2. A spillage shall be clean-up as follows:
   - Contain the spill- stop it spreading
   - Remove the source of the polluting substance- i.e. close any taps or valves where necessary
   - Clean up
   - Rehabilitate the area
3. All spills shall be addressed immediately.
4. The responsible person shall take steps to prevent the spill from spreading and immediately begin with clean up procedures.
5. Adequate PPE shall be worn when handling oil, diesel, solvents or other chemicals

7.2.1 Spills on concrete or other non tarmac surface

1. Oil, diesel, acid or other liquid chemical spills on concrete cement floors shall be mopped up with loose absorbent fibre.
2. Used fibre shall be put into a 210 litre drum marked for that purpose.
3. The drums shall be sent to the WAMY once it is full.
4. All diesel, oil and petrol contaminated fibre or soil shall be handled as hazardous waste.

5. Large oil spills shall be contained with fibre booms, bio tubes or sand filled plastic bags.
6. The spread of the substance shall be prevented.
7. Excess oil, diesel and liquid chemicals shall be pumped up and/or scooped into a holding tank/drum marked for that purpose.
8. The use of chemicals to absorb/emulsify oil shall be avoided.
9. The biological degreasers shall be used to remove traces of oil left on the concrete surface.
10. Only degreasers that are compatible with oil separators and water shall be used where there is oil separators installed.

7.2.2 Spills on tarmac surfaces

1. Spills shall be cleaned immediately because oil and diesel softens the tar surface.
2. Excess oil and/or other chemicals shall be soaked up with a suitable absorbent (loose fibre) and send to the WAMY.
3. The remaining spill or strain shall be cleaned with an approved biological cleaner.

7.2.3 Spills on soil

A bioremediation agent containing ‘’oil/diesel eating bacteria’’ shall be used in the following manner:

1. The excess oil and/or diesel shall be removed as quickly as possible to prevent further penetration into the ground by scooping up excess with shovels.
2. Plastic sheeting shall be used where necessary to divert and pick up the soil.
3. Any excess oil/diesel/chemicals shall be placed into a drum marked for that purpose and sends it to the WAMY.
4. Bioremediation of oil/diesel polluted soil on site shall be done where practicable.

7.2.4 Large spills on surface and underground

1. This is more than 100 litres of diesel, oil, acid or any other hazardous substance.
2. The spill shall immediately be reported.
3. Excess diesel spills, which occur in a bunded area into 210-liter drums shall immediately be pumped/scooped.
4. All oil and diesel spillage that contains water shall report to an oily water separator before being disposed of.
5. All water shall report to the service water system.
6. The bioremediation process shall immediately be started when the spill occurs on the soil.
7. Any contaminated ground/material shall be placed into drums marked for that purposed and send to the WAMY Yard.

7.2.5 Fine residue spillage

1. Fine residue spills shall be reported.
2. The necessary action according to the fine ore residue COP shall be taken.

3. Fine residue spill shall be contained and picked up to the FRDs Paddocks.

7.2.6 Sewerage spill or overflow – block drains/pipes

1. Sewerage spills or overflows shall be reported.
2. PPE shall be used.

7.2.7 Sewerage spills underground

1. In the events of minor contaminated of the ground with sewerage the following shall apply:
2. The sewerage spill shall be contained and picked-up, using a long handled shovel and placed in one of the portable toilets that contains a disinfectant.
3. PPE shall be worn, i.e. long rubber gloves, gum boots, facemasks and safety goggles.
4. The contaminated area shall be disinfected with a suitable environmentally friendly chemical e.g. lime and the area shall be washed well with water.
5. The spill shall be reported.

7.2.8 Sewerage spills at the water care works

1. The sewerage from overflow of drying beds or pipe leaks shall be contained using long handled shovels and placed back into the system.
2. Lime shall be sprinkled over the contaminated ground to discourage flies and disinfect the area.
3. In the event of a digestion tank failure the incident shall immediately be reported.
4. An earth retaining wall shall be put into place if necessary.
5. The area shall be cleaned up with earthmoving equipment.
6. Excess sewerage effluent shall be pumped back into the system to prevent pollution.

7.3 Mine residue emergency plans

7.3.1 Emergency preparedness

1. An emergency preparedness plan shall be compiled to include:
   - Emergency situation definition;
   - Detail actions required for the various emergency situation and the responsibility for the actions
   - List of emergency contacts including emergency centre , ambulance and hospital service and fire service; and
   - List of all responsible and affected parties giving contact details
2. Warning system shall be implemented to warn affected parties of possible evacuation
3. On-site system shall be implemented to monitor deterioration
4. In the event of an evacuation:
   - A press statement shall be released.

- Evacuait0on shall take place.
- Implementation of on-site system shall be done to monitor deterioration.
- Design and implementation of remedial measures shall take place.

7.3.2 Disaster Recovery Plan

1. Strategies shall be formulated and detailed to locate temporary deposition areas to reduce down time.
2. Measures shall be identified to rehabilitate disaster area and provide for long term deposition

7.3.2 Wastewater care works

1. In the event of the collapse of the wall of the main sewerage tank, the operators shall immediately notify the responsible person.
2. The instructions given in the spill management procedure shall then be followed.
3. If there are any leaks in Sewerage pipes, these shall be dealt with as outlined in the spills procedure.
4. Should there be a serious leak from the chlorine bottle, people shall be evacuated from the area and the responsible person shall be notified immediately.

8 Planned monitoring and environmental management programme performance assessment

8.1 Description of planned monitoring of the aspects of the environment which may be impacted upon

Refer to paragraph 15.1 and 15.2 of Section 1 (EIA) for the planned monitoring of the aspects of the environment which may be impacted upon.

8.2 Provide a description as to how the implementation of the action plans contemplated in Regulation 51 (b) (ii) as described will be monitored as described in paragraph 6 of the EMP will be monitored

An audit of legal compliances shall be conducted to make sure that the mine's environmental policy commitments to environmental legislation, regulations and the implementation of all the action plans as described in paragraph 6 of section 2 (EMP) (page 298) of the EMP will be monitored.

A legal auditor shall audit the legal register to ensure that the correct database is in place and that all the relevant legislation has been identified. All audit findings shall be recorded in the EMS. Appropriate corrective and preventive actions shall be formulated and implemented to address the problems.

An EMP performance assessment will be done every two years to monitor the adequacy of the implementation of the action plans.

Random site visits or inspections may be done by the government officials and any deviation raised shall be managed through the EMS.

Ad hoc inspections shall also be conducted the environmental management section during the course of their duties and non-conformances shall be addressed through the EMS.

8.3 Frequency of proposed reporting for assessment purposes

According to section 55(2)(a) of the MPRDA, a performance assessment must be conducted every two years, therefore, the performance assessment for the mine shall be done every two years.

Refer to paragraph 15.4 of Section 1 (EIA) (page 179) for the planned time frames for monitoring.

9 Financial provision in relation to the execution of the environmental management programme

9.1 Plan showing the location and aerial extent of the aforesaid main mining actions, activities, or processes anticipated

Refer to Figure 15 for the site layout plan. This plan is also attached as Addendum 2B.

9.2 Annual forecasted financial provision calculation

Refer to Table 64 below for the annual forecasted financial provision calculation (2012).

Table 70: Annual forecasted financial provision calculation

COMPONENT NO.	DESCRIPTION	PREMATURE CLOSURE 2012	REFERENCE AS PER TOOLBOX	PREMATURE CLOSURE 2013
1	Dismantling of processing plant and related structures	51 199 779	A1	54 066 966
2 (A)	Demolition of steel buildings and structures			
2 (B)	Demolition of reinforced concrete buildings and structures	18 839 590	A2; A3; A4; A5; A6; A8.1; A8.3; A8.5; E5; E6	19 894 607
3	Rehabilitation of access roads	1 108 957	A8.2	1 171 059
4 (A)	Demolition and rehabilitation of electrified railway lines	2 046 870	A8.4	2 161 495
4(B)	Demolition and rehabilitation of non electrified railway lines			
5	Demolition of housing and facilities	13 099 109	B5; D1; D2; D3	13 832 660
6	Opencast rehabilitation including final voids and ramps	4 993 155	G1; G2; G3	5 272 772
7	Sealing of shafts, audits, and inclines	2 532 458	E1; E2; E3; E4	2 674 275
8(A)	Rehabilitation of overburden and Waste rock	4 423 601	F4	4 671 323
	Rehabilitation of	49 505 996	F1; F2	52 278 332

COMPONENT NO.	DESCRIPTION	PREMATURE CLOSURE 2012	REFERENCE AS PER TOOLBOX	PREMATURE CLOSURE 2013
	processing waste deposits and. FRD			
8 (B) 2	Rehabilitation of CRD. Not to be retreated	51 134 658	F3; F9	53 998 199
8(B)3	Rehabilitation of CRD. To be retreated			
9	Rehabilitation of subsided areas			
10	General surface rehabilitation including grassing of all denuded areas	5 236 578	A9.1; A9.4; D4.1; D4.4; E7.1; E7.4, G4.4	5 529 826
11	River Diversions			
12	Fencing			
13	Water Management	1 200 000	F10.4	1 267 200
14	2 to 3 years of maintenance and aftercare	3 874 500	A9.2; A9.3; D4.2; D4.3; E7.2; E7.3; F10.2; F10.3; G4.3	4 091 472
		209 195 251		220 910 185
1	Preliminary and General	11 986 435		13 254 611
2	Contingencies	19 977 392		22 091 018
		241 159 078		256 255 814
	VAT	33 762 271		35 875 814
	Total	274 921 349		292 131 629

9.3 Confirmation of the amount that will be provided should the right be granted

The revised quantum as requested from DMR is R292,131,629

9.4. The method of providing financial provision contemplated in Regulation 53

The financial provision approved by the DMR for the sale of the mine in September 2011 has been escalated by the CPI to reflect 2013 provision. Due to the transition period during and after the sale of Finsch from DBCM to Petra Diamonds it was deemed that the environmental liability had not increased. The current preliminary closure plan and financial liability will therefore have been revised in line with the extended life of the mine. The rehabilitation plan and closure plans were work shopped closely with Finsch Mine by the appointed consultants; it is predicted that changes in timelines and the financial provisioning would need to be looked at, but the rehabilitation plans would probably remain much the same.

Figure 15: Site layout plan	
Client: Petra Diamonds, Finsch Mine	SHANGONI Management Services (Pty) Ltd
Project: EMP Amendment	
Date: May 2012	

10 Environmental awareness plan (section 39 (3) (c))

The following cycle for environmental awareness training shall occur:

10.1 Procurement and contractors

1 During the contract negotiation a contractor shall be issued with the Environmental Contractors procedure, which includes reference to Waste Management, Spill Management, Spill Management, Storage, use and disposal of fuel/oil, ordering, storage of hazardous substances and Incident Reporting procedures.

2 The contractor shall be required to brief and train all employees on the Environmental Procedures prior to commencing with work.

3 Training records shall be available on contractor site.

10.2 Induction training

1 New employees or contractors and employees or contractors returning from annual leave shall receive induction training prior to commencing of their tasks.

2 If a contractor's activities have a significant impact on the environment, competency training shall be scheduled by the section leader responsible for that section in liaison with contractor representative.

3 After the employee has received induction training form the environmental management section, additional training shall be provided in the respective areas of work.

4 The Section Leader /Alternative shall be responsible for managing the frontline training in their relevant areas.

5 With ISO 14001 addressing all levels of management, Supervisors shall be trained on the effective internal communication of the EMS and its requirements which shall include contemporary environmental issues as well as exposure to the requirements of ISO 14001.

6 Awareness Training at Management level shall include an introduction to ISO 14001 as well as an overview of the EMS.

10.3 Comprehension training

1 Training on the awareness and management of environmental aspects shall include:

- Environmental Policy Statement
- Roles and Responsibility Procedure
- Emergency Preparedness and Response Procedure
- Spills Management Procedure
- Waste Management Procedure
- Incident Non-Conformance Reporting Procedure

10.4 Training briefing and training session

1 For training performed on the mine, the relevant person shall keep all records of attendance for the period of employment plus an additional 5 years thereafter.

10.5 Competency / Job Specific Training

1 Training needs personnel performing tasks, which can cause significant environmental impacts, have been identified and shall be done.

10.6 Verification of effectiveness

1 Every Section Leader /Alternative in each area of operation and /or the Environmental Section shall evaluation personnel to determine the effectiveness of training provided.
2 The effectiveness of training shall be based on the incidents, internal audit findings, external audit findings and non –conformances raised in areas.
3 If an issue, e.g. waste management results in a trend of non-compliance this shall be raised.
4 Scheduling of training shall then take place.

10.7 Internal /external audits and incident reports

1 Internal /External Audits and Incident Reports shall take place to continuously evaluate the effectiveness of the Training system.

10.8 Training needs analysis

1 Awareness training needs shall be identified for all employees.

10.9 Retraining

1 The Supervisor shall be responsible to reschedule any employee who missed training for whatever reason.
2 Retraining shall take place within reasonable period of time.

11 Attachment of specialist reports, technical and supporting information

Refer to addendum 3 (specialist studies) for all specialist studies attached to this EMP. The measures contained in the specialist reports are only recommendations which have been incorporated into this EMP.

12 Section 39 (4) (a) (iii), capacity to manage and rehabilitate the environment

The following are based on the previous year's budget:

- Environmental Projects (Rehabilitation): R3,900,000
- Consultancy: R600,000

13 Undertaking

The Environmental Management Programme will, should it comply with the provisions of section 39 (4) (a) of the Act and the right be granted, be approved and become an obligation in terms of the right issued. As part of the proposed Environmental Management Programme, the applicant is required to provide an undertaking that it will be executed as approved and that the provisions of the Act and regulations thereto will be complied with.

14 Identification of the report

Herewith I, the person whose name and identity number is stated below, confirm that I am the person authorised to act as representative of the applicant in terms of the resolution submitted with the application, and confirm that the above report comprises EIA and EMP compiled in accordance with the guideline on the Departments official website and the directive in terms of sections 29 and 39 (5) in that regard.	
Full Names and Surname	
Identity Number	
Signature	