



August 2012

BATLHAKO MINING LIMITED

Final EIA Report and EMP: Mining Right Application on Groenfontein, Vlakfontein and Vogelstruisnek

Submitted to:

Department of Mineral Resources, Klerksdorp
Department of Economic Development, Environment, Conservation and Tourism,
Mmabatho

DMR reference number: **NW 30/5/1/2/2/10007 MR**

Due date for public comment: Monday 27 August 2012



FINAL EIA REPORT

Report Number. 12614182-11536-9

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Purpose of this Document

Batlhako Mining is considering the development of opencast chrome ore mining operations on the farms Groenfontein 138 JP, Vlakfontein 164 JP and Vogelstruisnek 173 JP in the Magisterial District of Mankwe in the Northwest Province. These areas have been mined in the past and rehabilitated. No new infrastructure will be constructed. The chrome ore will be hauled to Batlhako Mining's nearby Ruighoek Chrome Mine, where it will be processed through existing plant.

Batlhako Mining has applied to the Department of Mineral Resources (DMR, Klerksdorp Regional Office) for a mining right in terms of the Mineral and Petroleum Resources Development Act (No 28 of 2002, hereafter MPRDA). Under the MPRDA Regulations, Batlhako is required to submit an Environmental Management Programme (EMP) which describes how the environmental impacts of the proposed development will be managed and mitigated. The EMP must be based on an Environmental Impact Assessment (EIA).

The EIA process also covers the listed activities triggered by the proposed project in terms of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998), as amended and the EIA Regulations, 2010. The application for authorisation under NEMA has been submitted to the North West Department of Economic Development, Environment, Conservation and Tourism (DEDECT);

Golder Associates Africa (Pty) Ltd, an independent company, has conducted the EIA process for Batlhako Mining.

The first phase of EIA is the Scoping Phase. During this phase, interested and affected parties are given the opportunity to comment on the proposed mining activities and the proposed scope of EIA specialist studies. The comments received thus were recorded in an appendix to the Final Scoping Report, which was submitted to the DMR and DEDECT on 11 July 2012.

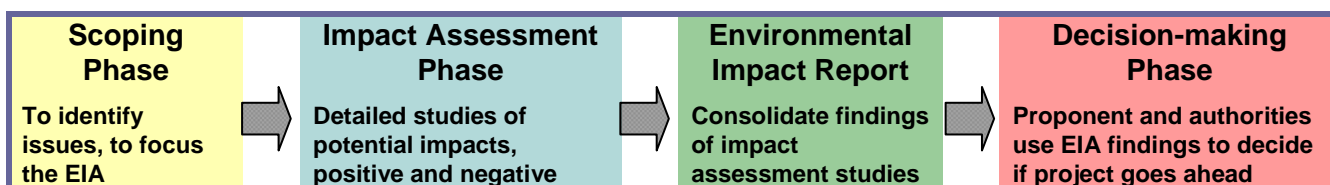
The Draft EIA Report/EMP was made available for public comment from 27 June to 6 August 2012. The due date for comment on this Final EIA report is **Monday 27 August 2012**.

The EIA process has been undertaken in accordance with the requirements of the National Environmental Management Act (NEMA).

Summary of what the Final EIA Report/EMP contains

This report contains:

- A description of the proposed mining activities;
- An overview of the EIA process, including public participation;
- A description of the existing environment in the proposed project area;
- The environmental issues and impacts which were identified during the scoping phase;
- The Plan of Study for impact assessment and terms of reference of the specialist studies planned for the Impact Assessment phase; and
- A list of interested and affected parties involved during the EIA process and their comments (Comments and Response Report).
- The assessed environmental impacts and recommended mitigation measures.



The figure above shows the various phases of an Environmental Impact Assessment. This EIA is in the Decision-making Phase, during which the authorities make use of the findings of the EIA process to decide whether the project may proceed.



PUBLIC REVIEW OF THE FINAL EIA REPORT/EMP

This Final EIA Report/EMP has been made available for comment for a period of 21 days from **Tuesday 7 August 2012** until **Monday 27 August 2012**. Copies of the document are available at the public places listed in the table below and upon request from the Public Participation Office of Golder Associates.

Name of Public Place	Contact Person	Contact Number
Ruighoek Mine Security Gate Mine	Security guard on duty	
Golder Associates Africa, Midrand	Mabel Qinisile	011 254 4959
The Golder Associates Africa website	www.golder.com/public	

OPPORTUNITIES FOR PUBLIC REVIEW

The following methods of public review of the Final EIA Report and EMP are available:

- Completing the comment sheet enclosed with the report;
- Additional written submissions; and
- Comment by e-mail or telephone.

**DUE DATE FOR COMMENT ON THIS FINAL EIA REPORT AND EMP IS
Monday 27 August 2012**

Please submit comments directly to:

Ms Delta Mahlaku: North-West Department of Economic Development, Environment, Conservation and Tourism

By facsimile: (014) 597 0148

By e-mail: dtmahlaku@nwpg.gov.za

By mail: P O Box 5624, RUSTENBURG, 0300

By hand: 80 Kerk Street, RUSTENBURG, 0299

With a copy to the Public Participation Office:

Antoinette Pietersen / Mabel Qinisile

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P O Box 6001

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EXECUTIVE SUMMARY

Background

Batlhako Mining Ltd (Batlhako) applied for mining rights on certain areas on the farms Groenfontein 138 JP, Vlakfontein 168 JP and Vogelstruisnek 173 JP. These areas were mined in the past and partially rehabilitated, but recent prospecting has confirmed viable remaining chrome ore reserves.

The new mining operations will augment current and planned ore production at Ruighoek Mine and will not require any new infrastructure. The chrome ore will be hauled from the new mining operations to Ruighoek and processed through the existing plant.

The following mining operations are envisaged:

- Groenfontein: 100 000 tpa 2015 – 2017;
- Vlakfontein: 100 000 tpa 2018 – 2020; and
- Vogelstruisnek: 100 000 tpa 2021 – 2023.

Potential Impacts and Specialist Studies

The following potential environmental impacts were identified during the scoping phase of this EIA and have been investigated during the environmental impact assessment phase of the project:

Geohydrology

Dewatering will create a cone of depression around the opencast areas, within which a lowering of the groundwater table will be experienced. The effects were modelled, potential users were identified, potential reduction in the flow of affected watercourses was estimated and mitigation measures were developed. The potential for acid mine drainage to develop after closure appears to be very low, but verification is recommended when mining commences.

Surface hydrology

Local catchments were identified, runoff scenarios were modelled and recommendations made for separating clean and dirty water, pollution control and management of stormwater in a 1:50 year rainfall event in accordance with Regulation 704.

Air quality

Dispersion modelling of particulate mobilisation due to ground clearing, drilling, blasting, mining and loading and hauling of ore indicated off-site exceedances of all standards for airborne particulates at Vlakfontein and exceedance of the PM₁₀ standard at Vogelstruisnek. Specific mitigation measures are recommended.

Ecology, soils, land use and land capability

The impacts of clearing vegetation and stripping topsoil from about 360 ha of previously rehabilitated areas are described and mitigation measures are recommended, including rehabilitation measures.

Noise and vibration

Potential sensitive receptors in the form of local residential areas were mapped, pre-project baseline noise and vibration levels were recorded, and impact of intrusive noise levels and vibrations from blasting operations were modelled. Only Maologane and Witrantjies are predicted to experience intrusion levels of 3.4 and 5.5 dBA respectively during the night-time, which would be expected to lead to complaints. Structural damage as a result of vibration is not anticipated.

Visual

Mining operations will be partially visible from various villages and local roads but, given the existing mining operations in the area, the visual impact is not expected to be of high significance, provided dust is controlled effectively.



Heritage

There is one Stone Age site on Vogelstruisnek that could be directly affected. It will either have to be avoided or permission obtained to destroy it. Indirect impacts on a graveyard near the mining area on Vogelstruisnek and a Stone Age site on Vlakfontein can be avoided.

Public consultation

An advertisement was published in the Bonus on Monday 7 May and the Rustenburg Herald on Thursday 10 May 2012. The draft Scoping Report was made available for public comment from Thursday 10 May until Tuesday 19 June 2012, following which it was updated and made available for public review as a final Scoping Report from Wednesday 20 June until Wednesday 11 July 2012.

The draft EIA Report and EMP were made available for public comment from Wednesday 27 June to Monday 6 August 2012. This Final EIA Report and EMP were made available for public comment from Tuesday 7 August until Monday 27 August 2012. The Comment and Response Report was updated continuously as comments were received.

Conclusion

No fatal flaws or impacts that cannot be mitigated to acceptable levels were identified and, from an environmental perspective, the mining right application can be approved and the NEMA activities applied for can be authorised.



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Database of potential interested and affected parties

APPENDIX B

Letter of invitation and registration, comment and reply sheet

APPENDIX C

Newspaper Advertisements

APPENDIX D

List of Registered I&APs

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Site Notices

APPENDIX F

Comment and Response Report

APPENDIX G

Letters Announcing Final Scoping Report, Draft EIA Report/EMP and Final EIA Report

APPENDIX H

Environmental Management Programme



GLOSSARY OF TERMS

Backfill: Waste rock and low grade ore that is returned to an opencast pit to fill the mined out excavation.

Chromite: A mineral, iron magnesium chromium oxide: (Fe, Mg) Cr₂O₄. Chromite is the main mineral from which the metal chromium is produced.

Chromitite: A rock formed mostly of the mineral chromite.

dB: Decibel – a unit for measuring sound pressure levels (loudness).

dBA: A-weighted sound pressure level (sound pressures levels up to 55 dB).

DEA: Department of Environmental Affairs.

DEDECT: Department of Economic Development, Environment, Conservation and Tourism.

DMR: The South African Department of Mineral Resources - the government department tasked with authorising the use of South Africa's mineral resources.

DWA: Department of Water Affairs.

EIA: Environmental Impact Assessment. The process of considering a proposed development and its environmental context and scientifically determining how the development may change the environment.

EIR: Environmental Impact Report the document that describes the EIA and the results of the assessment.

EMP: Environmental Management Programme. The document that describes how negative environmental impacts will be mitigated and positive impacts enhanced.

GN: Government Notice.

MAP: Mean annual precipitation – the average rainfall per year in a region.

Mining Right: Authorisation from the government, through the DMR, giving the holder the right to mine a specified mineral deposit. The process and requirements for obtaining mining rights are specified in the MPRDA and regulations.

MPRDA: The Mineral and Petroleum Resources Development Act (Act 29 of 2004), the South African legislation which specifies by whom, how and under what circumstances mineral resources can be exploited.

NDA: National Department of Agriculture.

Red Data List: List of species whose continued existence is threatened.

Opencast: Mining by removal of the surface layers, working from above, not from shafts or tunnels. Also the pit formed by opencast mining.

Overburden: Rock or other material overlying a useful deposit of minerals.

SANS: South African National Standards

TWQR: Target Water Quality Requirement (TWQR) – the desired water quality (e.g. in a river) to make the water suitable for human consumption and as habitat for indigenous species.



1.0 INTRODUCTION AND OVERVIEW

1.1 Project description

Batlhako Mining Ltd (Batlhako) is owned by two South African companies, Bonmerci Investments 103 (Pty) Ltd (74%) and Vengawave (Pty) Ltd (26%). Bonmerci is wholly owned by Volclay South Africa Pty Ltd, which is in turn owned by AMCOL Mauritius Ltd and its ultimate holding company is the NYSE-listed AMCOL International Corporation.

Batlhako owns and operates the Ruighoek open cast Chrome Mine on the farm Ruighoek 169 JP, near Pilanesberg Game Reserve in the Magisterial District of Mankwe in the Northwest Province. A mining right was received from the North West Department of Mineral Resources (DMR) on 18 August 2008 (Ref No: (NW) 30/5/1/2/3/2/1/324 EM).

Batlhako held prospecting rights on the farms Groenfontein 138 JP, Vlakfontein 168 JP and Vogelstruisnek 173 JP until August 2011. These areas have been mined in the past and partially rehabilitated. Chromitite reefs LG1 and LG2 were previously mined on Vlakfontein by Samancor. The exact extent of mining is unknown, but from the locations of old waste dumps, it appears to have been in the north and south. AMCOL drilled on the Ruighoek boundary during December 2010 and confirmed the presence of chromitite seams LG1, LG2, LG3 and LG4. The LG1 and LG2 seams are primary targets, anticipated to have high Cr₂O₃ contents (45 - 48%) and high Cr / Fe ratios (> 1.8). LG3 and LG4 are apparently poorly developed and are currently of secondary interest.

After completion of the prospecting programme, which indicated sufficient chrome ore reserves for viable opencast mining, Batlhako submitted an application for mining rights to the Klerksdorp office of the DMR. The application was accepted on 2 March 2012 (Regional Manager, Department of Mineral Resources, 2012).

Surface infrastructure at Ruighoek Chrome Mine includes two old shaft entrances (closed to prevent access), offices, workshops, a sewage plant, an ore processing plant, a residential village and hostel accommodation. No new infrastructure will be constructed. The chrome ore will be hauled from the proposed opencast mining operations on Groenfontein, Vlakfontein and Vogelstruisnek to Ruighoek Mine, where it will be processed through the existing plant. See Figure 1-1.

Batlhako currently mines the LG6 Chromitite reef on Ruighoek by open cast mining methods at a rate of 90 000 tons of ore per annum and this operation is expected to continue until 2022. Batlhako is considering an expansion of the opencast mining operations that could commence in 2013 and produce ore at a rate of 210 000 tpa until 2023, and an underground mine that could commence in 2022 and produce 300 000 tpa of ore until 2057. An EIA and EMP Amendment process is currently being undertaken for this project (Stoop, A; Roux, E.; May 2012).

Currently, it is envisaged that the chrome ore production will be supplemented as follows:

Groenfontein: 100 000 tpa 2015 – 2017;

Vlakfontein: 100 000 tpa 2018 – 2020; and

Vogelstruisnek: 100 000 tpa 2021 – 2023.

The above schedule is tentative and subject to change.

1.2 Regional

The farms Groenfontein, Vlakfontein, Ruighoek and Vogelstruisnek are located near the western border of the Pilanesberg National Park, in the North West Province. The area is about 145km directly north-west of Pretoria and 62 km north-northwest of Rustenburg, just off the R565 that passes along the western border of the Pilanesberg National Park in a north-south direction. Two settlements, Tlhaltlhaganyane and Mabeleng are located to the southeast and south of Ruighoek respectively and two settlements, Witrandjie and Maologane are located on the farm Vogelstruisnek.



1.2.1 Magisterial District and relevant Local Authority

The abovementioned farms fall within the jurisdiction of the Mankwe Magisterial District, which forms part of the Moses Kotane Local Municipality, situated within the boundaries of the Bojanala Platinum District Municipality, in the North West Province.

1.2.2 Land tenure and use of immediately adjacent land

- The location of the mining operation is shown on the topographic map (1:50 000) in Figure 1-1. Two settlements, Tlhaltlhaganyane and Mabeleleng are located to the southeast and south of Ruighoek respectively (See Figure 1-2);
- The Horizon Chrome Mine, operated by Xstrata Alloys, lies immediately to the south of Mabeleleng. Rustenburg Minerals Development, a chrome mine operated by Assore, lies about 3 km north of the Ruighoek Chrome Mine offices;
- On Portion 6 of Vogelstruisnek the Baphalane Tribe is the landowner in the form of a Trust. The Government of South Africa is the owner of the remaining extent of the farm, which is unoccupied and unutilized;
- The Government of South Africa is also the owner of Portion 1 of the farm Vlakfontein and the remaining extent of the farms Groenfontein and Vlakfontein. This land is unoccupied and unutilized;
- Apart from the above-mentioned chrome mines, the land in the surrounding area is used mainly for informal farming and rural residential purposes.



EIA/EMP - GROENFONTEIN, VLAKFONTEIN AND VOGELSTRUISNEK

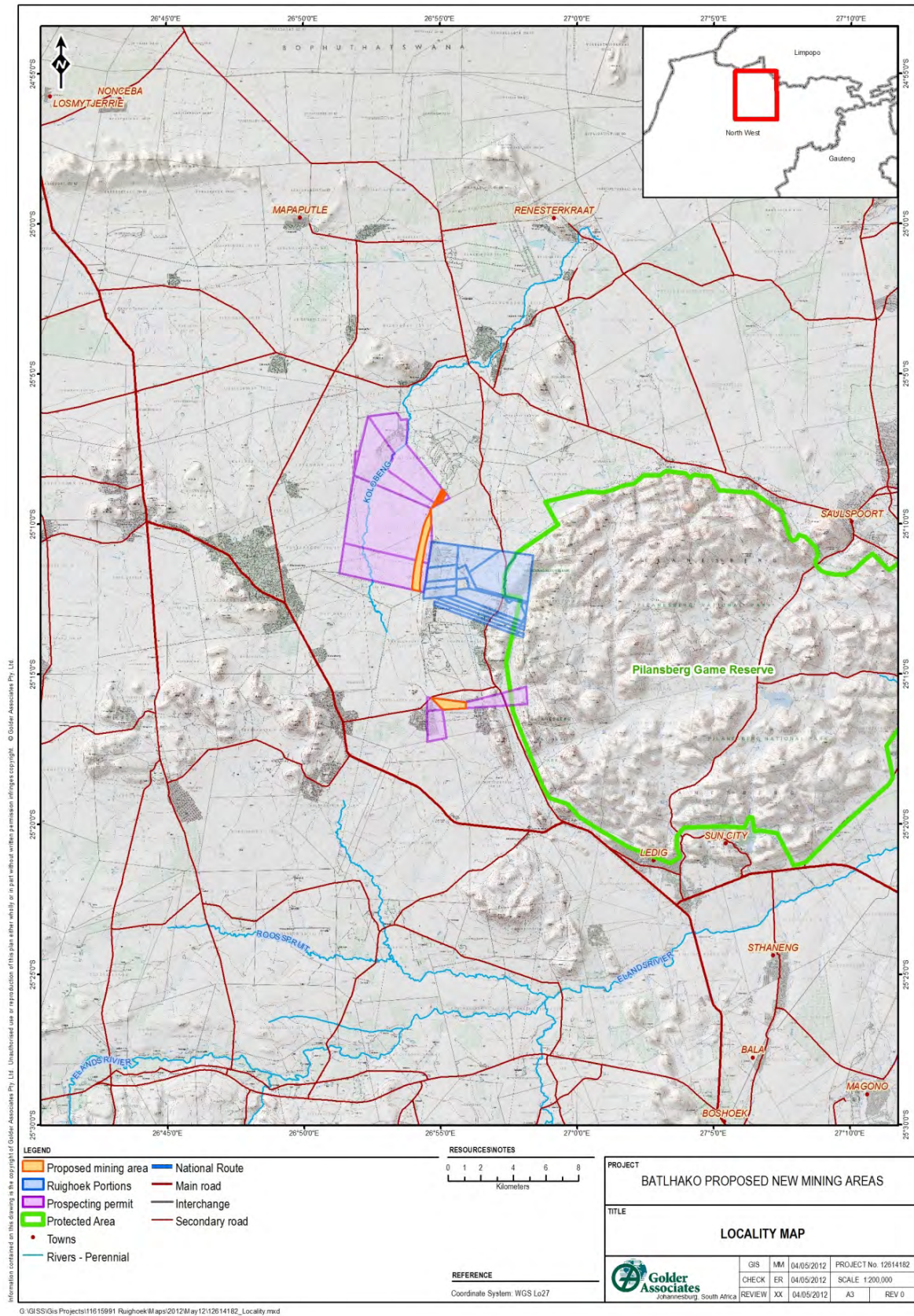


Figure 1-1: Locality map of project area



EIA/EMP - GROENFONTEIN, VLAKFONTEIN AND VOGELSTRUISNEK

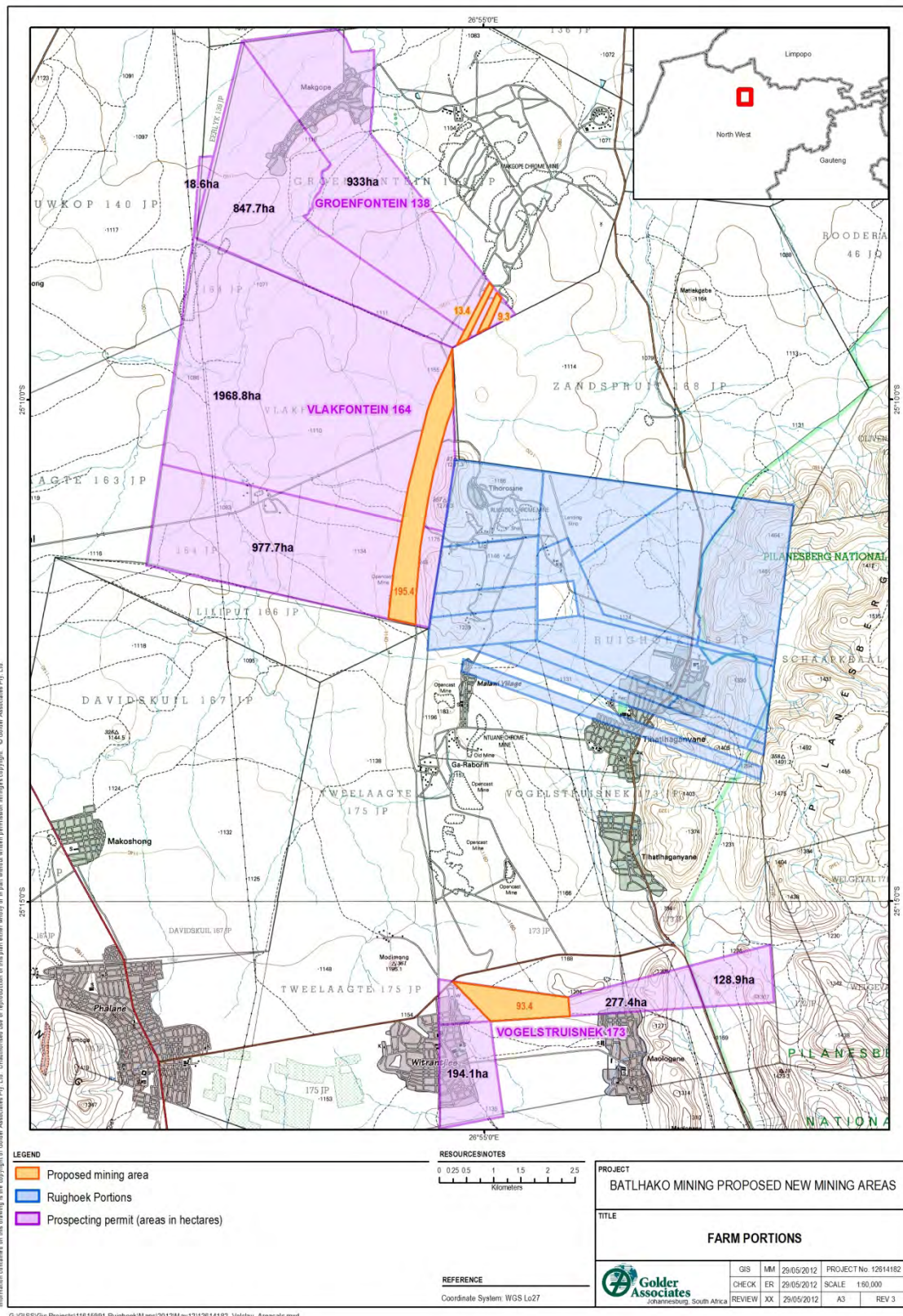


Figure 1-2: Proposed new mining areas



2.0 PROPONENT AND PRACTITIONER DETAILS

2.1 Details of the proponent

For purposes of this EIA/EMP, the following person may be contacted at Batlhako Mining:

Table 2-1: Proponent's contact details

Contact Person	Louis Bredell
Address	Postnet Suite 82 Private Bag X5 Strubens Valley 1735
Telephone	011 958 1667
Fax	011 958 2245
Cell phone	071 677 1217
E-mail	LouisBredell@amcol.com

2.2 Details of Environmental Assessment Practitioner

Batlhako has appointed Golder Associates Africa (Pty) Ltd (GAA) as an independent Environmental Assessment Practitioner (EAP) to undertake Environmental Impact Assessment (EIA) that is required to support the application for mining rights.

Golder Associates Africa is a member of the world-wide Golder Associates group of companies, offering a variety of specialised engineering and environmental services. Employee owned since its formation in 1960, the Golder Associates group employs more than 8 000 people who operate from more than 180 offices located throughout Africa, Asia, Australasia, Europe, North America and South America. Golder Associates Africa (GAA) has offices in Midrand, Pretoria, Florida, Durban, Rustenburg, Cape Town, Maputo and Accra. GAA has more than 300 skilled employees and is able to source additional professional skills and inputs from other Golder offices around the world.

GAA has no vested interest in the proposed project and hereby declares its independence as required by the EIA Regulations.

For purposes of this EIA, the following persons may be contacted at GAA:

Contact Persons	Etienne Roux	Antoinette Pietersen
Purpose	Technical	Public Participation
Address	P O Box 6002 Halfway House 1685	P O Box 6002 Halfway House 1685
Telephone	011 254 4970	011 254 4805
Fax	011 315 0317	011 315 0317
Cell phone	082 774 2045	083 280 5024
E-mail	Eroux@golder.co.za	Apietersen@golder.co.za



2.3 Legal Requirements

In terms of the MPRDA and the MPRD Regulations R. 527, an application for a mining right must be supported by an EIA process. In terms of Regulation 3 of R. 527, consultation must take place with interested and affected parties (I&APs), a scoping report conforming to Regulation 49(1) of R.527 must be submitted to the DMR, followed by an environmental impact assessment report conforming to Regulation 50 and an environmental management programme conforming to Regulation 51.

The EIA process being followed has been designed to be compliant with the MPRD Regulations and the EIA Regulations. In terms of Regulation 49(1) of R.527 and Regulation 28 of GN R.543, a scoping report must:

- a) describe the methodology applied to conduct scoping;
- b) describe the existing status of the environment prior to the mining operation;
- c) identify and describe the anticipated environmental, social and cultural impacts, including the cumulative effects, where applicable;
- d) identify and describe reasonable land use or development alternatives to the proposed operation, alternative means of carrying out the proposed operation and the consequences of not proceeding with the proposed operation;
- e) describe the most appropriate procedure to plan and develop the proposed mining operation;
- f) describe the process of engagement of identified interested and affected persons, including their views and concerns; and
- g) describe the nature and extent of further investigations required in the environmental impact assessment report.

The activities listed in the NEMA Regulations that are triggered by the project are the following:

- GN R.545 (18 June 2010), listed activity 15: *“Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more”* – Transformation of land is inevitable with open cast mining;
- GN R.544 (18 June 2010), listed activity 13: *“The construction of facilities or infrastructure for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic metres”* – in this case, diesel fuel; and
- GN R.544 (18 June 2010), listed activity 22 (ii): *“The construction of a road wider than 8 metres, outside urban areas, where no road reserve exists”* – Batlhako Mining will need to construct haul roads to transport the ore to existing facilities at Ruighoek.

2.4 Decision-making Authority

The DMR will be the decision-making authority for the EIA, EMP and mining right application process, which is being undertaken in terms of the MPRDA.

The application for authorisation of the relevant activities listed in the NEMA Regulations has been submitted to the North West Department of Economic Development, Environment, Conservation and Tourism (DEDECT).

The final EIA Report and EMP will be submitted to the DMR and DEDECT as part of the EIA process being undertaken in support of Batlhako's application for mining rights on the farms Groenfontein 138 JP, Vlakfontein 164 JP and Vogelstruisnek 173 JP.



In the spirit of cooperative governance, the DMR will consult with the following government departments as part of its decision-making process:

- North West Department of Economic Development, Environment, Conservation and Tourism (NWDEDECT);
- Department of Water Affairs (DWA);
- Department of Environmental Affairs (DEA);
- National Department of Agriculture (NDA); and
- Local Municipality – Moses Kotane Local Municipality.

3.0 DESCRIPTION OF THE RECEIVING ENVIRONMENT

This section of the report provides a description of the receiving environment and existing conditions on and in the vicinity of the proposed mining sites. Due to the proximity of Groenfontein, Vlakfontein and Vogelstruisnek to Ruighoek, some of this material was sourced from an EMP Amendment prepared for Batlhako's mining operations on Ruighoek 169 JP during 2010 (Stoop, A; Thomas, M; August 2010) and from more recent specialist studies undertaken for an EIA/EMP Amendment currently being undertaken for an expansion of the mining activities on Ruighoek. Site-specific information on the proposed mining areas on Groenfontein, Vlakfontein and Vogelstruisnek was sourced from the specialist studies described in section 5.1 of this scoping report.

3.1 Geology

The main geological feature within which the farms Groenfontein, Vlakfontein, Ruighoek and Vogelstruisnek are located is the Bushveld Complex, a saucer-shaped volcanic intrusion about 375 km wide (east to west) and 300 km north to south. It is approximately 2 billion years old.

The Bushveld Complex is divided into three main geographic sectors (or "limbs"); Eastern Limb, Western Limb, and Northern Limb. It is also divided from bottom to top into four geological zones: the Lower, Critical, Main and Upper Zone. The abovementioned farms are situated in the Western Limb (Figure 3-1), which contains considerable chromium reserves within the Lower Zone.

Mineralization at the proposed mining areas is associated with the Lower Critical Zone and Lower Zone of the Rustenburg Layered Suite, which comprises a layered sequence of pyroxenites, bronzitites, harzburgite, and dunites inter-layered with chromitites. These chromitite layers (or "reefs") are sequentially labelled LG1 to LG7 from the base of the Lower Zone. See Figure 3-2.

The Batlhako chrome deposit stretches across portions of the farms Ruighoek 169 JP, Groenfontein 138 JP, Vlakfontein 164 JP Vogelstruisnek 173 JP and Bakhoutrandje 205 JP. The lower and middle group chromites outcrop across the entire area. Extensive opencast mining of the LG 1, 2, 5 and 6 seams and also underground mining of the LG6 seam has been undertaken in the past.

In the proposed mining areas Batlhako will exploit mainly the LG1 and LG2 layers, which are on average 0.30 m and 0.28 m thick respectively. The other layers are poorly developed but will also be mined if they become economically viable due to changes in market conditions. The chromitite layers are enclosed by medium to coarse grained pyroxenite with subordinate disseminated chromite.

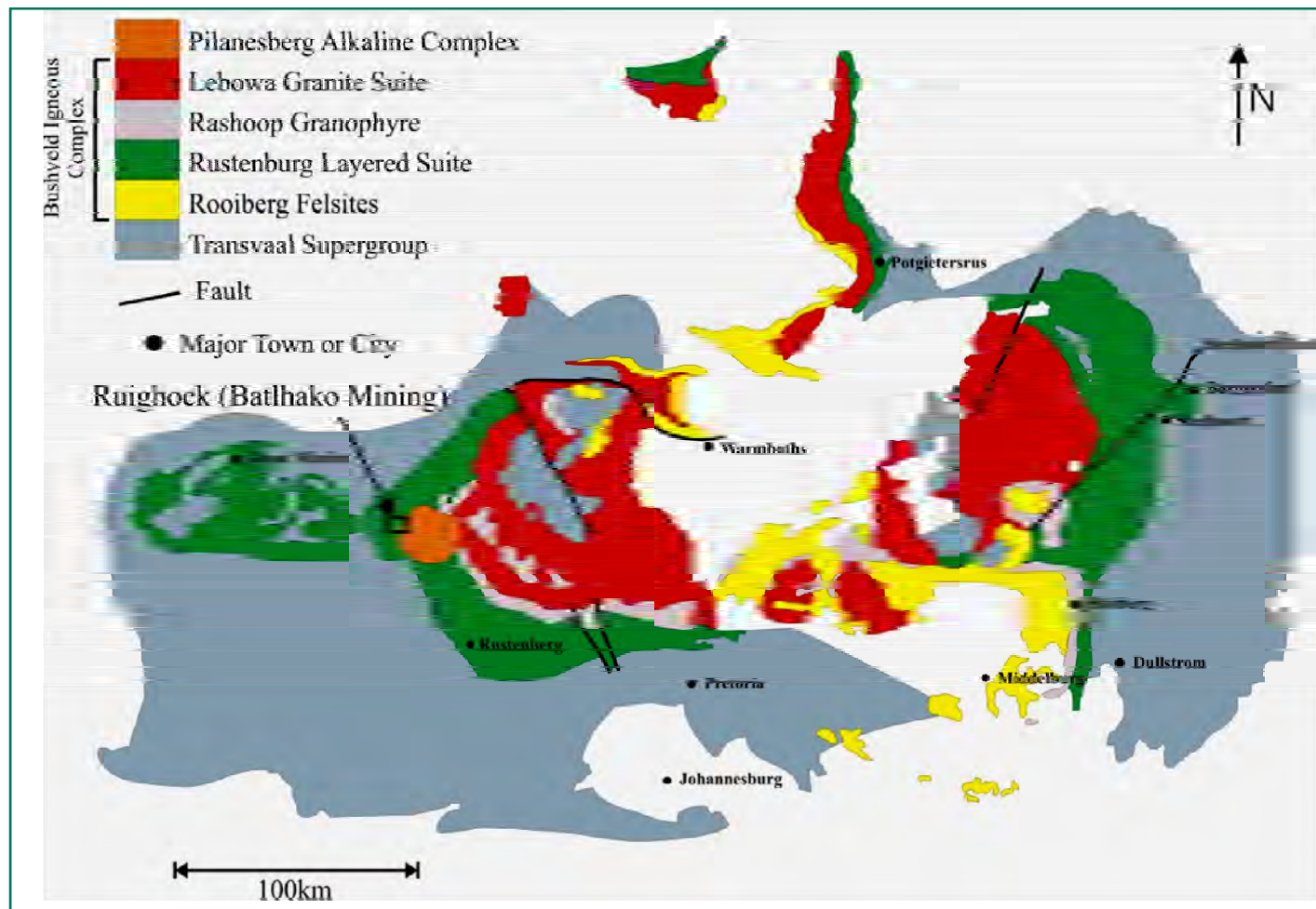


Figure 3-1: Main geological features of the Bushveld Complex



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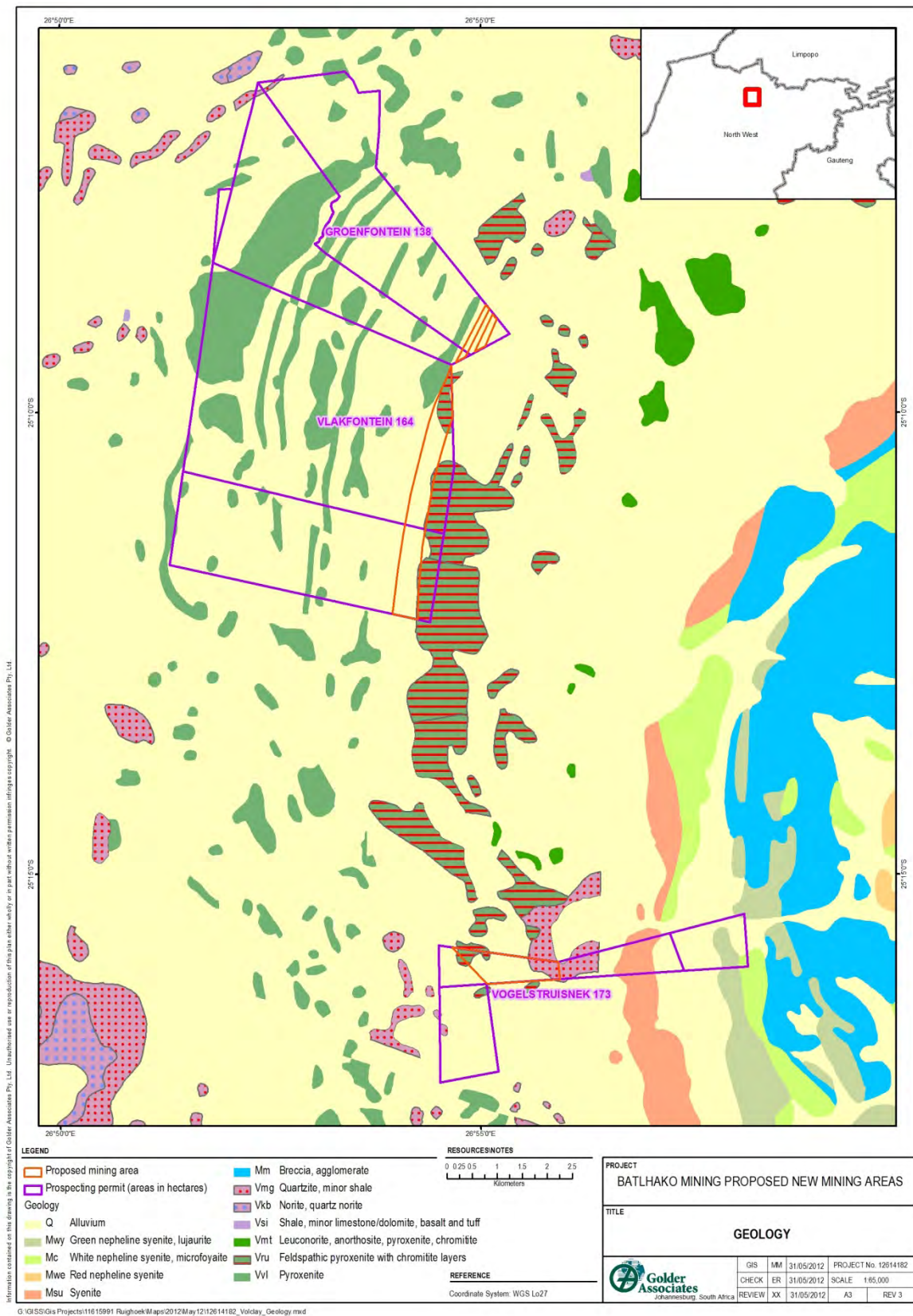


Figure 3-2: Geological features of the project area



3.2 Climate

The farms Groenfontein, Vlakfontein, Ruighoek and Vogelstruisnek are located in the subtropical high-pressure belt. The mean circulation of the atmosphere over the subcontinent is anticyclonic throughout the year (except for near the surface), due to the semi-permanent presence of the South Indian Anticyclone (high pressure (HP) cell), Continental High (high pressure cell) and the South Atlantic Anticyclone (low pressure (LP) cell) in the high pressure belt located approximately 30°S of the equator. Temperature is controlled by perturbations in the westerly wave, leading to the development of cold fronts from the polar region moving into the mid-latitudes.

Seasonal variations in the positioning and intensity of the HP cells determine the extent to which the westerly waves and lows impact the atmosphere over the region. In winter, the high pressure belt intensifies and moves northward while the westerly waves move eastwards around the South African coast or across the country in the form of a succession of cyclones or ridging anticyclones. The anticyclonic HP belt weakens in summer and shifts southwards, causing the influence of the westerly wave and lows to weaken.

Anticyclones (HP cells) are associated with relatively stable atmospheric conditions and little to no rainfall. Such conditions are not favourable for air pollutant dispersion, especially with regard to pollutants emitted close to the ground.

Cold fronts, which occur predominantly during winter, are associated with westerly waves, unstable atmospheric conditions and atmospheric turbulence which creates favourable conditions for air pollutant dispersion.

The tropical easterlies and the occurrence of easterly waves and lows affect Southern Africa mainly during the summer months. These systems are largely responsible for the summer rainfall pattern and the north easterly wind component that occurs over the region.

Batlhako does not undertake any meteorological monitoring and no directly measured data is available for the proposed mining areas, but the Pilanesberg meteorological station is located at the Pilanesberg airport, approximately 30km south-west of the Ruighoek mine (25°20' S 27°10' E). Although the intervening topography may be expected to influence the meteorology to some extent, it is considered that the meteorological conditions in the vicinity of the Ruighoek mine will be similar to those at the Pilanesberg airport. A summary of the climatic data for the period 1961 to 1990 is presented in Table 3-1.

Table 3-1: Pilanesberg meteorological station climatic data for 1961-1990

Month	Temperature (° C)				Precipitation		
	Highest Recorded	Average Daily Maximum	Average Daily Minimum	Lowest Recorded	Average Monthly (mm)	Average Number of days with >= 1mm	Highest 24 Hour Rainfall (mm)
January	39	32	19	14	78	10	65
February	39	31	18	10	71	8	51
March	39	30	16	8	58	8	50
April	36	27	12	3	38	6	42
May	31	25	7	-1	6	1	23
June	28	22	3	-5	12	2	23
July	27	22	2	-4	3	1	10
August	32	26	6	-1	5	1	15
September	35	28	11	2	25	4	37
October	37	30	15	6	57	7	44
November	40	31	16	9	61	10	42
December	39	31	18	10	105	12	55
Year	40	28	12	-5	519	69	65



The climatic regime of the study area is characterized by hot, moist summers and mild, dry winters. The monthly and annual evaporation rates greatly exceed the precipitation rates, resulting in semi-arid surface conditions (ARC, February 2007).

Table 3-2: Summary of average monthly evaporation data

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	MAE*
206.3	203.7	210.0	205.4	167.1	159.3	121.5	100.6	84.4	93.4	128.2	170.2	1850

* MAE: Mean annual evaporation (S-Pan)

3.3 Wind Field

The meteorological characteristics of a site govern the dispersion, transformation and eventual removal of pollutants from the atmosphere. Dispersion comprises vertical and horizontal components of motion. The vertical component is defined by the stability of the atmosphere and the depth of the surface mixing layer. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field. The wind speed determines both the distance of downwind transport and the rate of dilution of airborne pollutants.

Wind roses summarize the strength, direction and frequency of winds experienced at a given location. Wind roses for the proposed mining area, as shown in Figure 3-3 to Figure 3-5 were based on available literature, data from Pilanesberg Airport and MM5 modelled meteorological data for 2009-2010 and are expected to be representative of the conditions on site (Bennet, A; Heath, R., March 2012).

Winds at the Ruighoek mine are expected to originate equally from the east (25% of the time) and east-north-east (8.75 % of the time) and to be moderate, with a low percentage (12.57%) of calm conditions (<1 m/s).

Diurnal wind roses showing slight variations for 6-hour periods, starting from midnight, are shown in (Figure 3-4), while seasonal wind roses showing significant variations are shown in (Figure 3-5).

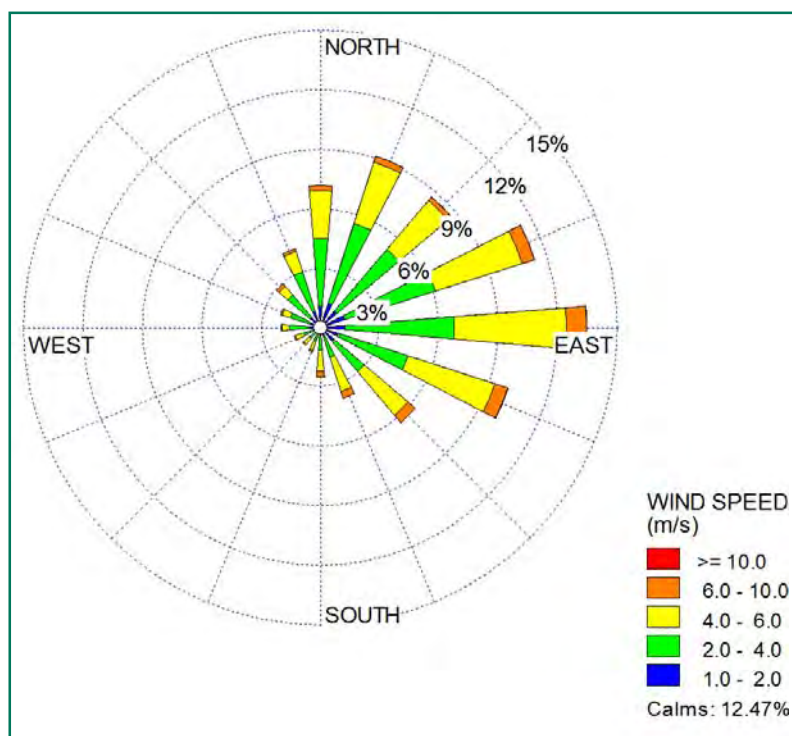


Figure 3-3: Modelled wind rose for the proposed mining area for 2009-2010.



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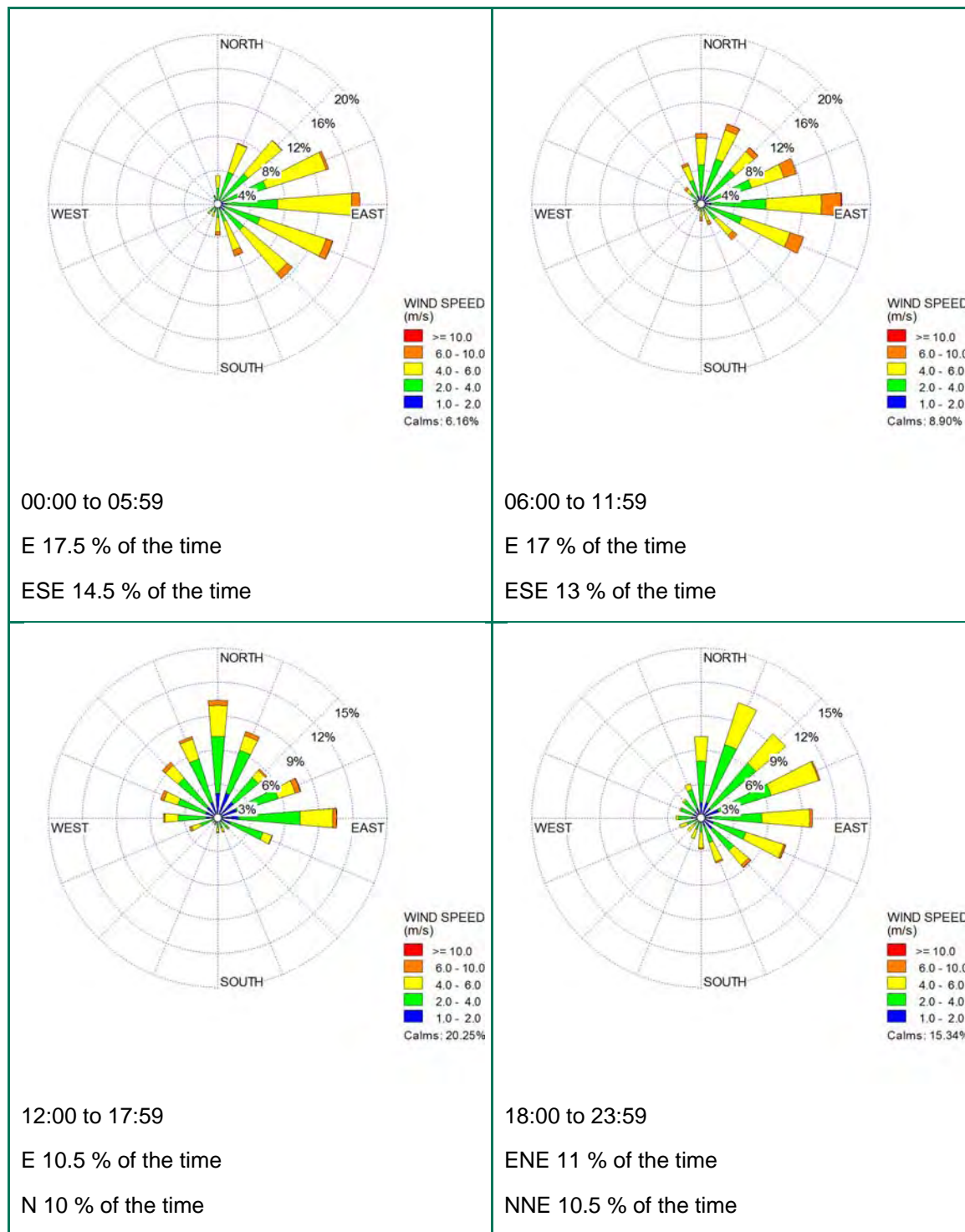


Figure 3-4: Modelled diurnal wind roses for the proposed mining area with predominant wind directions for 2009-2010.



EIA/EMP - GROENFONTEIN, VLAKFONTEIN AND VOGELSTRUISNEK

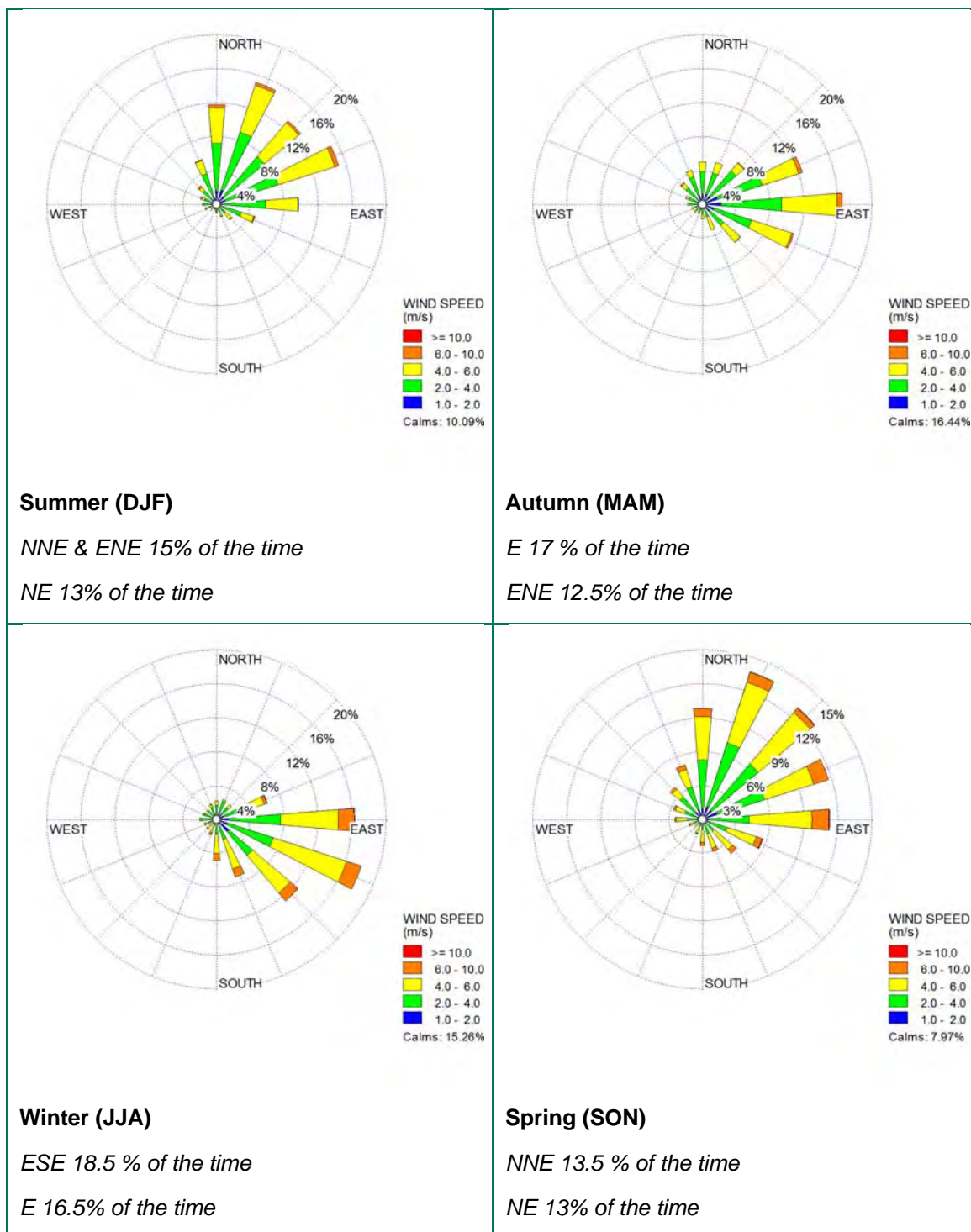


Figure 3-5: Modelled seasonal wind roses for the proposed mining area with predominant wind directions for 2009-2010



3.4 Air Quality

Bathlako Mining does not undertake any ambient air quality monitoring and there is no measured air quality data for the vicinity of the proposed mining operations. Most of the monitoring facilities are located in the urban areas (i.e. Rustenburg) and/or on the larger platinum mines such as Impala, Lonmin and Anglo Platinum (See Figure 3-6).

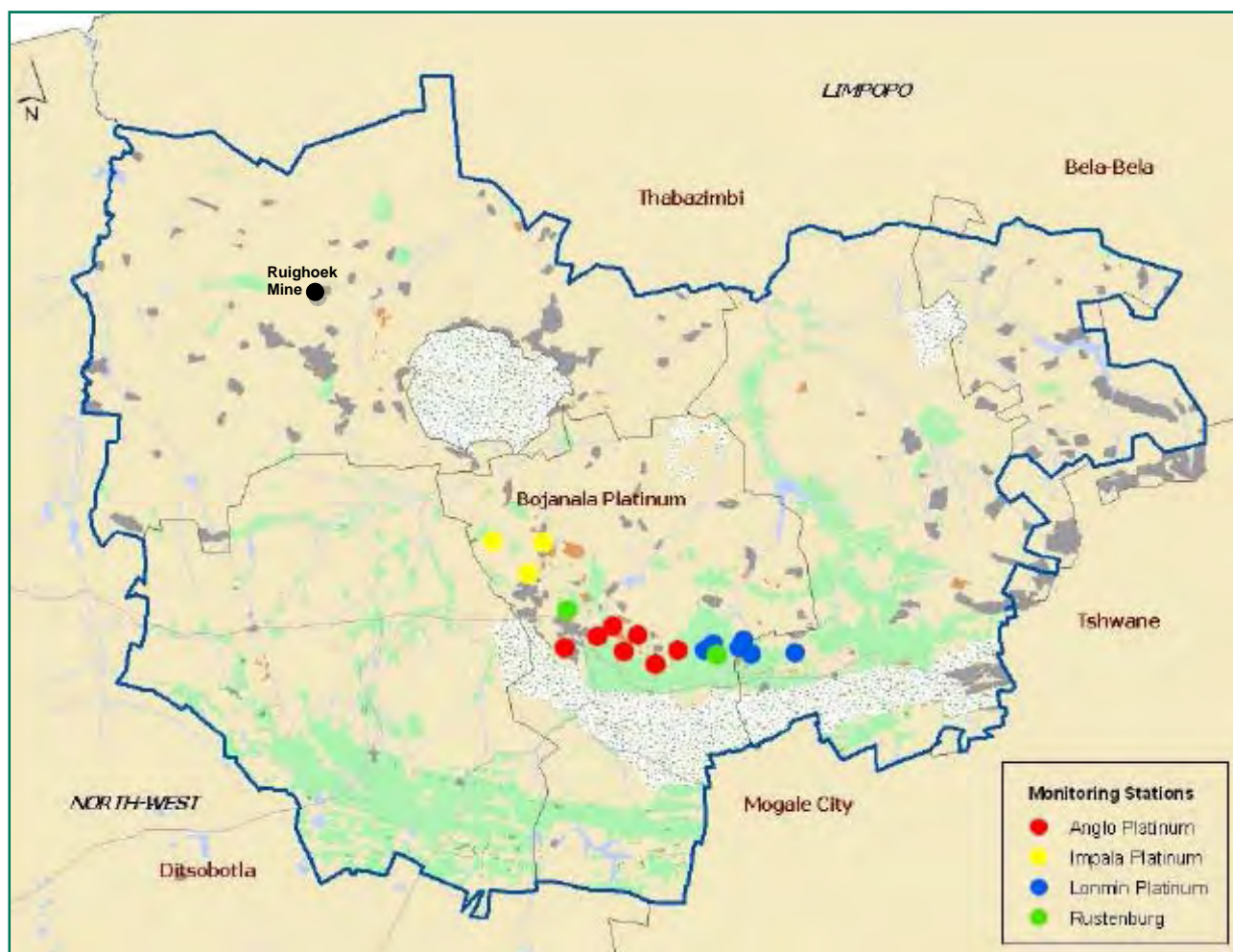


Figure 3-6: Location of ambient air quality monitoring stations in Bojanala Platinum District Municipality in relation to the Ruighoek mine (Bojanala Platinum District Municipality AQMP Baseline Assessment, 2010).

Data recorded at the platinum mines show infrequent exceedances of the national standard of 48 ppb for the daily SO_2 concentration, several exceedances of the current national daily standard of $120 \mu\text{g}/\text{m}^3$ for PM_{10} and numerous exceedances of the 2015 national daily standard of $75 \mu\text{g}/\text{m}^3$. These mines are located approximately 40km to 80km south-east of the proposed mining operations at Groenfontein, Vlakfontein, Ruighoek and Vogelstruisnek and, although airborne pollutants can travel long distances, their concentrations diminish with distance from the emission source. The contribution of the emission sources associated with the platinum mines to the air quality in the vicinity of Groenfontein, Vlakfontein, Ruighoek and Vogelstruisnek could be estimated by means of dispersion modelling, but in view of the loss of accuracy with distance and the contribution from local sources, such an exercise cannot take the place of actual measurements taken locally.



Potential air quality pollution sources of local significance include:

- Fugitive emissions from existing chrome mining operations such as clearing operations (scrapping, dozing and excavating), materials handling operations (tipping, off-loading, loading), vehicle entrainment of dust from haul roads, wind erosion from open areas, drilling and blasting. These result mainly in fugitive dust releases and small amounts of NO_x, CO, SO₂, methane and CO₂ gases.
- Vehicle tailpipe emissions. These include CO₂, CO, SO₂, NO_x and hydrocarbon gases as well as particulate material and lead.
- Household fuel combustion (particularly coal and wood used by smaller communities/settlements).
- Biomass burning (veld fires in agricultural areas within the region).
- Various miscellaneous fugitive dust sources (agricultural activities, wind erosion of open areas, vehicle entrainment of dust along paved and unpaved roads).

The following were identified as sensitive receptors (Figure 3-7):

- Witrandjie village, less than 500 m west of Vogelstruisnek;
- Mabeleleng village approximately 1 km south-east of Vlakfontein;
- Maologane village, approximately 1 km east-south-east of Vogelstruisnek;
- Tlhatlhaganyane village, approximately 2 km to the north-east of Vogelstruisnek;
- Makgope village, approximately 2.5 km to the north-north-west of Groenfontein;
- The Ruighoek Mine village, immediately north of the Ruighoek mine, 2.5 km from Groenfontein;
- The Pilanesberg Nature Reserve, which is highly dependent on tourism, is located 2.5 km and 4.5 km to the east of Vogelstruisnek and Vlakfontein respectively;
- Makoshong village located approximately 5.5 km to the north-west of Vogelstruisnek;
- Seolong village located approximately 8.5 km to the north-west of Vlakfontein; and
- Maberskraal village located approximately 9 km to the west of Vlakfontein.

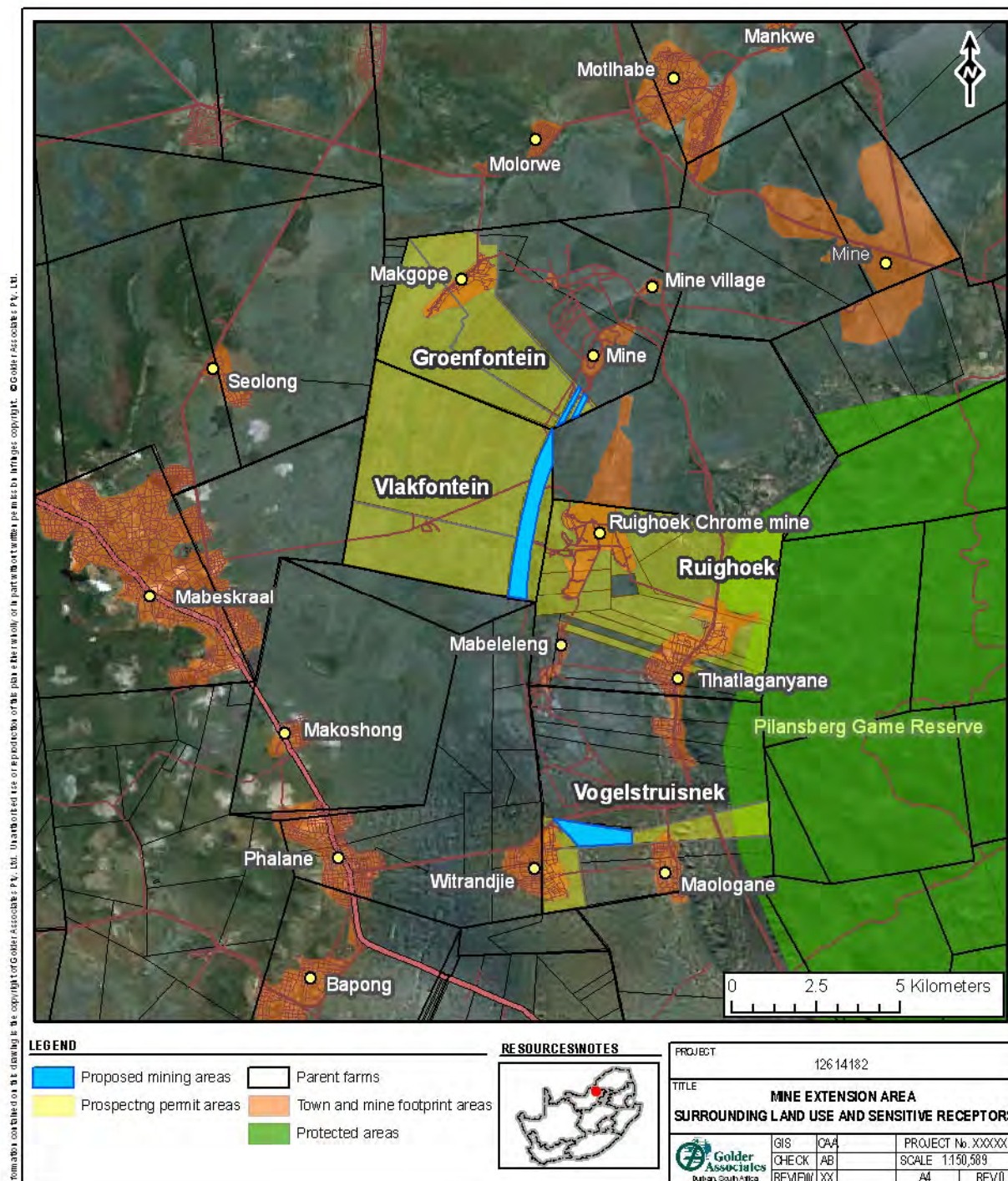


Figure 3-7: Potentially sensitive receptors in the vicinity of the proposed mining areas

3.5 Topography

The project area lies in the wide, shallow Motlhabe River valley which is oriented north-south and falls gently towards the north. The terrain within the valley is relatively flat, but rises abruptly at the Pilanesberg mountains which bound the valley to the east. A rugged, north-south trending ridge of hills bounds the valley to the west. The average elevation in the valley ranges from approximately 1,050 to 1,550 m above mean sea level.



Figure 3-8: Topography of the project area (Map Source: Google Earth)

3.6 Soil and Land Capability

A survey conducted by the Agricultural Research Council's Institute for Soil, Climate and Water (ARC-ISWCW) found that the soils of the area around Ruighoek Mine comprise deep, dark brown to black swelling clays, with smaller areas of dark brown, less swelling clays as well as a significant zone of shallow lithosols, especially in the south and south-west (ARC, February 2007).

The black swelling clay soils of Arcadia (Ar) form have high clay contents, high CEC values, are of neutral to alkaline pH and have low P values in their natural state. The shallower rocky soils of Mayo form (My/R) have lower clay contents (as well as lower silt contents) with consequently lower CEC values. Although they are, in this case, more alkaline they also have low P values in the natural state. Other soil forms identified in the area include Witbank (clay), Shortlands (sandy clay loam), Bonheim (clay and loam - clay), Swartland (loam to clay loam) and Mispah (sandy clay loam) (Steenekamp, P I., March 2012).

A study on soil types, land use and land capability that focused specifically on the proposed mining areas on Groenfontein, Vlakfontein and Vogelstruisnek (Viljoen, C., May 2012) found the soil types illustrated in Figure 3-9 and the summarized results are presented in Table 3-3.

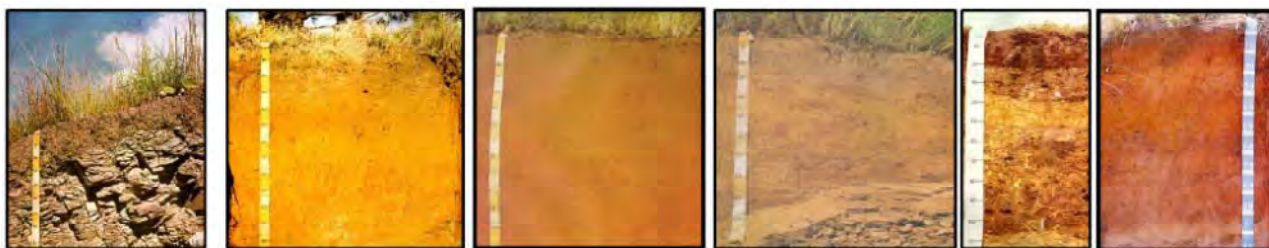


Figure 3-9: Soil types: Mispah, Avalon, Hutton, Clovelly, Witbank and Bainsvlei (left to right).



Table 3-3: Agricultural potential of soil types on proposed mining areas

Farm	Soil Type	Agricultural Potential		Area (ha)	Current Land Use
		Dry Land	Irrigation		
Groenfontein	Mispah	Low	Low	5.778	Wilderness
	Avalon	Low	Medium	16.9	Grazing
Vlakfontein	Mispah	Low	Low	13.927	Wilderness
	Avalon	Low	Medium	54.366	Grazing
	Hutton	High	High	52.354	Arable
	Clovelly	High	High	111.833	Grazing
	Witbank	Low	Low	12.305	Wilderness
	Mispah	Low	Low	22.255	Wilderness
Vogelstruisnek	Avalon	Low	Medium	19.959	Grazing
	Bainsvlei	Low	Medium	51.175	Grazing

The proposed open pit mining areas and surrounding areas are mainly used by local cattle farmers for seasonal grazing purposes, but there are also patches of wilderness and small patches of arable land.

3.6.1 Agricultural potential

3.6.1.1 Dryland

The dominant Arcadia (turf) soils (Ar map unit) have a narrower moisture range for cultivation than most other agricultural soils. These swelling clay soils saturate easily and drain slowly, causing anaerobic conditions. If allowed to dry out these soils can crack, damaging roots. Surface crusting is also a potential problem which can lead to decreased infiltration rates. These black clay soils are however naturally fertile, with high cation exchange capacities and moderately high organic carbon contents. If well managed, they can be productive soils.

Valsrivier soils (Va/E map unit) have somewhat less clay, with less of a swelling nature, and are somewhat easier to cultivate. The main limiting factor of this unit is the loss of topsoil, coupled with the uneven soil surface and the stream bed running through the unit.

The shallow soils (Mayo; My/R map unit), are too shallow, rocky and steep to cultivate and have, at best, only a grazing potential.

3.6.1.2 Irrigation

The Arcadia soils can be irrigated if subsurface water is available, bearing in mind the limitations as stated above. They do however require a high level of management to properly maintain moisture levels.

3.6.2 Land capability

Arcadia turf soils (Ar) can be classified as having an arable land capability class, although the potential will be low due to the limitations outlined above. The Ar(d) and Va/E (Valsrivier) map units can be classified as having a land capability class of grazing, due to surface disturbance and/or loss of topsoil. The My/R (Mayo) map unit has land capability class wilderness, due to its shallow, rocky nature.



3.7 Ecology

According to the NW Biodiversity Inventory and Database (2003) the region in which the study area is located has a floral diversity ranking of high. A total of 109 plant species were recorded during the floristic survey of the study area, which is markedly higher than the 40 plant species presented in the PRECIS dataset by SANBI (SIBIS: SABIF, 2009, internet), and can be attributed to the variable topography of the study area, and the resulting environmental heterogeneity.

Based primarily on position along the slope catena, physiognomy, moisture regime, rockiness, slope and soil properties, four vegetation communities were recognised, but there is variation within these communities as a result of current and historic anthropogenic disturbance. The communities are:

- Bottomland *Acacia karroo*-*Acacia tortilis* bushveld
- Foothill mixed bushveld
- Upper- Midslope *Acacia caffra*-*Combretum molle* bushveld
- Artificial wetland

The areas on Ruighoek affected by mining activities show complete or severe transformation and disturbance. These include *inter alia*, the staff village, offices and workshops, processing facilities, spoil heaps, opencast pit areas and areas cleared for supporting activities, such as car parks. (Zinn, A; Hudson, A, February 2012).

The proposed mining areas on Groenfontein, Vlakfontein and Vogelstruisnek are mainly bottomland. These areas were previously mined and rehabilitated, but after only 10 to 15 years growth of vegetation, the floral diversity is still relatively low.

3.7.1 Flora

The general vegetation type occurring in the area is Clay Thorn Bushveld, also called Springbok Flats Turf Thornveld. The field survey undertaken for the expansion of the Ruighoek Mine recorded the following floral species:

3.7.1.1 Grasses

The study area is known to support very low vegetation species diversity. Grass cover was very sparse and the grass community was dominated by Pinhole Grass *Bothriochloa insculpta*, Three-awn Rolling Grass *Aristida bipartita*, and Sweet Signalgrass *Brachiaria eruciformis*, which reflects large scale disturbance by mining and farming activities in the past. The 27 grass species recorded during the survey are listed in Table 3-4. **No Red Data** grass species were recorded during the study.

Table 3-4: Grass species recorded at the Ruighoek Chrome Mine.

Biological Name	Common Name
<i>Antheophora pubescence</i>	Wool grass
<i>Aristida bipartite</i>	Rolling grass
<i>Aristida congesta</i> subsp. <i>Bipartita</i>	Spreading three awn
<i>Aristida congesta</i> subsp. <i>Congesta</i>	Tassel three awn
<i>Aristida stipitata</i>	Long-awned grass
<i>Bewsia biflora</i>	False love grass
<i>Bothriochloa insculpta</i>	Pinhole grass
<i>Brachiaria eruciformis</i>	Sweet signal grass
<i>Chloris pycnothrix</i>	Spiderweb grass
<i>Chloris virgata</i>	Feather top chloris



Biological Name	Common Name
<i>Digitaria diagonalis</i>	Brown seed finger grass
<i>Digitaria eriantha</i>	Common finger grass
<i>Eragrostis curvula</i>	Weeping love grass
<i>Eragrostis lehmanniana</i>	Lehmann's love grass
<i>Eragrostis tef</i>	Tef
<i>Eustachys paspaloides</i>	brown Rhodes grass
<i>Fingerhuthia Africana</i>	Thimble Grass
<i>Ischaemum afrum</i>	Turf grass
<i>Melinis repens</i>	Natal Red Top
<i>Panicum coloratum</i>	Small Buffalo grass
<i>Perotis patens</i>	Cats tail
<i>Setaria incrassate</i>	Vlei bristle grass
<i>Sorghum versicolor</i>	Black Seed sorghum
<i>Sporobolus africanus</i>	Ratstail dropseed
<i>Themeda triandra</i>	Red grass
<i>Urelytrum agropyroides</i>	Quinine grass
<i>Uruclia panicoides</i>	Garden uruchloa

3.7.1.2 Forbs

The forb species diversity was also very low, most probably due to past disturbance, especially cultivation, in combination with the low natural diversity. Eight forb species were recorded (Table 3-5). **No Red Data** forb species were recorded during the study.

Table 3-5: Forb species recorded at the Ruighoek Chrome Mine.

Biological Name	Common Name
<i>Chlorophytum fasciculatum</i>	Hen and chickens
<i>Asparagus cooperi</i>	Asparagus fern
<i>Aster squamatus</i>	
<i>Commelina Africana</i>	Yellow Commelina
<i>Datura ferox</i>	
<i>Datura stramonium</i>	
<i>Hermannia depressa</i>	
<i>Lantana camara</i>	

3.7.1.3 Shrubs and Trees

Shrubs and trees showed relatively high diversity, when compared with the other floral types and 35 species were recorded in the study area (Table 3-6). Most of the tree and shrub diversity was found on the rocky ridges and outcrops. The low lying areas were dominated by *Acacia* species, most notably *Acacia tortilis*, *Acacia nilotica* and *Acacia karroo*. These species are of a similar age and size throughout the study area, indicating that this area was cleared by mechanical means or by fire within the last 50 years. This clearing was most likely due to agricultural practices as older topographical maps dating from 1986 show cultivated fields in this area. The rocky ridges and outcrops show considerably higher tree and shrub diversity. **No Red Data** shrub or tree species were recorded during the study.



Table 3-6: Shrub and tree species recorded at the Ruighoek Chrome Mine.

Biological Name	Common Name
<i>Aloe marlothii</i>	Mountain Aloe
<i>Euphorbia ingens</i>	Tree euphorbia
<i>Acacia tortillis</i>	Umbrella Thorn
<i>Acacia nilotica</i>	Scented thorn
<i>Acacia karroo</i>	Sweet thorn
<i>Acacia nigrescens</i>	Knob thorn
<i>Acacia robusta</i>	Ankle thorn
<i>Ziziphus mucronata</i>	Buffalo thorn
<i>Ficus glumosa</i>	Mountain fig
<i>Croton gratissimus</i>	Lavender fever berry
<i>Englerophytum magalismontanum</i>	Transvaal milkplum
<i>Mimusops zeyheri</i>	Transvaal red milkwood
<i>Pozolzia mixta</i>	Soap nettle
<i>Commiphora pyracanthoides</i>	Common corkwood
<i>Tarchonanthus camphorates</i>	Wild camphor bush
<i>Kiggelaria Africana</i>	Wild Peach
<i>Ximenia caffra</i>	Sourplum
<i>Ehretia rigida</i>	Puzzle bush
<i>Diospyros lycoides</i>	Blue bush
<i>Euclea natalensis</i>	Natal guarri
<i>Bridelia mollis</i>	Velvet sweetberry
<i>Pappea capensis</i>	Jacket plum
<i>Canthium gaffillanii</i>	Velvet rock alder
<i>Tapiphyllum paevifolium</i>	Mountain medlar
<i>Vangueria infausta</i>	Wild medlar
<i>Buddleja saligna</i>	Wild olive
<i>Combretum molle</i>	Velvet bushwillow
<i>Combretum hereroense</i>	Russet bushwillow
<i>Rhus lancea</i>	Karree
<i>Rhus pyroides</i>	Common wild currant
<i>Sclerocarya birrea</i>	Marula
<i>Peltophorum africanum</i>	Weeping wattle
<i>Dichrostachys cinerea</i>	Sickle bush
<i>Gymnosporia buxifolia</i>	Common spike thorn

3.7.2 Fauna

The following fauna species were recorded:

3.7.2.1 Avifauna (Birds)

The NW Biodiversity Inventory and Database (2003) categorises the region in which the study area is located as having low-medium bird diversity. Data presented on SANBI's SIBIS database (SIBIS: SABIF, 2009, internet) indicates that a total of 127 bird species have been recorded in the 2526BB quarter degree grid square. This is substantially more than the 35 bird species recorded during the site survey (see Table 3-7). This low diversity can be attributed to:



- The time of year at which the survey was undertaken – during the dry season many summer residents migrate north and only common residents would be observed;
- Mining activities, most notably blasting, would disturb many bird species in the immediate area; and
- Egg collecting by adjacent land users may reduce the abundance and diversity of resident bird species.

No Red Data bird species were recorded.

Table 3-7: Bird species recorded during the 2011 survey

Scientific Name	Common Name
<i>Mirafrababota</i>	Sabota Lark
<i>Dryoscopus cubla</i>	Blackbacked Puffback
<i>Bostrychia hagedash</i>	Hadedab Ibis
<i>Fancolinus swainsonii</i>	Swainson's Spurfowl
<i>Fancolinus sephaena</i>	Crested Francolin
<i>Vanellus coronatus</i>	Crowned Lapwing
<i>Vanellus armatus</i>	Blacksmith Lapwing
<i>Streptopelia senegalensis</i>	Laughing Dove
<i>Streptopelia capicola</i>	Ring-necked Dove
<i>Corthaixoides concolor</i>	Grey Go-away-bird
<i>Apus caffer</i>	Whiterumped Swift
<i>Urocolinus indicus</i>	Redfaced Mousebird
<i>Coracias caudata</i>	Lilacbreasted Roller
<i>Tockus nasutus</i>	African Grey Hornbill
<i>Upupa africana</i>	African Hoopoe
<i>Corvus albus</i>	Pied Crow
<i>Pyconotus nigricans</i>	Black-fronted Bulbul
<i>Pyconotus barbatus</i>	Common Bulbul
<i>Turdus olivaceus</i>	Olive Thrush
<i>Cossypha humeralis</i>	Whitethroated Robin-Chat
<i>Zosterops pallidus</i>	Cape White-eye
<i>Tchagra senegala</i>	Blackcrowned Tchagra
<i>Lamprotornis nitens</i>	Red-shouldered Glossy Starling
<i>Acridotheres tristis*</i>	Indian Myna
<i>Nectarinia talatala</i>	White-breasted Sunbird
<i>Nectarinia mariquensis</i>	Marico Sunbird
<i>Passer domesticus</i>	House Sparrow
<i>Ploceus velatus</i>	Southern Masked Weaver
<i>Pytilia melba</i>	Melba Finch
<i>Estrilda erythronotos</i>	Blackcheeked Waxbill
<i>Uraeginthus angolensis</i>	Blue Waxbill
<i>Lagonosticta senegala</i>	Redbilled Firefinch
<i>Batis molitor</i>	Chinspot Batis
<i>Bubuculus ibis</i>	Cattle Egret

*Exotic species



3.7.2.2 Arthropoda

Sixty seven terrestrial arthropod¹ species were recorded during the survey (Table 3-8). The low species richness recorded may be due to seasonal variability. Reduced habitat availability in the region, due to the destruction and degradation of the vegetation in the surrounding area, may also have contributed to the low arthropod diversity. **No Red Data** arthropoda species were recorded.

Table 3-8: Arthropod species recorded at the Ruighoek Chrome Mine.

Superclass	Class	Order	Family	Genus	Species	Common Name
	Insecta	Isoptera	Termitidae	<i>Trinervitermes</i>		
				<i>Amitermis</i>	<i>hastatus</i>	
		Mantodea	Hymenopodidae	<i>Harpagomantis</i>	<i>tricolor</i>	
			Mantidae	<i>Sphodromantis</i>	<i>gastrica</i>	
		Dermaptera	Libiduridae	<i>Labidura</i>	<i>riparia</i>	
		Orthoptera	Bradyporidae	<i>Hetrodes</i>	<i>pupus</i>	
			Tettigonidae	<i>Phaneroptera</i>		
			Gryllidae	<i>Gryllus</i>	<i>bimaculatus</i>	
			Pamphagidae	<i>Hoplolopha</i>		
			Pyrgomorphidae	<i>Phymateus</i>	<i>morbillosus</i>	
			Acrididae	<i>Acrida</i>	<i>acuminata</i>	
				<i>Locustana</i>	<i>pardalina</i>	
		Hemiptera	Reduviidae	<i>Etrichodia</i>	<i>crux</i>	
			Alydidae	<i>Mirperus</i>	<i>faculus</i>	
			Pyrrhocoridae	<i>Scantius</i>	<i>fosteri</i>	
			Nemopteridae	<i>Nemia</i>	<i>costalis</i>	
		Coleoptera	Carabidae	<i>Passalidius</i>	<i>fortipes</i>	
				<i>Acanthoscelis</i>	<i>ruficornis</i>	
			Meliridae	<i>Melyris</i>		
			Tennebrionidae	<i>Psammodes</i>	<i>striatus</i>	
				<i>Stenocara</i>	<i>dentata</i>	
		Diptera	Tabanidae	<i>Tabanus</i>	<i>taeniatus</i>	
			Bombyliidae	<i>Exoprosopa</i>		
			Calliphoridae	<i>Chrysomya</i>	<i>chloropyga</i>	
				<i>Chrysomya</i>	<i>albiceps</i>	
		Lepidoptera	Saturniidae	<i>Bunaea</i>	<i>alcinoe</i>	
			Eumenidae	<i>Delta</i>	<i>hottentottum</i>	
		Hymenoptera	Apidae	<i>Apis</i>	<i>mellifera</i>	
			Formicidae	<i>Tetraponera</i>		
				<i>Messor</i>	<i>capensis</i>	
				<i>Camponotus</i>	<i>fulvopilosus</i>	
		Scorpiones	Buthidae			
		Araneae	Arachnidae			
Myriapodia						Centipede
						Millipede

¹ *Arthropoda*: A large division of Articulata, embracing all those that have jointed legs. It includes Insects, Arachnida, Pchynogonida, and Crustacea. (Source: www.brainyquote.com/words/ar/arthropoda132553.html)



3.7.2.3 Mammals

Due to the relatively small area covered by the study, the agricultural disturbance that has occurred and the low floral diversity, a high diversity of mammal species was not expected. The mammal community consists primarily of pioneer species, such as rodents (e.g. the genus *Mastomys*) and other species that are widespread and common to most vegetation types.

Sixteen mammal species were recorded within the study area (Table 3-9). Although more species are known to occur in the area, the study area itself may not be suitable for all these species. Human disturbance and the fence around the property may exclude many mammal species from the site. **No Red Data mammal species were recorded.**

Table 3-9: Mammal species recorded during the 2011 survey

Scientific Name	Common Name	NEMBA Threatened and Protected Species List (2007)	IUCN Red List of Threatened Species (2011)
<i>Lemniscomys rosalia</i>	Striped Mouse	-	Least concern
<i>Aethomys chrysophilus</i>	Red Veld Rat	-	Least concern
<i>Mastomys coucha</i>	Multimammate Mouse	-	Least concern
<i>Saccostomus campestris</i>	Pouched Mouse	-	Least concern
<i>Crocidura hirta</i>	Lesser Red Musk Shrew	-	Least concern
<i>Elephantulus myurus</i>	Rock Elephant Shrew	-	Least concern
<i>Lepus saxatili</i>	Scrub Hare	-	Not listed
<i>Prongolagus randensis</i>	Jameson's Red Rock Rabbit	-	Not listed
<i>Hystrix africaeaustralis</i>	Porcupine	-	Least concern
<i>Paraxerus cepapi</i>	Tree Squirrel	-	Not listed
<i>Procavia capensis</i>	Rock Hyrax	-	Least concern
<i>Cercopithecus aethiops</i>	Vervet Monkey	-	Least concern
<i>Felis lybica</i>	African Wild Cat	-	Not listed
<i>Panthera pardus</i>	Leopard	Vulnerable	Near Threatened
<i>Sylvicapra grimmia</i>	Common Duiker	-	Least concern
<i>Oreotragus oreotragus</i>	Klipspringer	-	Least concern

3.7.2.4 Herpetofauna (Reptiles)

According to the NW Biodiversity Inventory and Database (2003) the reptile and amphibian biodiversity of the region in which the study area is located has a ranking of medium. Six reptile species were recorded during the study (Table 3-10). All of the recorded species are common. **No Red Data reptile species were recorded.**

Table 3-10: Herpetofauna species recorded at the Ruigheok Chrome Mine.

Common Name	Biological Name
Puffadder	<i>Bitis arietans</i>
Brown House Snake	<i>Lamprophis fuliginosus</i>
Variable Skink	<i>Mabuya varia</i>
Cape Skink	<i>Mabuya capensis</i>
Striped Skaapsteker	<i>Psammophylax tritaeniatus</i>
Stripe-bellied Sand Snake	<i>Psammophis subtaeniatus</i>



The small size of the study area and seasonal variability may have contributed to the low reptile species diversity recorded. There was also a low degree of endemism², with none of the recorded species being endemic to the region. The African Rock Python (*Python sebae*) is known to occur in the general area of the North West Province, with the closest records of this species in the Pilanesberg Park approximately 3-4km from the study site. **No Red Data species were recorded.**

3.7.2.5 Amphibia

Three common amphibian species were recorded within the study area (see Table 3-11). These species rely on ephemeral water bodies and are not dependent on permanent water bodies. No open water bodies, streams or other man-made water bodies (such as water troughs) were found in the study area. Therefore it is unlikely that any of the more water-reliant species will occur in the study area. **No Red Data amphibian species were recorded.**

Table 3-11: Amphibian species that may occur at the Ruighoek Chrome Mine.

Common Name	Biological Name
Bushveld Rain Frog	<i>Breviceps adsperus</i>
Guttural Toad	<i>Bufo gutturalis</i>
Western Olive Toad	<i>Bufo poweri</i>

The Ruighoek Chrome Mine area, including the new processing plant site is heavily impacted by agricultural and other human activities and it is unlikely that the area is important from a conservation point of view, or that the area is likely to be inhabited by any Red Data species. No Red Data species were found during the study and the North West Province Biodiversity Database further substantiates that this area is unlikely to accommodate any Red Data species.

3.7.3 Ecological Function

The precautionary principle was applied throughout the determination of the ecological function of the various vegetation communities. In instances where ecological function was found to be borderline between two categories, the community was classified in the higher category.

Much of the Bottomland *Acacia karroo*-*Acacia tortilis* bushveld and Foothill mixed bushveld vegetation communities within the study area have been disturbed. In addition, other anthropogenic activities including agriculture, livestock grazing and mining outside the study area have also disturbed large tracts of Bottomland *Acacia karroo*-*Acacia tortilis* bushveld. At a landscape level these communities are important dispersal habitats, linking the mountainous Pilanesberg to the hills and ridges located in the study area, and to similar Maberskraal Ridge Bushveld habitats located north-west of the study area. Where not transformed or heavily degraded by mining activities, the ecological function of these communities can be considered medium to high.

3.7.4 Conservation Importance

The precautionary principle was applied throughout the determination of the conservation importance of the various vegetation communities. In instances where conservation importance was found to be border-line between two categories, the community was classified in the higher category.

The conservation importance of the Bottomland *Acacia karroo*-*Acacia tortilis* bushveld is considered moderate to high, as although large areas have been transformed and disturbed, the possible presence of the Red Data Giant Bullfrog (*Pyxicephalus adspersus*) and Yellow-throated sandgrouse (*Pterocles gutturalis*), and the protected tree *Boscia albitrunca* cannot be excluded.

² *Endemism, endemic*: A species that is endemic is unique to its own place or region and is found only there, and not found naturally anywhere else (Source: [http://en.wikipedia.org/wiki/Endemic_\(ecology\)](http://en.wikipedia.org/wiki/Endemic_(ecology)))



3.8 Surface Water

There are no perennial surface water features within the proposed mining areas on Groenfontein, Vlakfontein, Ruighoek and Vogelstruisnek, only drainage lines that experience ephemeral flow after significant rainfall events.

Two non-perennial tributaries of the Motlhaba River cross the Ruighoek mining area. The tributaries are generally dry and flow only after significant rainfall. They are not utilised as water sources by the local community or livestock.

3.9 Groundwater

Information available from previous groundwater investigations at Ruighoek (Golder, May 2007) and (Brink, D; Canahai, G; February 2012) can be summarised as follows:

- The main aquifers are secondary fractured aquifers and weathered rock aquifers;
- Groundwater levels ranged from 5.82 mbgl to 20.38 mbgl (1130 mamsl to 1133 mamsl) based on data collected in 2001;
- Yields in boreholes identified during a 2001 hydrocensus varied from dry to 10 l/s;
- Boreholes are used mostly for domestic use and stock watering;
- Groundwater quality generally did not meet the South African Water Quality Guidelines for domestic use due to high salinity, high Ca, high Mg and high nitrate;
- The main source of groundwater recharge was identified as high-lying ground in the Pilanesberg Mountains and low-lying areas of the Motlhaba River catchment;
- Annual groundwater abstraction was estimated at 105 m³/yr; and
- The fractured/weathered rock aquifers are described as “minor”. Safe sustainable yields of boreholes are about 0.5 l/s.

Two aquifers were identified:

- Weathered zone aquifer which extends to a depth of 5 m to 30 m. The saturated zone in this aquifer can vary from 0 m to 20 m. Porosity is of the order of 1% to 25%. Transmissivity ranges from 30 m²/day to 150 m²/day. The aquifer is of limited extent and subject to dewatering under sustained pumping conditions; and
- Fractured rock aquifers are associated with sub-vertical fracture zones and are usually present in the slightly weathered rock beneath the weathered zone.

3.9.1 Occurrence of groundwater

Drilling results from previous studies conducted at Ruighoek indicate that the area is underlain by a variable thickness of weathered pyroxenite underlain in turn by relatively unweathered and fractured pyroxenite. Groundwater was not encountered in the weathered zone. The existence of perched aquifers in the weathered zone over relatively unweathered pyroxenite was indicated in previous groundwater studies. The absence of a perched aquifer in newly drilled boreholes at Ruighoek suggests that perched aquifers are not developed in all areas or that dewatering from the underground workings has also affected the perched aquifer.



Based on the past drilling results, groundwater occurrence at Ruighoek appears to be limited to fractures in unweathered pyroxenite.

The slug test results indicated a hydraulic conductivity of the order of 10^{-9} m/s (1.8×10^{-4} m/d). This suggests that the groundwater resource potential of fractured pyroxenite at Ruighoek Chrome Mine is low. However, fractured rock aquifers are variable and the results from a single borehole cannot fully reflect this variability. The possibility that water-bearing zones with higher conductivities are present in the area cannot be excluded on the results of the previous groundwater study.

3.9.2 Summary of groundwater baseline

The groundwater study conducted at the Ruighoek Chrome Mine indicated:

- Dewatering in the vicinity of the pit due to previous underground mining;
- No development of a perched aquifer in weathered pyroxenite;
- Limited groundwater occurrence in fractured pyroxenite;
- A maximum groundwater level of approximately 20m below surface in the pit footprint; and
- Poor quality groundwater in the vicinity of the old Ruighoek plant site, including Cr(VI) contamination.

The findings of the groundwater study are consistent with previous findings and indicate that the local aquifers are of minor significance as a groundwater resource due to poor yields.

3.10 Noise

A noise impact assessment for planned extensions at Ruighoek mine was undertaken in 2007 (Jongens, A, April 2007). A noise and ground vibration survey of the proposed mining areas on Groenfontein, Vlakfontein and Vogelstruisnek was done on 15 and 16 May 2012. (van der Merwe, B, June 2012). The measuring points are shown in Figure 3-10 and the measurements appear in Table 3-12.

The following equipment was used in the noise surveys of June 2012:

Larsen Davis Integrated Sound Level meter Type 1 – Serial no. S/N 0001072;

Larsen Davis Pre-amplifier – Serial no. PRM831 0206;

Larsen Davis ½" free field microphone – Serial no. 377 B02 SN 102184; and

Larsen Davis Calibrator 200 – Serial no.3073.

The instruments used in the noise surveys were calibrated before and after the measurements were done and they coincided within 1.0 dBA. The batteries were fully charged and a wind shield was in use at all times.

A Minimate Plus with serial number BE14853 coupled with a Triaxial Geophone with serial number BG13752 was used to determine the prevailing vibration levels.

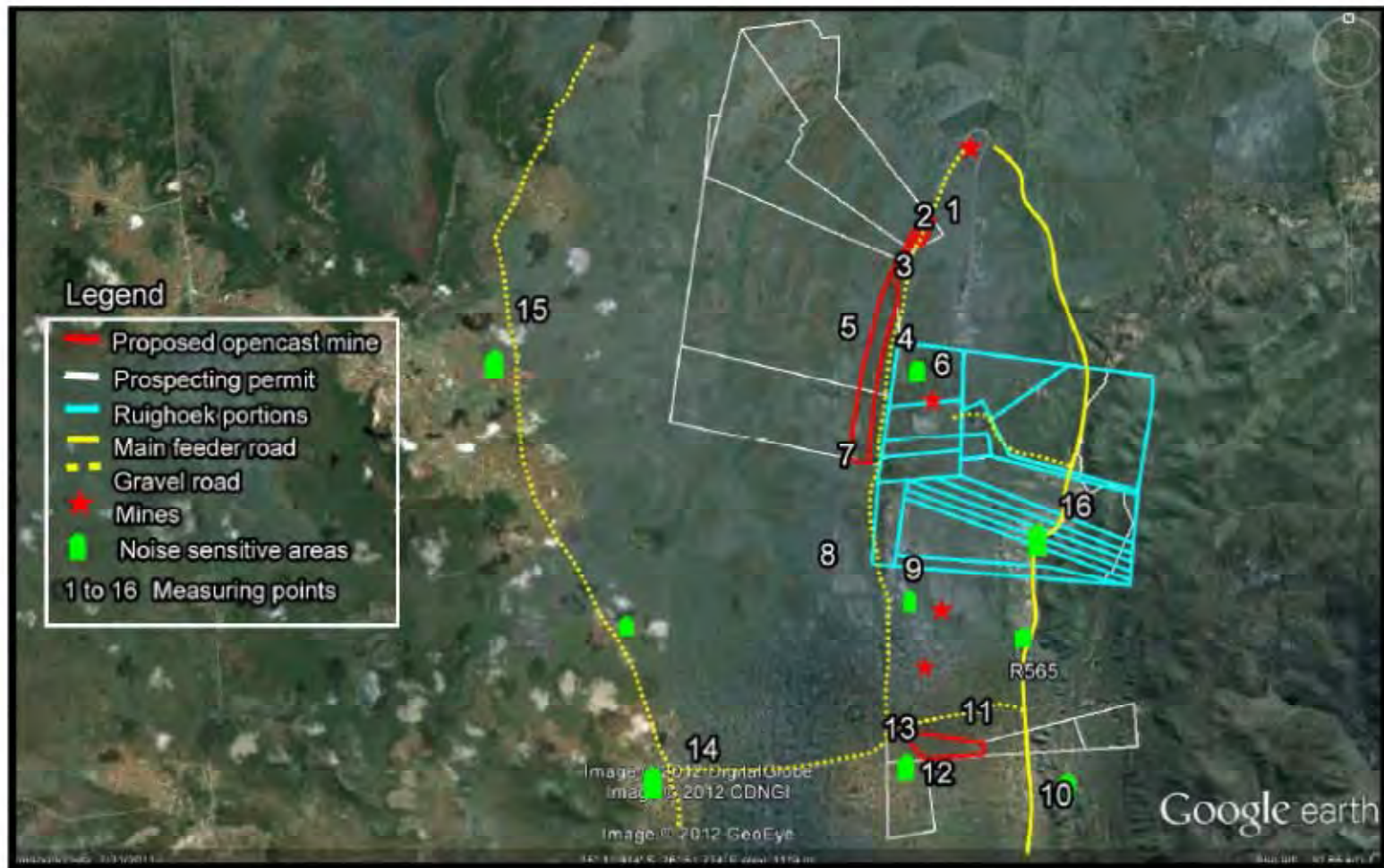


Figure 3-10: Noise measuring points, roads and sensitive areas



The baseline noise climate of the study area can be summarised as follows:

- The main sources of noise in the study area are traffic on the R565 and activities at the existing Ruighoek and Horizon Chrome Mines; and
- The noise sensitive areas in the study area are the villages of Mabeskraal, Makoshong, Phalane, Witrandjies, Maologane, Malawi village, Tlhatlhtaganyane, Thorosane, Mabeleleng, Raborife and Ruighoek Mine.

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

- In general the residual noise levels in the study area are low and the area is very quiet. The noise levels are representative of a typical rural area;
- The existing noise climate alongside Road R565 is slightly degraded with regard to residential living. Residences are negatively impacted in places from traffic noise for up to 50 metres from the road;
- The noise from the Ruighoek and Horizon Mines is audible up to a distance of about 1 500 metres, but should only be disturbing at night up to an offset of 700 metres from the mines;
- Residual noise levels in Tlhatlthaganyane Village are relatively low. Daytime ambient conditions range from about 46dBA on the western side of the village to 52dBA near the main road. Evening conditions range from about 41 dBA to 42 dBA, while the night-time ambient levels fall even lower to about 35 dBA. These are acceptable suburban residential conditions (SANS 10103);
- Residual noise levels in Mabeleleng Village are generally relatively low. Daytime ambient conditions range from about 40 dBA on the northern side of the village to 55 dBA on the southern side. In the north, evening conditions are about 38 dBA, while the night-time ambient levels fall even lower to about 30 dBA. These are acceptable suburban residential conditions (SANS 10103). On the southern side of the village, the Horizon mine noise has a significant impact at night when the plant operates between 22h00 and 06h00; and
- Residual noise levels in the Ruighoek Mine Village are relatively low. Daytime ambient conditions lie in the region of about 43 dBA. Evening noise levels are about 37 dBA, while the night-time ambient levels fall even lower to about 33 dBA. These are acceptable suburban residential conditions (SANS 10103).

Table 3-12: Noise and ground vibration levels at selected measuring points

Measuring points	Daytime			Night time			Ground vibration–mm/s
	Leq - dBA	Lmax - dBA	Lmin - dBA	Leq - dBA	Lmax - dBA	Lmin - dBA	
1	30.1	57.3	18.5	32.1	42.6	28.3	0.310
2	30.9	54.0	19.3	32.1	42.6	28.3	0.770
3	34.4	59.7	18.4	32.1	42.6	28.3	0.465
4	54.5	78.6	19.8	29.1	46.5	20.7	0.310
5	32.3	58.9	17.9	32.1	42.6	28.3	0.220
6	40.4	54.3	33.1	40.7	69.3	30.7	0.310
7	55.1	79.3	18.9	32.6	53.3	28.1	0.220
8	32.4	59.4	17.7	32.1	42.6	28.3	0.250
9	37.5	58.9	22.5	42.9	48.0	37.9	0.310
10	41.9	60.0	28.3	37.5	58.9	22.5	0.250
11	31.3	53.1	21.0	35.7	61.8	18.6	0.250
12	46.0	65.2	27.6	34.8	57.8	27.0	0.220
13	44.1	64.6	29.3	35.4	62.7	22.2	0.220
14	37.0	57.5	25.8	29.2	48.6	18.5	0.280
15	42.1	56.9	27.5	32.8	47.7	19.0	0.280
16	49.7	70.4	21.8	42.3	49.7	24.3	0.420



The prevailing ambient noise levels in the study area are typical of the noise levels expected next to roads and mining activities. At some measuring points the night time noise levels were higher than during the daytime because of insect noises. No blasting took place in the project areas during the survey and the ground vibration levels were insignificant, being below 1,0 mm/s at all measuring points.

3.11 Visual Aspects

The study area lies along the lower eastern slopes of a series of hills that protrude above the surrounding plains, west of the Pilanesberg, which dominates views to the east. The project area is primarily gently rolling to almost flat, punctuated by a number of geographically isolated hills and ridges (Figure 3-13).

The Vogelstruisnek and Vlakfontein/Groenfontein sites are for the most part located in very gently rolling to almost flat areas that have few prominent or distinguishing topographical features. However, the southern extent of the Vlakfontein mining area is bordered to the east by the isolated ridge against which the existing Ruighoek mine is located. The eastern perimeter of the proposed Vogelstruisnek open pit mine is located approximately 1.4km from a ridge associated with the Pilanesberg formation. A significant part of the eastern section of the study area also extends into the Pilanesberg range.



Figure 3-11: View from Vogelstruisnek site looking southeast, with westernmost ridges of Pilanesberg in the background



Figure 3-12: View from northernmost extent of Vlakfontein site, to the east and towards the Pilanesberg

The Pilanesberg ring complex which is the result of an ancient, extinct volcano is characterised by prominent, roughly concentric mountains and ridge lines, the closest of which are situated approximately 3 kilometres east of the Ruighoek mine.



Figure 3-13: The natural topography is predominantly rolling to flat, with isolated ridges and hills. The Pilanesberg is visible in the background

The flat plains are covered by various *Acacia* species and other woody species in varying densities. Due to the clay soils, most tree species are stunted. The deterioration (probably due to overgrazing) of the grass sward has caused an increase in coverage by the woody species, giving the area a 'low bush' character.

The hills are mostly covered with mixed bushveld tree species that appear to be in better condition than the vegetation on the plain. The combination of topographic relief and the healthy vegetation cover, gives the hills an aesthetic appeal that contributes positively to the sense of place of the area.

The project area is not characterised by prominent water features or drainage lines and runoff channels in the study area are more likely to be visually distinguished by the associated riparian vegetation and larger trees growing along them than by visible water. However, the Molobeng River that flows northwards some 2.5km west of the Vlakfontein/Groenfontein site has an incised and well-defined channel that is prominent in short-range views. This watercourse also has an extensive wetland area associated with it and is likely to be



inundated after heavy runoff events, which will create a much more prominent, albeit temporary visual element in the landscape.

The Vlakfontein/Groenfontein project area has been mined and partially rehabilitated in the past. The area is dominated by grasslands with a relatively sparse distribution of larger shrubs and trees. The vegetation cover becomes denser along the foothills of the Ruighoek mine ridge. Some agricultural activity and disturbance is also evident in the southern parts of the Vlakfontein site.

A number of mines and settlements occur in the area. The Ruighoek open cast chrome ore mine site contains rock stockpiles, mining shafts, tailings dams, workshops and other infrastructure. A staff village is situated amongst tall trees at the base of the hill to the immediate north of the mine.

The Horizon Chrome Mine is situated to the south of the Ruighoek mine and the settlement of Mabeleleng is located between these two mines. A larger settlement, Tlhatlhaganyane, is nestled at the base of the Pilanesberg hills to the south-east of Ruighoek mine. The R565 runs through this settlement.

To the east of Ruighoek are the impressive hills associated with the Pilanesberg National Park. These are the dominant natural feature in the area and can be seen from several kilometres away. Their obvious scenic beauty contributes greatly to the sense of place of the study area. The Pilanesberg National Park is a major tourist attraction and it has attracted some tourist activity along its edges.

The landscape has many redeeming aesthetic features, due primarily to its physical setting, which is dominated by the wooded hills of the Pilanesberg and the series of hills/koppies that protrude above the surrounding plain in a north-south alignment, west of the Pilanesberg.

The existing mines and settlement areas represent extensively transformed landscapes that retain little to none of their pre-existing sense of place and character. Accordingly, their visual resource value is low.

Whilst the 'untouched' hills and their side slopes are considered to have a high visual quality, the plains, where mining and settlement activities tend to dominate, have a moderate rating. The lower rating is as a consequence of the intrusive nature of these anthropogenic elements.

The overall visual quality of the study area is considered to be moderate to high, i.e. a landscape that exhibits some positive character but which has evidence of alteration/degradation/'erosion' of features resulting in areas of more mixed character. Such a landscape is potentially sensitive to change.

When one considers the strong sense of place that the overall landscape evokes, the aesthetic value of the study area could have tourism potential, but only in areas that do not have direct views of the mining activities and/or the settlements (Young, G., January 2007) and (Bothma, J., February 2012).

3.12 Sites of Archaeological and Cultural Significance

The Pilanesberg complex of mountains consists of an eroded circular alkaline volcanic structure, 1 250 million years old and comprising a 27 km diameter extinct volcano surrounded by six rings of mountains. This formation created a unique enclave that has hosted human occupation from the earliest times. During the Late Iron Age, access to the Pilanesberg was controlled by well-positioned and extensive settlements near the periphery of the circular mountain range, close to some of the entrances leading to the pathway-like valleys which criss-cross the central part of the Pilanesberg.

During the Late Iron Age numerous communities became established in large village complexes near and on the slopes and spurs of mountains and kopjes to the north, west and south of the Pilanesberg. Whilst Ga Ramoga and Moruleng on the north-eastern perimeter of the Pilanesberg were occupied by Kgatla communities, the Batlhako had already settled to the west of the Pilanesberg with the Tlokwa still further to the south at Marothodi and Pilwe. A mixed Tswana and Ndebele population occupied mountain sites such as Matone, Mogare, Phatswane and Mukukunupe further to the north-east.



The Late Iron Age farmers were followed by colonists in the second half of the 19th century, who continued a mixed farming existence until the land was expropriated during the 1970s for incorporation into the Bophuthatswana homeland.

Prospecting and later chrome mining became important activities on the farm Ruighoek 169 JP. The land was first leased to a prospector in the early 1940s. (van der Walt, J; du Preez, L; , November 2011).

During the early 20th century the western limb of the Merensky Reef was discovered and platinum mining commenced near Swartklip (Northam) and Rustenburg. Chrome ore mining also commenced to the north and to the west of the Pilanesberg. The impact of these early chrome mining activities can still be observed in the project area today.

The Pilanesberg National Park was opened in 1979 and covers a surface area of 500km². It contains examples of most southern African mammals and some 300 bird species. The central feature of the park is a man-made lake known as Mankwe on the river by the same name.

Sun City, on the edge of the Pilanesberg, was the first of several casinos and holiday resorts to be established soon after the Bophuthatswana homeland was granted independence in 1977. The complex incorporates the Superbowl, a huge concert area, four luxury hotels, including the Palace of the Lost City, as well as many sporting and gambling facilities and an artificial beach, the Valley of the Waves.

The Pilanesberg area is dominated by stone-walled sites that date from the Late Iron Age, some of which were occupied into the historical period. These sites are associated with Tswana groups such as the Tlhako, Kgatla Kgafêla, the Tlôkwa and Nguni-affiliated clans who were either living in the area from an earlier time before the Sotho-Tswana arrived, or who were descended from Mzilikazi's Ndebele who temporarily occupied settlement complexes in the area before they moved to the Zeerust-Marico in AD1832.

The Batlhako tribe, under Chief Batleng Ntuané, had an important presence in this area as early as the 1920s. Prospecting and later chrome mining became important activities on the farm Ruighoek 169 JP. The land was first leased to a prospector in the early 1940s. (van der Walt, J; du Preez, L; , November 2011).

The high-lying ridge to the west of the mining area on Ruighoek reportedly includes archaeological remains of previous inhabitants of the area and a number of graves may be expected in the vicinity of the project area.

3.13 Sensitive Landscapes

No areas of biophysical sensitivity, such as wetlands or threatened species habitats were identified during the various specialist studies conducted at the Ruighoek Chrome Mine for its approved EIA and EMP.

3.14 Socio-Economic

The study area is situated within the Bojanala District Municipality and the Moses Kotane Local Municipality in the North West Province, which had a quoted population of 3, 2 million in 2010 (<http://www.southafrica.info/about/geography/north-west.htm>).

The local municipality has a population of about 237 000 with 15% being economically active and 51% unemployed. The population makeup of the Ruighoek Mine area is 5% black, 95% white, and less than 1% coloured and Asian. The population in Tlhatlaganyane and Mabeleleng, the small towns closest to the Ruighoek site, are 100% black.

There are more males than females in the area, but a significant number of households are headed by females. There are large numbers of job seekers in the economically active age group who could supply the mining project with unskilled employment, but skilled workers are relatively scarce.

Only 15% of the residents in the Moses Kotane Local Municipality are employed, while 16% are officially listed as unemployed. This results in the majority of the population being dependent on the income generated by those that are employed, pensions, and other social grants. The high level of unemployment in the area results in high levels of crime and other social pathologies such as sexually transmitted diseases and substance abuse.



Most of the people living in the area have access to electricity. Only the households located within the Ruighoek Mine area use waterborne toilets connected to a sewage system. The majority of neighbouring residents still have a pit latrine with no ventilation. Piped water inside each dwelling is available only to residents living within the Ruighoek Mine area, with other areas mostly having access to a community tap.

The most prominent economic sectors in the Bojanala District Municipality are the wholesale and retail trade, and community, social and personal services. The main sectors in the Moses Kotane Local Municipality are community, social and personal services, and mining.

Currently, the Moses Kotane Local Municipality is undertaking several projects, including housing and related services aimed at upgrading the basic services and infrastructure in the area. The communities neighbouring the Ruighoek Mine present many opportunities for Corporate Social Investment programmes owing to high unemployment levels, high crime levels, low skills levels, and low levels of formal education, as well as poor housing and services in certain areas.

The surrounding areas outside the 500 m blasting buffer zone of Ruighoek Mine are used for small-scale agriculture and livestock farming. The people in the Ruighoek area speak mainly Setswana and Afrikaans. Mini-bus taxis represent the dominant mode of transport for the people of the region.

3.15 Summary of the Baseline Environmental Conditions

The following section summarises key aspects of the environment that may be affected by the proposed mining operations on Groenfontein 138 JP, Vlakfontein 164 JP and Vogelstruisnek 173 JP.

- The geology comprises pyroxenites of the Bushveld Complex with chromite seams;
- The project area is located within the western margin of a wide, flat valley which is bounded by a range of rugged hills to the west and the Pilanesberg Mountains to the east. The topographic fall is to the northeast;
- Potential sources of air pollution in the area include dust from mining operations, vehicle traffic on unpaved roads, household fuel combustion and veld fires;
- The Arcadia soil form, consisting of black swelling clays underlies most of the area;
- Land use in the surrounding area is generally grazing with limited areas devoted to crop cultivation;
- Land capability is arable (with low potential due to the requirement for intensive management) over Arcadia soils;
- The biodiversity of the area has been heavily impacted by human activities over an extended period of time;
- No Red Data flora or fauna species have been identified in the study area;
- Groundwater is limited to fractures in the pyroxenite bedrock. These fractures have a low hydraulic conductivity and are of minor significance as a groundwater resource due to poor yields and high Mg concentrations;
- The main sources of noise at Ruighoek are traffic on the R565 and noise from the Horizon Chrome Mine;
- The current noise climate does not exceed acceptable suburban residential standards;
- The visual quality of the area is moderate to high and is potentially sensitive to change; and
- No sensitive biophysical receptors were identified during the specialist studies.



The following receptors may be affected by the proposed project.

- Ruighoek mine village;
- Mabeleleng village;
- Tlhatlhaganyane village;
- Raborife village;
- The Pilanesberg Nature Reserve;
- Makgope village, approximately 7 km north of Ruighoek; and
- Two proposed eco-tourism lodges on the farm Zandspruit, which would be located about 6 km north-east of the Ruighoek mining operation.

4.0 MOTIVATION FOR THE POPOSED PROJECT AND ALTERNATIVES CONSIDERED

4.1 Background

Chromite ore and concentrates are used primarily in metallurgical applications such as the production of ferrochrome, which is a major input in the production of stainless steel. Other applications include refractories, foundry sands and chromium chemicals.

Despite the current economic crisis in the eurozone and a slowdown in the growth rate of the Chinese economy, the long term outlook for chrome remains good as it is closely linked to stainless steel production, which is expected to experience renewed growth in demand in the medium to long term.

Batlhako will seek to sell its product to ferrochrome producers, first within the local market and then on the export market, depending on market conditions. The proposed mining project is also expected to add value to the mineral resource by beneficiating the ore to higher value, non-metallurgical products such as foundry sands and chemical grade fines.

4.1.1 Chromite mining

A large percentage of the world's economically mineable chromite ore reserves are located in the Bushveld Complex, a saucer-shaped deposit in the northern part of South Africa. The complex is the largest known layered intrusion in the world. It stretches some 480km east-west and 240km north-south over the North West and Limpopo Provinces. Chromite ore is mined along the eastern and western rims of the complex, which has a surface area of about 66,000 km². The proposed mining project is located on the western rim of the Bushveld Complex.

4.2 Benefits of the Project

The positive aspects of the proposed mining project include the benefits of employment and income generation in the area as well as the development of BEE opportunities, during construction, operation and eventual closure and rehabilitation.

4.3 Alternatives Considered

In terms of Regulation 50 (d) of the MPRD Regulations R. 527 under the Mineral and Petroleum Resources Development Act, Act 28 of 2002, an environmental impact assessment report must include *inter alia* the following:

- “(d) *A comparative assessment of the identified land use and development alternatives and their potential environmental, social and cultural impacts.*”

Alternatives considered for the proposed project are as follows:



4.3.1 No-go alternative

If the chromite ore reserves on Groenfontein 138 JP, Vlakfontein 164 JP and Vogelstruisnek 173 JP are not mined, South Africa and the local communities will forego the benefits of the associated employment opportunities and revenue streams and the life of Batlhako's chrome ore mining activities in the area will be shortened.

The proposed mining areas were mined and re-vegetated about two decades ago. As discussed in section 3.6, their pre-mining agricultural potential was already medium to low and rehabilitated areas generally recover only some of their original potential over the medium term. Currently, their agricultural potential is still quite low and they are at best used for grazing.

4.3.2 Postponement of mining project

The above-mentioned chromite ore reserves could be left in the ground to be mined at a much later date, but if Batlhako Mining, who has applied for a mining right, does not pursue this project, Batlhako's rights will lapse and other parties would be free to pursue the right to mine these ore reserves. However, Batlhako already has an ore processing plant at Ruighoek and is in a position to process the ore mined on Groenfontein, Vlakfontein and Vogelstruisnek at lower cost than a party who would need to erect a new processing plant.

4.3.3 Underground mining

While it would be technically possible to extract the chromite ore from the abovementioned reserves by means of underground mining methods, it would be less safe and more expensive, to the point of non-viability.

5.0 ENVIRONMENTAL IMPACT ASSESSMENT

The proposed mining of the chromite ore reserves on Groenfontein 138 JP, Vlakfontein 164 JP and Vogelstruisnek 173 JP has the potential to impact on a range of biophysical and socio-economic aspects of the local environment.

One of the main purposes of the EIA process is to understand the significance of these potential impacts and to determine to what extent they can be minimised or mitigated. Based on experience with and past studies on the very similar mining operations Ruighoek 169 JP, the impacts on soils, surface water, groundwater, air quality, the ecology and the local socio-economic fabric can be readily predicted and appropriate mitigation measures can be formulated.

The EIA process for this project has been designed to comply with the requirements of the MPRDA and the MPRD Regulations R.527 promulgated on 23 April 2004. Cognisance has also been taken of the following key principles contained in the National Environmental Management Act (Act 107 of 1998) (NEMA), which is South Africa's framework environmental legislation:

- Sustainability – development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs;
- Mitigation hierarchy – avoidance of environmental impact, or where this is not possible, minimising the impact and remediating the impact; and
- The duty of care of developers towards the environment.

The assessment of the impacts of Batlhako's proposed mining operations on Groenfontein, Vlakfontein and Vogelstruisnek will be conducted in accordance with these principles.



Based on the findings of the EIA, a comprehensive Environmental Management Programme (EMP) will be developed and implemented to control and minimise the impacts during construction, operation and decommissioning of the proposed mines.

5.1 Plan of study for impact assessment

The impact assessment component of the EIA is subdivided into several specialist fields of study. Once completed, the findings of the specialist studies will be integrated. The significance of the impacts will be assessed in terms of the methodology described in section 5.2.

The terms of reference of the specialist investigations to be conducted during the impact assessment phase are set out below. The description is presented in fairly general terms, but all the issues that need to be addressed by the studies are captured.

5.1.1 Groundwater

When developing a mine plan, some of the most important requirements with regard to groundwater are to:

- Assess the extent to which groundwater flow into the mine workings may affect the safety and efficiency of the mining operations;
- Identify local groundwater users and determine their dependence on the groundwater resource;
- Determine the pre-project (baseline) groundwater quality;
- Assess the potential impact of the proposed mining operations on the groundwater quality and yield; and
- Develop an appropriate dewatering plan that will provide safe working conditions while minimising any adverse effects on groundwater quality and groundwater users in the vicinity of the mine.

A groundwater investigation for a planned opencast mining operation would normally encompass the following:

- Hydrocensus of existing boreholes in the area;
- Review of existing groundwater information;
- Geophysical survey to establish suitable locations for monitoring boreholes and such dewatering boreholes as may be required;
- Sampling and pump-testing of boreholes to characterise the groundwater regime;
- Assessing the impacts of the proposed mining operations on the groundwater regime;
- Formulating appropriate mitigation measures.

5.1.2 Surface hydrology

The surface water study will be designed for compliance with Regulation 704 under the National Water Act (Act 36 of 1998) (NWA) and will encompass the following:

- Recording baseline information about local surface water bodies in terms of water quality, flow rate and water use;
- Determining the quantity and quality of runoff from the proposed mining areas for rainfall events with 50 year and 100 year recurrence intervals to properly size and design stormwater control measures;
- Delineating clean and dirty areas on the site;



- Determining the site water balance and identifying opportunities for recycling runoff from the dirty water collection areas to the mining process;
- Making recommendations to minimise potential impacts on the environment and ensure compliance with all regulatory requirements;
- Sizing of any dirty water collection and impoundment systems that may be required;
- Development of a programme for monitoring of the surface water quality; and
- Establishing whether Batlhako Mining will need a water use licence in terms of Section 21 of the National Water Act.

5.1.3 Air Quality

The proposed opencast mining operations will cause particulate emissions to atmosphere through drilling, blasting, overburden stripping and stockpiling, and ore loading, hauling and delivery to the processing plant at the Ruighoek mine. Such particulate emissions will lead to increased dust fall in areas adjacent to the mining operations and haul roads and increased atmospheric concentrations of PM₁₀ further afield.

If a dirty water collection and impoundment system is necessary, the construction thereof will involve earthmoving activities to remediate contaminated areas, preparation of the areas where construction is required, undertaking of excavations for the stormwater collection and impoundment systems and construction of the required containment systems. Such operations also have the potential for significant dust generation.

The eventual closure and rehabilitation activities will involve excavating and removing any contaminated soil, demolishing redundant infrastructure, scarifying and revegetating exposed compacted areas and would have dust generation impacts similar to those of the construction phase.

Recommendations for dust control measures will be provided in the impact assessment report.

5.1.4 Ecology

The proposed mining areas have been disturbed by past agricultural, livestock grazing and mining activities. An ecologist with good knowledge of the adjacent areas, where ecological studies have been undertaken for the Ruighoek Mine, will undertake an ecological survey of the areas that will be affected by the proposed mining activities. The study will include an assessment of the existing ecological conditions, the impacts that would result from the mining activities and recommended mitigation measures.

5.1.5 Visual Impact

The visual impact assessment will describe the pre-project visual characteristics of the proposed mining areas, assess the visual impacts of the mining and ore hauling operations and propose appropriate mitigation measures, bearing in mind the tourist traffic through the area.

5.1.6 Noise

The noise specialist will undertake measurements to characterize the pre-project daytime and nighttime noise levels at existing sensitive receptor points, followed by an assessment of predicted noise levels at the perimeter of each opencast mine, along the haul roads to Ruighoek and at the sensitive receptor points. Vibration levels due to blasting and their potential impacts at sensitive receptor points will be assessed. Appropriate mitigation measures will be formulated.



5.1.7 Cultural and Heritage Resources

As required in terms of Section 38 of the National Heritage Resources Act 25 of 1999 (NHRA), the South African Heritage Resources Agency (SAHRA) will be notified of the intended development and informed that a Phase I Heritage Impact Assessment (HIA) will be undertaken on the areas that will be affected by the mining operations. The HIA will involve a desktop study of available literature on the area, followed by a field survey by off-road vehicle and on foot to:

- Determine whether there are any cultural or heritage resources on the surface as defined in the NHRA;
- Assess the impact of the proposed project on any such resources;
- Recommend appropriate mitigation measures.

5.1.8 Soils, Land Capability and Land Use:

This study will be undertaken over the areas that will be affected by the proposed mining activities and will encompass the following:

- Sampling of topsoil and sub-soils will be done on a 200 m X 200 m grid to a maximum depth of 1,5m by means of a 100mm diameter hand driven steel auger;
- Soil classification will be done in accordance with the Taxonomic Soil Classification System for South Africa, 1991 and a map of the soil types, land use and land capability will be compiled on a 1:10 000 scale;
- Samples will be analysed for pH, phosphorus (Bray 1) and exchangeable cations;
- The erodibility of the soils (*i.e.* exchangeable sodium percentage exceeding 15% of the cation exchange capacity) will be determined;
- If any wetland soils are found, the samples will be submitted to a wetland specialist and wetlands will be delineated;
- The impacts of the proposed mining project on the soils, land use and land capability will be assessed and rated in terms of significance and reversibility;
- Compilation of a soil utilisation guide and plan (stripping & stockpiling); and
- Mitigation and rehabilitation measures will be developed for incorporation into the EMP.

5.1.9 Socio-economics:

The current socio-economic fabric of the Moses Kotane Local Municipality, with special reference to the Mankwe Magisterial District, will be described. Information on the capital cost (local and imported) and the estimated local spend on remuneration, goods and services will be used to assess the socio-economic impact of the proposed project on relevant socio-economic characteristics of the area such as the population demographics, number of employment opportunities, number of unemployed and Gross Geographical Product. Recommendations for mitigation of adverse impacts and enhancement of positive effects will be provided.

5.2 Impact Assessment Methodology

The significance of the identified impacts will be determined using the approach outlined below (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows:



Occurrence		Severity	
Probability of occurrence	Duration of occurrence	Scale / extent of impact	Magnitude (severity) of impact

To assess each of these factors for each impact, the following four ranking scales are used:

Probability	Duration
5 - Definite/don't know	5 - Permanent
4 - Highly probable	4 - Long-term
3 - Medium probability	3 - Medium-term (8-15 years)
2 - Low probability	2 - Short-term (0-7 years) (impact ceases after the operational life of the activity)
1 - Improbable	1 – Immediate
0 - None	
SCALE	MAGNITUDE
5 - International	10 - Very high/don't know
4 - National	8 - High
3 - Regional	6 - Moderate
2 - Local	4 - Low
1 - Site only	2 - Minor
0 - None	

Once these factors are ranked for each impact, the significance of the two aspects, occurrence and severity, is assessed using the following formula:

$$\text{SP (significance points)} = (\text{magnitude} + \text{duration} + \text{scale}) \times \text{probability}$$

The maximum value is 100 significance points (SP). The impact significance will then be rated as follows:

SP >75	Indicates high environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 – 75	Indicates moderate environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates low environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	Positive impact	An impact that constitutes an improvement over pre-project conditions



5.3 Summary of issues already identified

Batlhako Mining and the EIA team have identified the following potential issues:

- Dewatering of the open cast mining pits will be necessary and will be done by pumping collected seepage out of the pits and/or abstracting groundwater by means of strategically placed boreholes. Dewatering will create a cone of depression around the opencast areas, within which a lowering of the groundwater table will be experienced, which could potentially impact on local groundwater users;
- Ingress of surface runoff into the open cast pits could interfere with operations and runoff from disturbed areas could cause erosion and transport silt into natural drainage lines;
- Under dry conditions, mining operations such as ground clearing, drilling, blasting, and loading and hauling of ore will mobilise particulates, which could impact on local air quality;
- Vegetation clearing of the areas to be mined and topsoil stripping will have ecological impacts and will affect the soils, land use and land capability within these areas;
- The proposed mining operations will have localised visual, noise and socio-economic impacts; and
- Although mining operations will take place on areas that were previously mined and rehabilitated, the possibility of affecting local cultural and heritage resources cannot be ruled out.

The issues identified by stakeholders during the public review period can be summarised as follows:

- Air quality – I&APS wanted to know about potential cumulative effects of additional mining activities in the area and potential health effects of the smelters about 50 km to the south-east. They also wanted to know whether air quality monitoring was being done in the project area;
- Availability and quality of water for use by livestock;
- Lack of fences exposes livestock to theft and danger of injury if they wander onto roads and into mining areas;
- Potential loss of grazing areas;
- Possible impacts to cultural and heritage resources within the project area;
- Potential impacts of blasting on local villages;
- I&APs enquired whether there are any rare or endangered species in the project area;
- Involvement of church-based organisations, schools, traditional leaders and community organisations in the public participation process and wider announcement of the process by means of local newspapers, flyers and local radio stations;
- Involvement of local people via employment, consultation and participation in the Social and Labour Plan;
- Educating of local people on environmental matters and operating sustainable projects;
- Concerns about mining operations encroaching onto villages and land owned by local people;
- The condition of the roads in the area; and
- Rehabilitation of mined areas to make them safe for people and animals.



These issues have been captured in a Comments and Response Report (CRR), which is attached as APPENDIX F. Stakeholder consultation is an ongoing process throughout the EIA and additional issues and concerns might be identified as the project progresses.

5.4 Project Phases and Activities

The environmental impacts of the project were assessed for the:

- Construction phase;
- Operational phase; and
- Closure and rehabilitation phase.

Potential cumulative impacts were also identified and assessed for each component, where applicable.

5.4.1 Construction

The **Construction Phase** marks the beginning of physical changes to the site. During this phase:

- Surveying and pegging out will take place of the areas where construction of roads and diesel storage facilities are to take place and where opencast mining will commence;
- Vegetation will be stripped from areas where construction work will take place and where mining will commence;
- The diesel storage facility will be built; and
- Haul roads will be built or upgraded.

It is anticipated that the construction phase will take approximately 2 to 3 months to complete.

5.4.2 Operation

During the **Operational Phase**:

- Opencast mining will commence and continue until all the economically viable chromite ore has been mined;
- Drilling and blasting will take place within the proposed open cast footprints;
- Vegetation will be stripped ahead of the advancing mining front;
- Topsoil, subsoil and overburden will be temporarily stockpiled;
- The roll-over mining method will be followed, during which continuous rehabilitation will take place as the mining front advances, by placing overburden, subsoil and topsoil sequentially in the mining voids, and re-vegetating the backfilled areas with locally indigenous plants; and
- The chromite ore will be road-hauled to the existing ore-dressing plant at Ruighoek.

The operational phase of the Project will continue for as long as the chromite mining operation remains economically viable, which is currently expected to be about 2 to 3 years for each of the three mining areas..

5.4.3 Closure and rehabilitation

The activities during the **Closure and rehabilitation Phase** will include:

- Dismantling of the diesel storage facilities, demolition of the concrete works and disposal of the rubble;



- Ripping of compacted areas, shaping them to be free-draining and re-vegetating them with locally indigenous plants; and
- Monitoring the vegetation, surface water and groundwater until rehabilitation targets have been achieved.

6.0 FINDINGS OF THE ENVIRONMENTAL IMPACT ASSESSMENT STUDIES

6.1 Geology

6.1.1 Construction

The construction phase will be confined to the surface of the mining right area and will have no impact on the existing geological regime (**SP = 0**).

Operation

To minimise the size of the opencast pit at any given time and to limit the deterioration in the quality of the topsoil associated with its storage, the rollover mining method will be followed.

The topsoil, subsoil and overburden from the first cut will be removed and stockpiled at the far end of the intended mining area. Thereafter, as the mining front advances, topsoil and subsoil will be removed and temporarily stored adjacent to the opencast mine, overburden will be removed and used to backfill the void immediately behind the moving opencast mine, following which the subsoil and topsoil will be placed on top of the backfilled overburden and re-vegetated. The economically viable chromite ore will be removed and hauled to the processing plant at Ruighoek.

The disturbance of the topsoil, subsoil and overburden will be temporary, but the removal of the ore will be permanent.

Incorrect or careless application of the rollover mining method could have an impact of **high (SP = 85)** significance on the geological regime. The following mitigation measures are recommended to reduce the impact to one of **moderate (SP = 60)** significance:

Careful stripping and separate storing of topsoil to avoid mixing with subsoil;

Strip and store subsoil separately from overburden and avoid mixing;

When backfilling the mining void, place overburden first, level, place subsoil, level, then place topsoil and shape to be free-draining.

Closure and rehabilitation

Filling of the last-mined void will result in the displacement of the first-mined topsoil, subsoil and overburden material from its original position at the first cut. Incorrect closure procedures could have an impact of **moderate (SP = 65)** significance, which can be mitigated to one of **moderate (SP = 50)** significance by placing and levelling the overburden first, then the subsoil and finally the topsoil.

Groundwater

Delta-H Water Systems Modelling Pty Ltd (Delta H) have developed a site-specific numerical groundwater flow and contaminant transport model (Witthüser, K; Holland, M;., May 2012) based on hydrogeological information available from earlier investigations (Golder, May 2007) and (Brink, D; Canahai, G;., February 2012).

The numerical model was used to estimate potential groundwater inflows into the proposed opencast mine workings and predict the extent of impact from dewatering, while taking into consideration the proposed expansion of the open cast workings on the adjacent farm, Ruighoek.



The confidence level of the model predictions is commensurate with the limited monitoring information and aquifer test data that is currently available. As indicated in section 6.2.4, mining of the proposed target areas will not commence before 2015. It is recommended that monitoring and dewatering boreholes be drilled in appropriate locations, as determined by a geophysical investigation, before mining commences, that the model be recalibrated after pumping tests and that the modelling exercise be repeated.

Several east-west striking fault zones occur to the south of the project area. A major north-south trending fault, the Frank Fault, is situated in the low-lying central sector of Ruighoek. This 150 m fault on the farm Ruighoek has a downthrow to the east and the rocks to the east dip at approximately 45°. Rocks containing the Middle and Upper Group chromitite layers are exposed in and around the Motlhabe riverbed and are severely disrupted by the Frank fault zone.

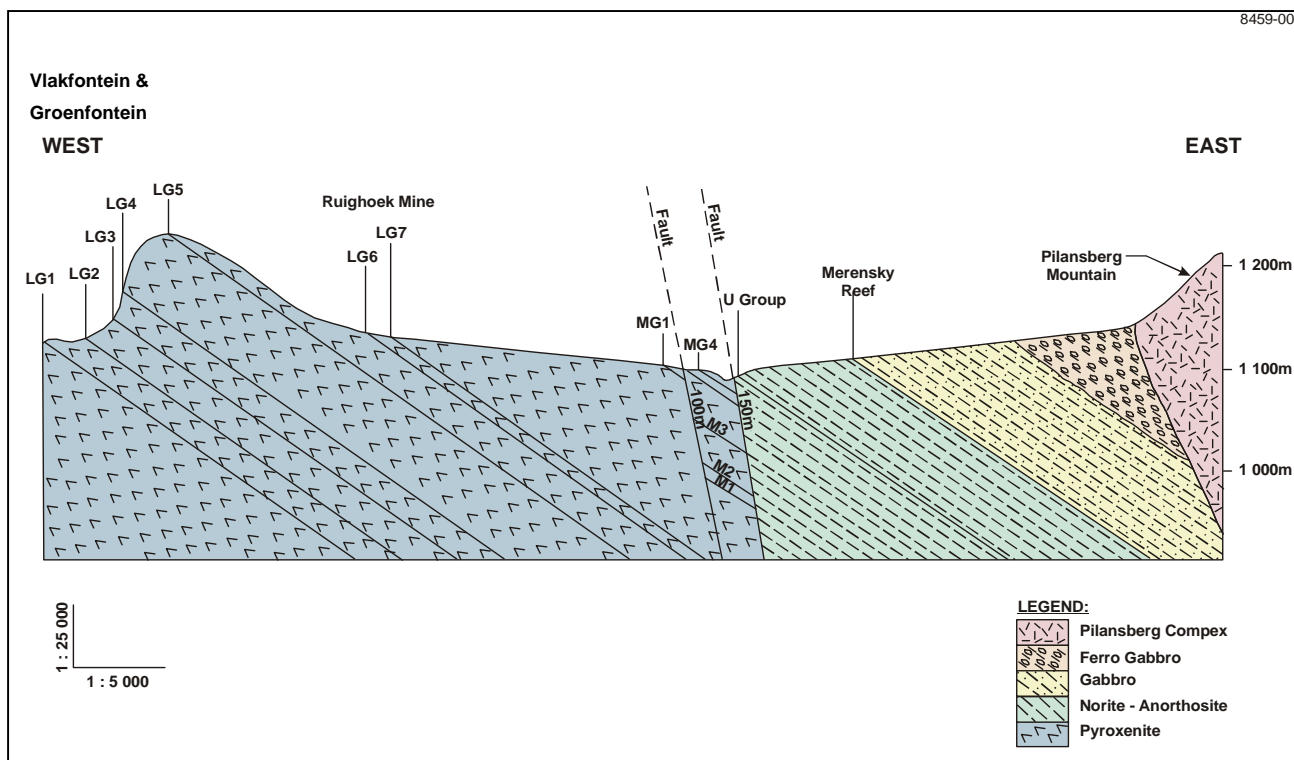


Figure 6-1: West-east cross-section through the Rustenburg Layered Suit at Vlakfontein, Groenfontein and Ruighoek

A piezometric map of the project area, showing groundwater levels, was drawn up from available hydrocensus information and is shown in Figure 6-2. The levels correlate well with the surface topography, and groundwater flows from higher lying ground towards lower lying springs or valleys where it accumulates or surfaces in the alluvial and hill wash deposits.

The software code chosen for the numerical finite-element modelling work was the 3D groundwater flow model SPRING, which was developed by the delta h Ingenieurgesellschaft mbH in Germany, and is widely accepted by environmental scientists and associated professionals.

Groundwater flow was modelled in the upper weathered zone (layer I, 30m thick), and the deeper fractured aquifer (layer II, 120metres thick). The top elevation of the uppermost layer was based on a 50m x 50m digital elevation model for the area. The horizontal model boundaries coincide with surface water courses or surface water catchment boundaries.

The mean annual precipitation (MAP) is 645 mm and the regional recharge rate is estimated at 4.5% of the MAP or 29 mm per annum.





6.1.2 Construction

The construction activities described in section 5.4.1 have the potential for spillage of fuel, lubricants, hydraulic fluids and cement, which could then migrate into the groundwater, resulting in an impact of **moderate (SP = 40)** significance.

The following mitigation measures are recommended:

- The clean water diversion berms, the dirty water collection channels and the stormwater impoundment/pollution control dam should be the first items to be constructed;
- Maintenance of construction vehicles to be undertaken in proper workshops, not in the field;
- Drip trays to be placed underneath vehicles when parked;
- If refuelling is done in the field, from a tanker, a spill kit and appropriately trained personnel must be available at the construction site;
- Hazardous materials must be contained within appropriately secured and bunded areas and their material safety data sheets must be available on site; and
- All spillages must be cleaned up immediately and the contaminated soil must be disposed of at an appropriately licensed site.

These mitigation measures are expected to reduce the groundwater impact to one of **very low (SP = 8)** significance.

6.1.3 Operation

The groundwater model was used to estimate the steady-state pit inflow rates shown in Table 6-1.

Table 6-1: Estimated groundwater flowrates into proposed opencast pits

Open Cast	Mine Inflows	
	ℓ/s	m ³ /d
Pit North-West (Groenfontein)	1.9	170
Pit West (Vlakfontein)	4.7	408
Pit South (Vogelstruisnek)	11.2	967

Groundwater inflows into mining voids are caused by the excavation method and other disturbances of the natural aquifer system (e.g. compaction), and are difficult to predict based on the hydraulic properties of the undisturbed aquifer system. The model predictions should therefore be verified once initial pit inflow rates and more monitoring data become available. Predicted inflow rates for later years of mine development can be improved significantly by observation data from earlier years and subsequent updates of the groundwater model.

Assuming re-use or other environmentally acceptable disposal practices of the groundwater entering the pits, the environmental impacts associated with the pit inflows are primarily associated with:

- Partial dewatering of the aquifer in the vicinity of the mine and subsequent impacts on groundwater users or groundwater dependant eco-systems.
- Interception of ambient groundwater flow, which would have discharged into the alluvial aquifers under natural conditions, provided baseflow to the rivers, or contributed to deeper regional groundwater flow.



The simulated impacts of the partial dewatering of the aquifer due to pit inflows are depicted in Figure 6-3 as contours of drawdown from the pre-mining groundwater table in metres, i.e. the lowering of the water table due to the proposed mining operations. The contour classes were chosen to differentiate the severity of associated impacts:

- 2 – 5 m drawdown – Minor to moderate impact.
- 5 – 10 m drawdown – Significant impact.
- >10 m drawdown – Severe impact.

The extent of the zone of impact of the proposed Groenfontein and Vlakfontein pits is ~ 1.2 km north and ~ 2.7 km west, while the cumulative impacts from the Ruighoek open cast pits extend to ~ 2.2 km east of the proposed mining areas. The extent of impact from the pit dewatering for the proposed Vogelstruisnek open cast mine extends for an approximate 2 km radius. The zone of influence of the dewatering cones will be limited by the topography. Along the hills and slopes between the mining areas (Ruighoek and Vlakfontein) the drawdown cone is restricted due to the limited extent of the vertical aquifer.

Yields of water supply boreholes located within the immediate vicinity zone of the open cast pits could be negatively impacted and some may dry up during the life of mine. Two rural villages namely Modimong and Mologane are located east and west of the proposed open cast mine on Vogelstruisnek respectively and may be affected by the dewatering of the pits, as it is expected that these villages are partially dependant on water supply from boreholes, although this has not been verified.

It is expected that the potential impacts of the pit inflows on the regional groundwater flow and groundwater contribution to baseflow are:

- Highly likely to occur.
- Widespread and will impact beyond the site boundaries.
- Minor to moderate reduction of BH yields depending on location.
- Reversible over time once pit dewatering stops.
- Of minor to moderate severity with a drawdown of the water table in the vicinity of the mine and a partial loss of baseflow for affected river courses (Motlhaba River).

The impact on groundwater during the operational phase is assessed as being of **moderate (SP = 56)** significance.

The following measures are recommended to reduce the assessed impact to one of lower, but still **moderate (SP = 48)** significance:

- Initiation of a regional hydrocensus to establish water levels and groundwater users in the vicinity of the mining area.
- Installation and testing of groundwater monitoring boreholes around the proposed pit areas and along the Motlhaba River. While the boreholes around the pit areas must extend at least to 10 metres below the pit bottom, the borehole depths along the river can be limited to 30 metres.
- Initiation of a ground- and surface water monitoring system with monthly monitoring of groundwater levels and quarterly groundwater sampling intervals including full chemical analyses (all major constituents and trace elements of concern, especially all nitrogen species).
- A standard operating procedure for water level monitoring and water sampling should be developed according to best practice (e.g. filters and acidifiers on site for metal analyses, purge boreholes prior to sampling).
- Initiation of additional hydraulic testing of the aquifers to assess aquifer parameters and enable more accurate model calibration with subsequent reduction in model uncertainty.
- Annual review of the model predictions and model update if required.

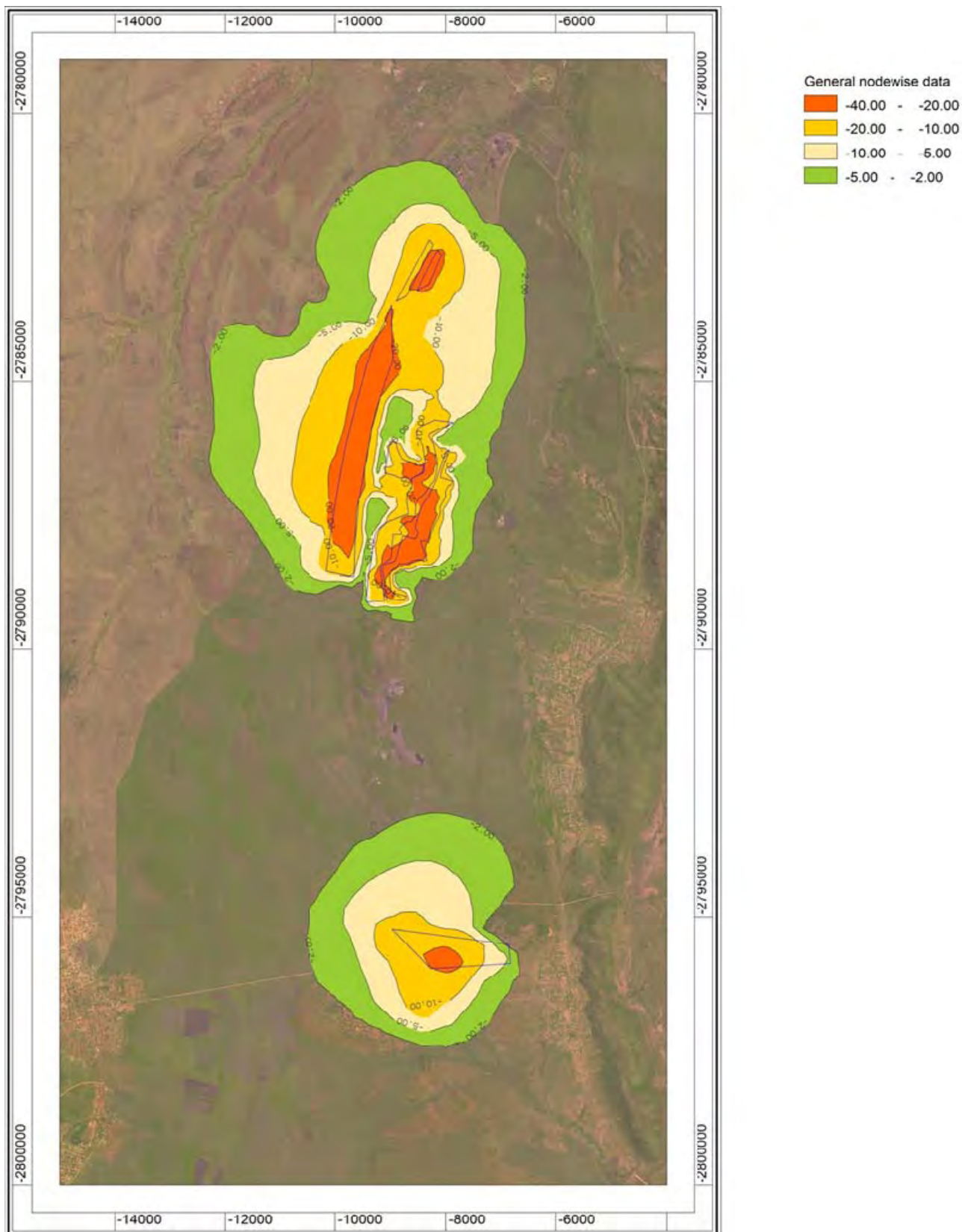


Figure 6-3: Simulated dewatering cones near Ruighoek pit and proposed Groenfontein, Vlakfontein and Vogelstruisnek pits.



6.1.4 Closure and rehabilitation

As mentioned in section 6.2.6.3, the ore and tailings at the Ruighoek mine showed no evidence of acid mine drainage. If this is verified by tests on the ore to be mined on Groenfontein, Vlakfontein and Vogelstruisnek and by field observations over time, the closure and rehabilitation activities will have a similar impact to those expected for the construction phase. The impact is therefore assessed as having **moderate (SP = 40)** significance before mitigation and **very low (SP = 8)** significance if the following mitigation measures are implemented:

- Maintenance of vehicles to be undertaken in proper workshops, not in the field;
- Drip trays to be placed underneath vehicles when parked;
- If refuelling is done in the field, from a tanker, a spill kit and appropriately trained personnel must be available at the construction site; and
- All spillages must be cleaned up immediately and the contaminated soil must be disposed of at an appropriately licensed site.

6.2 Surface hydrology

The surface water study was undertaken to characterise the pre-project surface water regime at the proposed mining areas and to develop a high level water balance for the opencast mining operations (Burse & Coleman, May 2012).

The project area is located east of the town of Mabieskraal in the North West Province. The study area falls within the two quaternary catchments A24D and partially A22F in the Croc (West) and Marico Water Management Area (WMA) (See Figure 6-4). A24D is drained by the Kolobeng and further downstream by the Bofule Rivers. A22F is drained by the Sandspruit and Mankwe Rivers, which flow into the Elands River. The Kolobeng River flows closest to the site in a northerly direction towards Zwartklip. The Bofule River flows to the north east of the project area and ultimately into the Crocodile River. The Mothlabe River flows northwards past the eastern side of the project area before joining the Kolobeng River.

Extensive portions of the exploration rights area are developed urban areas. The village of Makgope is located within the northern boundary area on Groenfontein and Vlakfontein. Large parts of Vogelstruisnek are built up, including the communities of Witrandjie and Maologane. Recent expansion of the villages is evident. The streams close to these urban developments are used by the communities for washing clothes and watering livestock.

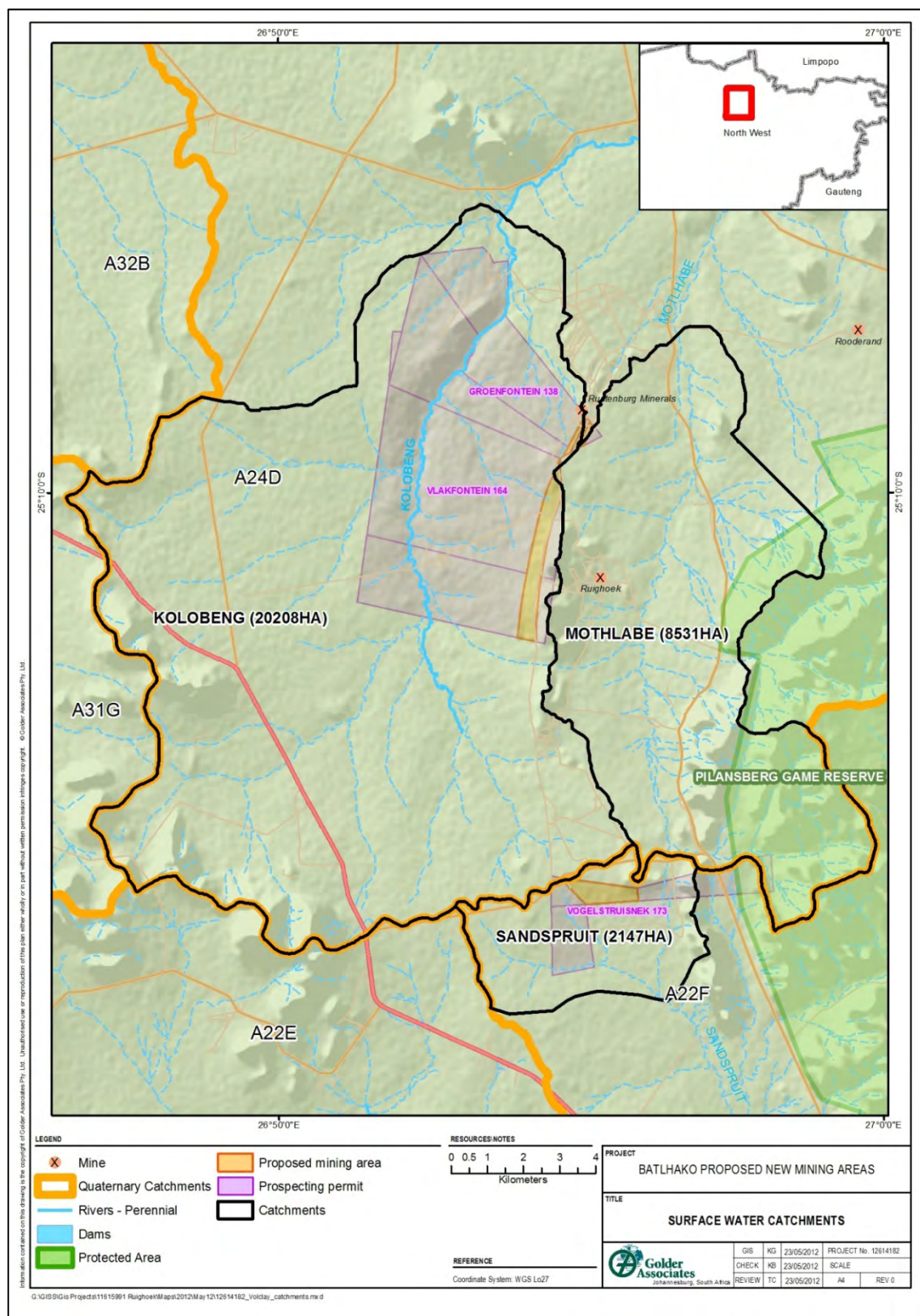


Figure 6-4: Location of quaternary catchments and streams crossing the project area



6.2.1 Rainfall

Rainfall data was extracted from the Pilanesberg rainfall station (0548165_W (POL)) data due to its proximity, long rainfall record and low percentage of patched data. The record extends from January 1904 to April 2012, of which 20.5% is patched. The annual rainfall for station Pilanesberg (POL) is 594.3 mm. The average monthly rainfall and the number of rain days per month for the station are given in Table 6-2.

Table 6-2: Rainfall data for Pilanesberg 0548165 W (POL)

Month	Average Monthly Rainfall (mm)	Number of rain days
Jan	118.4	8.7
Feb	93.5	6.8
Mar	83.6	6.3
Apr	34.4	3.3
May	14.2	1.5
Jun	5.6	0.6
Jul	3.9	0.4
Aug	6.8	0.6
Sep	11.5	1.3
Oct	46.9	4.3
Nov	75.1	6.6
Dec	100.4	7.5
YEAR	594.3	48.0

The 24-hour storm rainfall depths in Table 6-3 below for the 1:2, 1:5, 1:10, 1:20, 1:50, 1:100 and 1:200-year recurrence intervals were calculated from the database using the Design Rainfall Estimation Programme from the five closest rainfall stations.

Table 6-3: Computed 24 Hour Storm Rainfall Depths (mm)

Return Period (years)	1:2	1:5	1:10	1:20	1:50	1:100	1:200
Rainfall Depth (mm)	67.2	91.2	108.5	126.1	150.8	170.7	191.8

6.2.2 Flow

The Mean Annual Runoff (MAR) data for the Kolobeng, Mothlabe and Sandspruit Rivers was gathered using the Surface Water Resources of South Africa 1990 reports (WRC, 1990). The data for this quaternary catchment was used to calculate the runoff for the individual catchments by area weighting and the average monthly flow rates for these rivers are given in Table 6-4.

Table 6-4: Average monthly flow rates (million m³)

Catchment	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kolobeng River	0.591	0.611	0.392	0.185	0.066	0.034	0.027	0.021	0.017	0.042	0.148	0.292
Mothlabe River	0.250	0.258	0.166	0.078	0.028	0.014	0.011	0.009	0.007	0.018	0.062	0.123
Sandspruit	0.066	0.082	0.070	0.035	0.013	0.008	0.006	0.004	0.004	0.006	0.015	0.034



6.2.3 Water Quality

Water quality data was obtained from the two water quality monitoring sites that are available on the Department of Water Affairs (DWA) Water Management System database, namely:

- WMS A24_189038 at Rhenosterkraal, where the road crosses the Kolobeng River 21.5 km downstream of the study area in A24D; and
- WMS A22_184796 at the Sandspruit inlet to the Elands River, 21.8 km downstream of the study area in A22F

The values were compared to the South African Water Quality Guidelines for Domestic Use (1996) and values that exceed these guidelines are highlighted in Table 6-5. No values exceeding the Target Water Quality Requirement (TWQR) for domestic use were observed at the downstream monitoring site WMS A24_189038. At WMS A22_184796 the Ca and Mg values exceeded the TWQR, but still fell within the acceptable range for domestic use. However, fluoride concentrations were unacceptably high.



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Table 6-5: Water quality data at DWA monitoring points (June 2006)

Parameters	Units	WMS A24_189038	WMS A22_184796			SA Water Quality Guidelines			
			5 th Percentile	50 th Percentile	95 th Percentile	TWQR	Acceptable	Tolerable	Unacceptable
Electrical Conductivity	mS/m	14.6	29.4	62.2	67.6	70	150	370	520
pH	-	7.647	8.3	8.6	8.7	6 to 9	-	-	-
Na	mg/l	6.303	20.8	45.2	53.2	100	200	400	>400
K	mg/l	1.017	2.0	2.5	3.4	<50	50	100	>100
Ca	mg/l	11.778	16.5	39.4	57.5	32	80	>80	
Mg	mg/l	7.111	12.0	33.2	36.6	30	50	70	>70
Cl	mg/l	4.908	5.0	10.6	12.2	100	200	600	>600
SO4	mg/l	2	7.7	10.4	13.5	200	-	400	-
Alkalinity	mg/l of CaCO3	54.388	136.1	315.2	368.4	-	-	-	-
F	mg/l	0.128	1.94	2.38	2.65	0.7	1	1.5	>1.5
PO4	mg/l	0.068	0.013	0.020	0.038	-	-	-	-
Nitrate	mg/l	0.04	0.031	0.042	0.189	6	10	20	>20
NH4	mg/l	0.046	0.020	0.135	0.629	1	2	10	>10
Si	mg/l	7.703	0.017	0.041	0.077	-	-	-	-
SAR	-	0.358	7.0	14.0	16.3	-	-	-	-



6.2.4 High level dynamic water balance

A preliminary, high level dynamic water balance to estimate pit water make was developed from the limited available data. It should be updated prior to the commencement of mining. Figure 6-5 shows a schematic of the water circuits on the mine which were modelled in the water balance.

The mine water circuit will consist of the following facilities:

- **The Groenfontein and Vlakfontein opencast pits:** Dewatering by abstraction of groundwater and water entering the pits will take place into the proposed northern Pollution Control Dam (PCD). The abstracted water will be used for dust suppression and possibly potable water, depending on its quality.
- **Northern PCD:** The northern PCD will receive water from the northern pits. This dam will be designed according to GN 704 requirements, which specify such that it must not spill more than once in 50 years;
- **The Vogelstruisnek opencast pit:** Dewatering by abstraction of groundwater and water entering the pits will take place into the proposed southern PCD. The abstracted water will be used for dust suppression and possibly potable water, depending on its quality.;
- **Southern PCD:** The southern PCD will receive water from the southern pit. This dam will also be designed according to GN 704 requirements, which specify such that it must not spill more than once in 50 years.

Minimising the potential for surface water and groundwater contamination caused by mining activities requires careful planning and operation of mine water infrastructure.

The water balance model was built using GoldSim, which has the capacity to carry out dynamic probabilistic simulations. Deterministic models typically use averaged values of system variables and do not usually account for extreme meteorological events, which may have direct implications for water supply and disposal, and quite often determine important design requirements during the design and approval processes.

GoldSim allows the user to simulate different rainfall sequences, and to explore how these can affect the water balance. The magnitude of extreme meteorological events is as important as the timing at which they occur. While a proper monitoring system provides a good knowledge of what has happened in the past, it cannot predict what will happen in the future. The model can test and simulate future events and their associated risks.

A daily probabilistic water balance model was built to:

- Gain an understanding of the dynamics of the various circuits;
- Estimate runoff, seepage and average daily flows between all the components that make up the site water circuits;
- Calculate dam levels, spillage frequencies and spillage volumes for various rainfall scenarios; and
- Optimise operating rules for the water circuits.

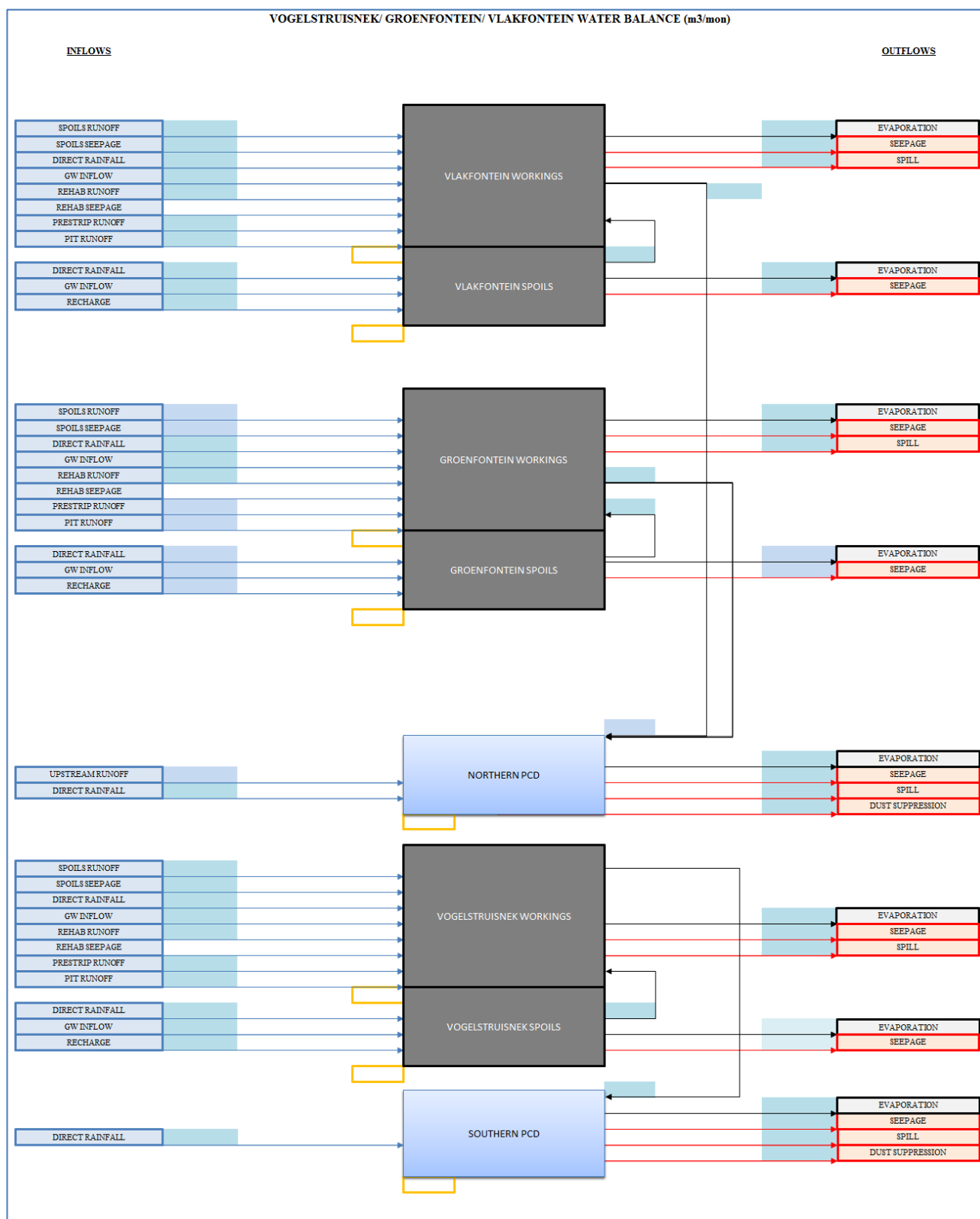


Figure 6-5: Water Schematic for Groenfontein, Vlakfontein And Vogelstruisnek pits



The following data/information about the proposed mining operation was taken into account in developing the water balance:

- The proposed mining areas on Groenfontein, Vlakfontein and Vogelstruisnek will be mined sequentially;
- Life of mine for the various pits:
 - *Groenfontein*: 2 years, 2015 – 2017 at a production rate of 100,000 tonnes per annum (tpa);
 - *Vlakfontein*: 3 years, 2018 – 2020 at a production rate of 100,000 tonnes per annum (tpa);
 - *Vogelstruisnek*: 2 years, 2021 – 2023 at a production rate of 100,000 tonnes per annum (tpa).
- The areas of the pits are as follows:
 - *Groenfontein*: 13.4 and 9.3 ha;
 - *Vlakfontein*: 195.4 ha;
 - *Vogelstruisnek*: 93.4 ha.
- At the Ruighoek mine the ore is dry to a depth of about 30 m and then it can become wet. After it has rained there is normally water in the pit;
- An estimated 70 m³ of water will be required daily at each site for dust suppression. If no water is available at the site, it will be hauled from Ruighoek;
- Potable water will be supplied from Ruighoek, at a rate of 100 litres per day;
- The box cut will have a dimension of 50 m wide x 80 m long, from 10 m down to 25 m deep;
- All this material will be stockpiled on the end of the mining area to be placed back into the final void;
- Pre-stripping will be double the size of the box cut; and
- The opencast void will be backfilled as the pit progresses.

The model was run for 100 simulations and modelled water balance results were produced for the three proposed mining areas as follows:

- Adequate pit dewatering will be achieved with a pumping capacity of 60 l/s;
- The rehabilitated mining voids are likely to decant within the timeframes indicated in Table 6-6. This water is likely to require pumping and treatment;
- The Northern and Southern PCDs are sized to a volume of 800,000 m³ to ensure adequate capacity for dewatering of the pits and to meet the spilling criteria. The dam capacity was sized to comply with Regulation 704, i.e. spilling with a frequency of less than 1 in 50 years' recurrence interval;
- In the model both of the dams are assumed to be constructed prior to mining (2015). The Southern PCD could be constructed later;
- Water balance modelling is an on-going process. Calibration should be carried out as flows and water uses are monitored and knowledge of the system is improved. This should improve the overall water balance;
- An automatic weather station should be installed and maintained such that data is accurately recorded at the mine.



Table 6-6: Estimated date and volume of decant from rehabilitated mining areas

Pit	Window of potential decant	Estimated average volume (m ³ /day)
Groenfontein	2036 - 2055	50
Vlakfontein	2060 - 2078	400
Vogelstruisnek	2058 – 2076	200

6.2.5 Stormwater management

A system of diversion conduits will be used to prevent clean surface water runoff from the catchments upslope of the mining areas from entering the opencast operations. The diverted clean runoff will be returned to the streams. The sub-catchments which need to be diverted away from the proposed pits and the proposed system of conduits are shown in Figure 6-6. The channels are labelled C1 to C15. In addition to these conduits, conduits will be constructed upstream of the high wall as mining progresses across the pits. The latter conduits will prevent runoff from entering the pit via the high wall and they will therefore move as mining progresses. The sub-catchment characteristics are shown in Table 6-7.

The Manning's 'n' coefficient used for the impervious areas and pervious areas were 0.015 and 0.12 respectively. The Green-Ampt Infiltration parameters used for Suction Head and Conductivity were 208.8 mm and 1 mm/hour respectively.

Table 6-7: Sub-catchment parameters used to develop Batlhako Mine stormwater management plan

Name	Area (ha)	Flow Length (m)	% Slope (%)	Peak Runoff (m ³ /s)	Runoff Volume (m ³)
S1	4.56	75.9	4.5	3.06	4,890
S2	7.70	59.2	3.0	5.23	8,270
S3	9.31	91.3	3.0	5.53	9,970
S4	27.13	180.8	2.5	11.64	28,730
S5	49.61	225.5	13.0	27.61	53,000
S6	46.33	298.9	16.0	23.95	49,390
S7	48.79	203.3	12.0	27.84	52,160
S8	73.87	360.3	10.0	31.73	78,220
S9	2.90	55.3	9.5	2.26	3,130



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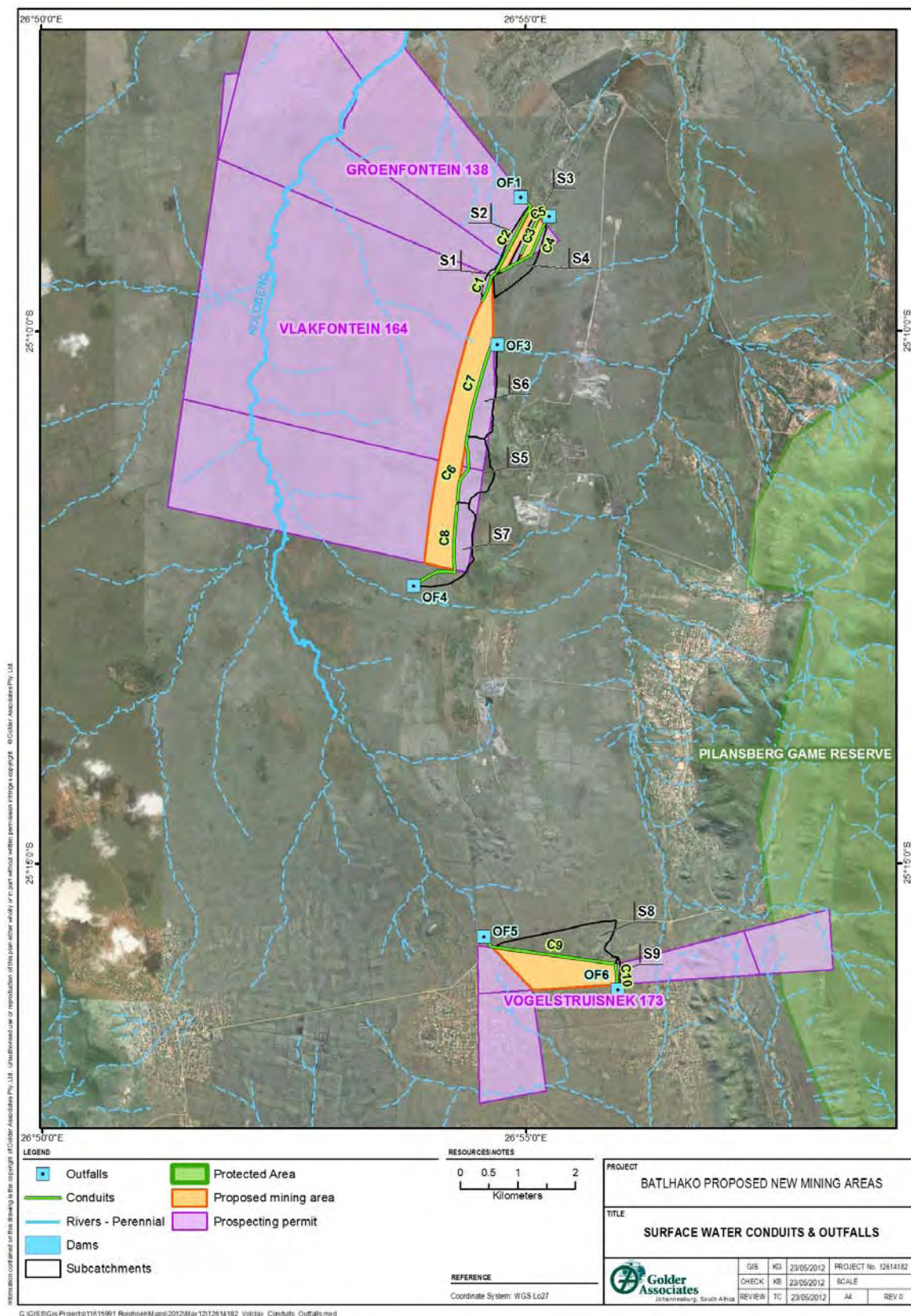


Figure 6-6: Stormwater management plan: sub-catchments and stormwater conduits for Batlhako Mining



The trapezoidal conduits were sized to convey the 50 year recurrence interval flood peak, as required by Regulation 704 under the National Water Act (Act 36 of 1998). The sizes of the conduits are listed in Table 6-8. The Manning's 'n' coefficient for the earthen channels was 0.03.

Table 6-8: Computed sizes of the stormwater conduits

Name	Length (m)	Side Slopes (H:V)	Bottom Width (m)	Slope of Conduit (m/m)	Depth of Water in Conduit (m)	Depth of Drain including Freeboard (m)	Maximum Flow (m ³ /s)	Velocity of water in Drain (m/s)
C1	537.4	2	1.0	0.0354	0.50	0.80	2.8	2.9
C2	1,547.4	2	2.0	0.0136	0.74	1.04	6.5	2.8
C3	936.6	2	1.2	0.0128	0.77	1.07	4.9	2.5
C4	1,367.6	2	3.0	0.0124	0.86	1.46	10.8	2.8
C5	110.4	2	3.0	0.0091	1.14	1.74	15.5	2.6
C6	1,198.0	2	3.0	0.0119	1.35	1.95	25.2	3.5
C7	1,733.2	2	4.0	0.0132	1.56	2.16	44.2	4.1
C8	1,996.7	2	3.0	0.0195	1.16	1.76	24.2	4.2
C9	2,380.2	2	3.0	0.0156	1.33	1.93	28.5	4.0
C10	434.5	2	1.0	0.0808	0.35	0.65	2.1	3.7

6.2.6 Impact Assessment

6.2.6.1 Construction

The potential impacts on surface water resources during the construction phase include the following:

- The removal of vegetation and the hardening of surfaces will result in additional runoff, which could cause local erosion and scour, resulting in the transport of more silt into local watercourses;
- Spillage of oils, fuel and chemicals could pollute proximal water bodies;
- The construction and/or use of roads at drainage line crossings could impact on the banks of streams and the flow hydraulics;

The impact is rated as being of **moderate (SP = 52)** significance. Implementation of the following mitigation measures is recommended to reduce the impact to one of **low (SP = 27)** significance:

- The stormwater management conduit systems and local pollution control dams must be constructed before the development of the mine to prevent stormwater from entering the site;
- The runoff from the construction areas will contain a high load of suspended solids and must be captured in a local sump to allow the solids to settle before pumping or gravity feeding to the local pollution control dam;
- Water in excess of that needed for dust control may be released to the river system in a controlled manner if the water quality meets the TWQR;
- Road crossings over drainage lines should be sized to accommodate the 50 year flood peak without overtopping;
- Appropriate erosion protection should be provided upstream and downstream of the crossings;



- Excavated material that cannot be used as topsoil, for road-building or for other construction purposes should be mixed with the overburden when backfilling the mine voids;
- Store new and used oils in bunded areas. See also section 6.1.2;
- No co-handling of reactive liquids or solids should be allowed;
- Create and monitor an inventory of chemicals held on site;
- Hazardous or toxic substances must be stored securely and their use controlled; and
- HAZOP sheets of all chemicals to be available and accessible.

6.2.6.2 Operation

The potential impacts on surface water resources during the operational phase are as follows:

- The mining of the pits will reduce the catchment area that feeds the local surface water resources and the flow that reports to the river system will be reduced. The reduction is estimated at less than 10%;
- The water collected in the pit will be pumped to a local storage dam, which has the potential to spill mine water into the river system. The mine water could be acidic and could contain high concentrations of dissolved salts, hydrocarbons, toxic metals and suspended solids; and
- The mining process will destroy the perched aquifer system and after rehabilitation the recharge water will report directly to the backfill and then to the pit floor.

A reduction of less than 10% in the runoff reaching the local watercourses would represent a **moderate (SP = 40)** impact, but if the mine water contains high concentrations of dissolved salts, hydrocarbons, toxic metals and suspended solids, a significant spillage could have an impact of **high (SP = 85)** significance.

Implementation of the following mitigation measures would reduce the impact to one of **low (SP = 18)** significance:

- Constructing a cover layer about 600 mm thick with a high clay content between the topsoil and the overburden when backfilling the mine void, to act as a perched aquifer system;
- Maintaining the stormwater management conduit systems and local pollution control dams in good condition by regular six-monthly inspection of the integrity of the conduits and liners
- Regular removal of debris and silt to from the conduits to ensure adequate flow and from the PCDs to maintain their design storage capacity.
- Lowering the water level in the PCDs as much as practically possible towards the end of the dry season to facilitate the maintenance of a freeboard of at least 0.8 metres during the wet season.

6.2.6.3 Closure and rehabilitation

After closure, groundwater will seep into the pits from the sidewalls and precipitation will percolate through the topsoil and subsoil layers. Over time, the pits will fill and there is the potential that polluted mine water will decant to the river system. Depending on the degree of pollution, the impact on downstream watercourses could be of **high (SP = 90)** significance. However, seepage from chromite ore tailings at Ruighoek, which had TDS, Mg and SO₄ values exceeding the TWQR, had a relatively high pH of 8.45, which indicates an absence of acid mine drainage. The Cr content was also very low (< 0.01 µg/l), but the As content (1.00 µg/l) exceeded the TWQR.

The following mitigation measures are recommended to reduce the impact to one of **low (SP = 18)** significance:



- Constructing a monitoring borehole up-gradient of and within each back-filled pit at the down-gradient end;
- Bi-annual monitoring of the boreholes for water level and water quality;
- If the water quality in the down-gradient part of the pit is worse than that in the borehole up-gradient of the pit and does not meet the TWQR for release into the environment or the WUL stipulations, the water should be treated until it is fit for release.

6.3 Air quality

6.3.1 Standards and guidelines

National standards for ambient air quality were set by the publication of Government Notice 1210 in Government Gazette no 32816 on 24 December 2009. The standards pertaining to PM₁₀, being particulates with an effective aerodynamic diameter of 10 microns, are shown in Table 6-9. Such small particles are suspended in the atmosphere and travel past the cilia and mucous membranes in the respiratory tract to enter the lungs, where they can cause adverse health effects.

Table 6-9: National Ambient Air Quality Standards for Particulate Matter (PM10)

Averaging Period	Concentration	Frequency of Exceedance	Compliance Date
24 hours	120µg/m ³	4	Immediate – 31 December 2014
24 hours	75 µg/m ³	4	1 January 2015
1 year	50 µg/m ³	0	Immediate – 31 December 2014
1 year	40 µg/m ³	0	1 January 2015

The reference method for the determination of the suspended particulate matter shall be EN 12341

The proposed national ambient air quality standards for PM_{2.5} are shown in Table 6-10.

Table 6-10: Proposed National PM2.5 standards

Averaging Period	Concentration	Frequency of Exceedance	Compliance Date
24 hours	65 µg/m ³	0	Immediate – 31 December 2015
24 hours	40 µg/m ³	0	1 January 2016 – 31 December 2029
24 hours	25 µg/m ³	0	1 January 2030
1 year	25 µg/m ³	0	Immediate – 31 December 2015
1 year	20 µg/m ³	0	1 January 2016 – 31 December 2029
1 year	15 µg/m ³	0	1 January 2030

Note: The World Health Organisation (WHO) has set an annual and 24-hour average guideline for PM_{2.5} of 25 µg/m³.

At this point in time there are no legislated standards or regulations in terms of allowable dust fallout rates and there is no national standard in terms of the methodology for dust fallout monitoring.

The Department of Water and Environmental Affairs (DWEA) has published guideline values for allowable dust fallout which have been accepted by the Department of Minerals and Energy (DME) as the reference fallout rates for dust deposition for the purpose of Environmental Management Programme Reports (EMPRs) (Table 6-11).



Table 6-11: DWEA dust fallout guidelines

Classification	Dust fallout averaged over 1 month (30-day average) (mg/m ² /day)
Very Heavy	> 1200
Heavy	500 – 1200
Moderate	250 – 500
Slight	< 250

On 27th May 2011 the DWEA published the draft National Dust Control Regulations for public comment (Government Gazette no 34307). It is expected that these regulations will be passed into law during 2012.

The draft regulations propose the following:

- No person may conduct any activity in such a way as to give rise to dust in such quantities and concentrations that:
 - The dust or dust fallout has a detrimental effect on the environment, including health, social, economic ecological or cultural heritage conditions or has contributed to the degradation of the ambient air quality beyond the premises where it originates from;
 - The dust remains visible in the ambient air beyond the premises where it originates from; or
 - The dust fall at the boundary or beyond the boundary of the premises where it originates exceeds:
 - 600 mg/m²/day averaged over 30 days in residential and light commercial areas, measured in accordance with reference method ASTM D1739; or
 - 1200 mg/m²/day averaged over 30 days in areas other than residential and light commercial areas, measured in accordance with reference method ASTM D1739.

It is important to note that people experience dust deposition as a nuisance effect, and that there are no direct human health implications because the dust is not inhaled. Indirect effects on human and animal health may result from the deposition of dust containing toxicants onto edible plants. Heavy dust deposition can have detrimental effects on plants if the leaves are smothered to the extent where transpiration and photosynthesis are affected.

6.3.2 Impact assessment

The meteorological analysis and interpretation was conducted using MM5 modelled meteorological data (Allan, C; Bennett, A.; June 2012). Batlhako does not have an available set of locally derived emission factors for the proposed mining activities and thus all simulated emissions were based on the comprehensive set of emission factors published by the US Environmental Protection Agency (US-EPA) in its AP-42 document: *Compilation of Air Pollution Emission Factors*. These predictive emission factor equations are derived empirically and are available for various mining activities.

The main emissions from the proposed mining activities are expected to include pollutants such as PM₁₀, nitrous dioxide (NO₂), sulphur dioxide (SO₂), carbon monoxide (CO), volatile organic compounds (VOC's) and TSP. However PM₁₀ and TSP are expected to be the most prevalent emissions from the following sources:

- The removal of overburden by bulldozers, excavators and graders (i.e. scraping equipment);
- Drilling and blasting within the proposed open cast footprint;
- The loading and unloading of overburden and chrome bearing ore (i.e. materials handling operations);
- Windblown particulate emissions from the overburden stockpiles and waste rock dumps; and
- Vehicle emissions during transporting (trace gases and particulates).



Note: An emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. Emission factors and emission inventories are fundamental tools for air quality management and planning. The emission factors are frequently the best or only method available for estimating emissions produced by varying sources.

Figure 6-7 provides an indication of the locations of the existing haul roads and the proposed mining areas and new haul roads.

Dispersion modelling was used to predict the ambient atmospheric concentrations of PM₁₀ and PM_{2.5} arising from the above activities. The ISC-AERMOD modelling software code was used to determine likely ambient air pollutant concentrations from the proposed mine activities. The AERMET pre-processor was used to process MM5 modelled regional meteorological data for input to ISC-AERMOD. The latter software code calculates likely changes in dispersion plume trajectory and concentration in response to changes in local terrain and meteorology. Input to a dispersion model includes prepared meteorological data, source data, information on the nature of the receptor grid and emissions input data.

Due to the lack of available baseline ambient air quality information for this region, it is recommended that Batlhako deploy an ambient air quality monitoring campaign in the vicinity of the proposed mine areas to determine the background air quality prior to the mining these proposed sites. This network should monitor the following pollutants; dust fallout (ASTM D1739 method), PM₁₀, NO₂ and SO₂ and monitor wind speed and direction as a minimum.

6.3.3 Construction

The mining areas and haul roads are shown in Figure 6-7. The construction activities described in section 5.4.1 will give rise to the mobilisation of particulates (dust and PM₁₀) and emission of exhaust gases from construction vehicles. Mobilisation of particulates will occur during land clearing, topsoil and subsoil stripping and stockpiling, drilling and blasting, and construction of haul roads. Wind erosion of exposed areas will also make a minor contribution on dry, windy days.

During the construction phase, there is likely to be a degeneration of the ambient air quality due to increased TSP and PM₁₀ levels from land clearing, drilling and blasting, ground excavation and cut and fill operations.

In the air quality specialist's professional opinion, no air quality impacts that could constitute a fatal flaw are anticipated during the construction phase, but mitigation measures should be implemented to reduce the nuisance factor of the emissions and to aid in ensuring compliance with current legislative requirements.

Without mitigation, the air quality impact during the construction phase is rated as being of **moderate (SP = 50)** significance.

The following mitigation measures are recommended:

- Wet suppression, applied sparingly, to ensure the absence of visible dust;
- Enforce low vehicle speeds on unpaved roads (< 30 km/h); and
- Vegetate the disturbed areas with a locally indigenous grass species as soon as possible.

Wet suppression is very effective, but for roads chemical binders such as Dustex or Dust-A-Side could also be used.

Application of appropriate mitigation measures would reduce the impact to one of **very low (SP = 10)** significance.



EIA/EMP - GROENFONTEIN, VLAKFONTEIN AND VOGELSTRUISNEK

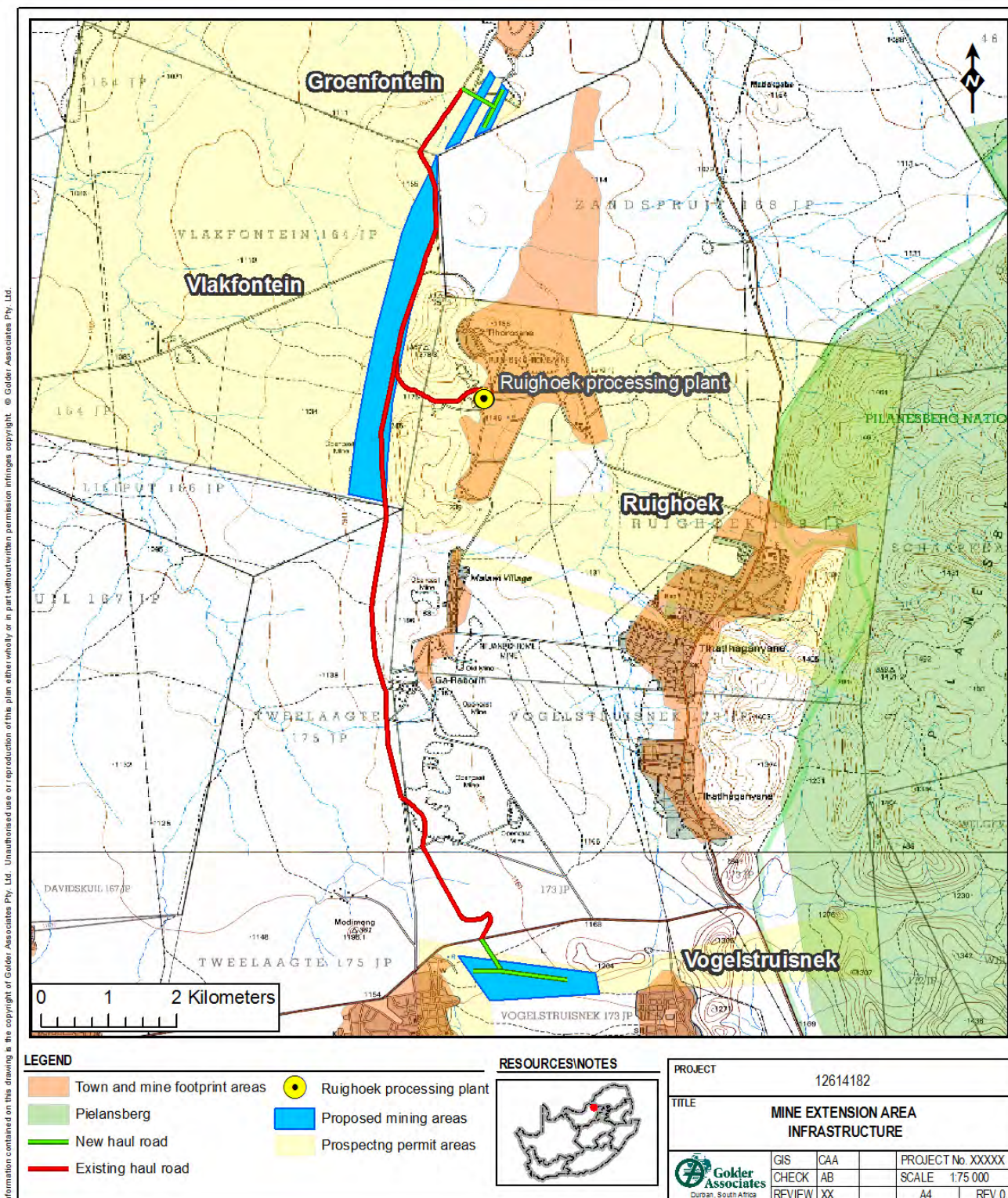


Figure 6-7: Mining areas and haul roads



6.3.4 Operation

The following activities will cause particulate mobilisation and result in increased concentrations of PM_{2.5}, PM₁₀ and TSP during the operational phase of the mine:

- Drilling and blasting;
- Removal of overburden by bulldozers, excavators and tipper trucks;
- Materials handling operations. Loading and stockpiling of topsoil and overburden and hauling of chrome ore;
- Windblown particulate emissions from the stockpiles; and
- Entrainment of particulate matter during the transport of the ore on haul roads.

Simulations were undertaken to determine PM_{2.5}, PM₁₀ and TSP concentrations during the operational phase. The Groenfontein, Vlakfontein and Vogelstruisnek operations were modelled individually instead of cumulatively, because these areas will be mined in succession, rather than simultaneously. The results are summarised in Table 6-12, with exceedances shaded in grey.

Table 6-12: Summary of dispersion modelling results

Pollutant	Averaging period	Ambient air quality standard	Groenfontein	Vlakfontein	Vogelstruisnek
TSP (modelled as dust fallout)	Dust fallout averaged over 1 month (30-day average)	Industrial < 1200 mg/m ² /day Residential < 600 mg/m ² /day	No exceedances	Residential limits are exceeded up to 3 km from the mine boundary. Industrial limits are exceeded approximately 1 km from the mine boundary.	No exceedances
PM ₁₀	1 year	50 µg/m ³	No exceedances	Limit is exceeded approximately 1 km from the mine boundary	No exceedances
PM ₁₀	24 hours	120 µg/m ³	No exceedances	Limit is exceeded up to 6 km from the mine boundary	Limit is exceeded up to 1 km from the mine boundary
PM _{2.5}	1 year	25 µg/m ³	No exceedances	Limit is exceeded up to 1.5 km from the mine boundary	No exceedances
PM _{2.5}	24 hours	65 µg/m ³	No exceedances	Limit is exceeded up to 5 km from the mine boundary	No exceedances

The results from the dispersion modelling indicated that the 24 hour average PM₁₀ concentrations would exceed the National ambient air quality limit (120 µg/m³) at and beyond the Vlakfontein and Vogelstruisnek mine boundaries.

Mining activity at the Vlakfontein mine is expected to have the greatest impact as all particulate pollutants exceeded the National ambient air quality standards in the dispersion modelling simulations. See Figure 6-8 to Figure 6-12. These elevated concentration levels may impact negatively on the health and wellbeing of sensitive receptors. The higher particulate and dust fallout concentrations predicted at Vlakfontein Mine (compared to Groenfontein and Vogelstruisnek mines) are a result of the larger pit dimensions and greater



haulage distances. It is anticipated that significant mitigation measures will need to be employed at the Vlakfontein mine.

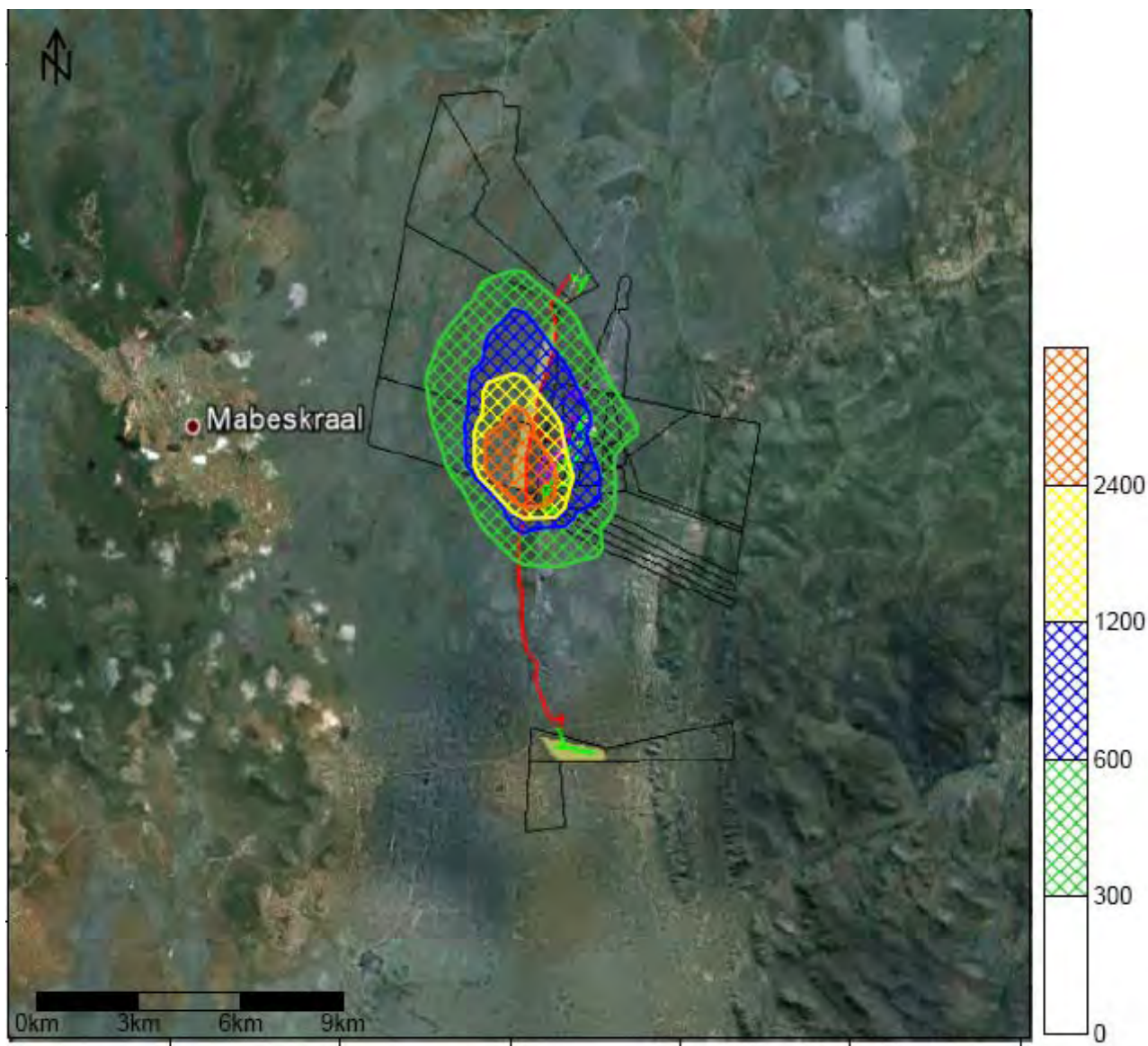


Figure 6-8: Modelled dust fallout ($\text{mg}/\text{m}^2/\text{day}$) as a result of the Vlakfontein mining operations

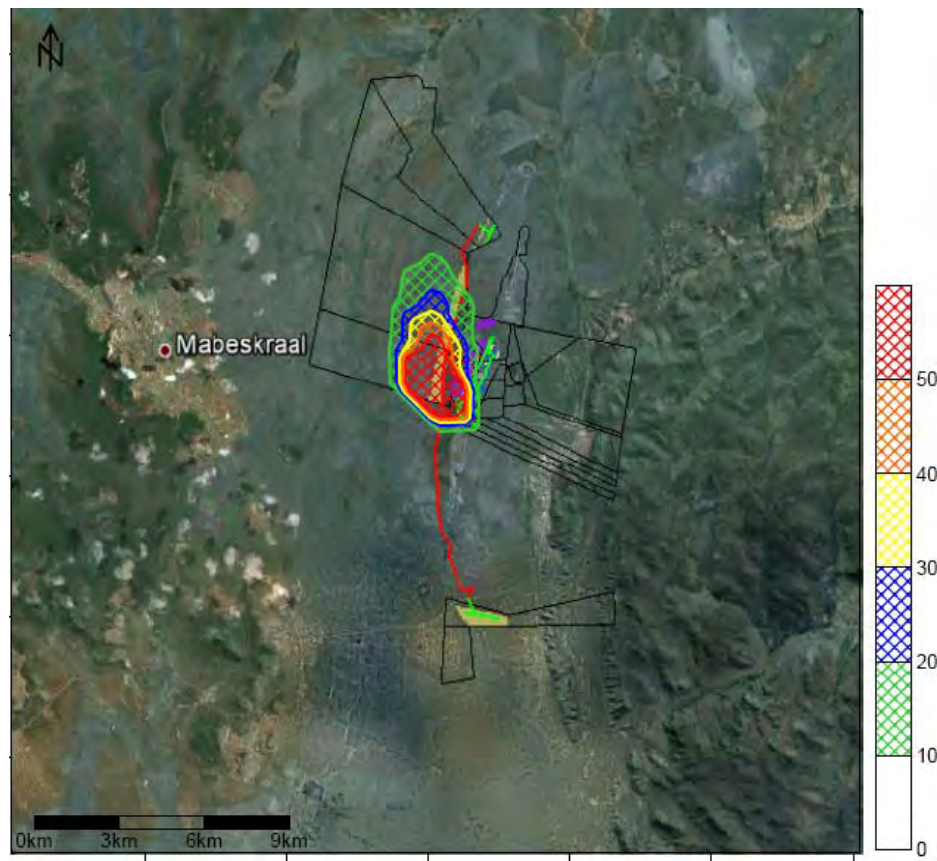


Figure 6-9: Annual average PM10 ($\mu\text{g}/\text{m}^3$) at Vlakfontein mining operations

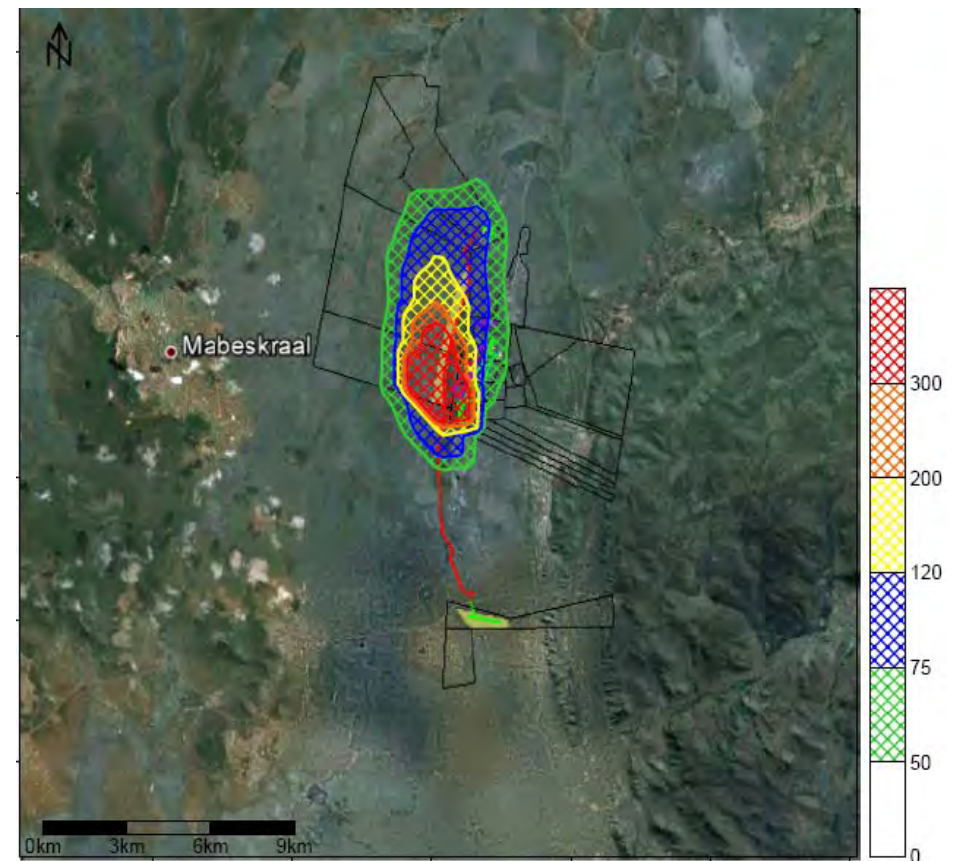


Figure 6-10: Daily average PM10 concentrations ($\mu\text{g}/\text{m}^3$) at Vlakfontein operations.

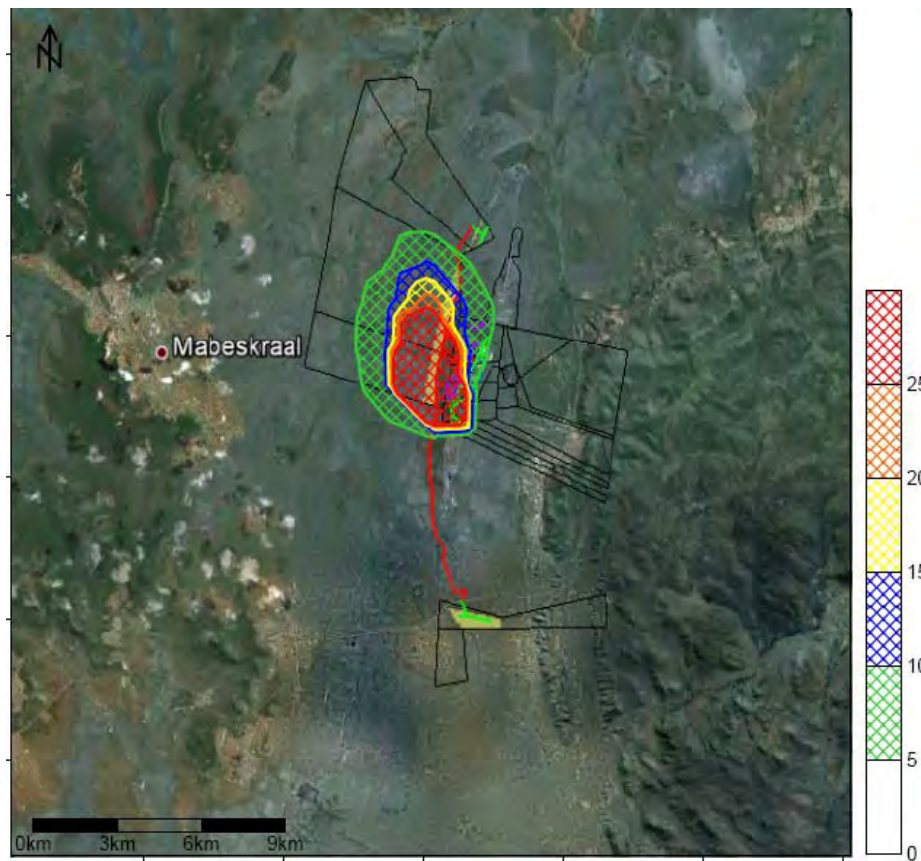


Figure 6-11: Annual average PM_{2.5} (µg/m³) at Vlakfontein operations

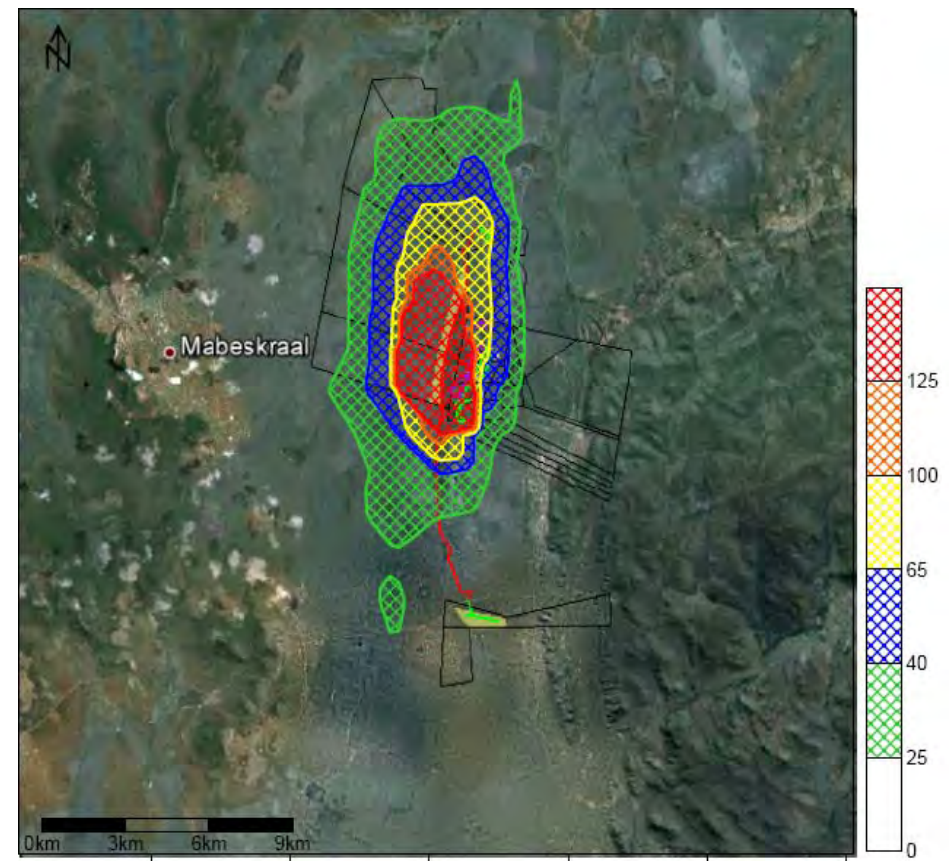


Figure 6-12: Daily average PM_{2.5} (µg/m³) at Vlakfontein operations



The air quality impact of the operational phase is assessed as being of **moderate to high (SP = 75)** significance at Vlakfontein and Vogelstruisnek before mitigation and of **moderate (SP = 30)** significance at Groenfontein.

The following mitigation measures are recommended to reduce the impacts at Vlakfontein and Vogelstruisnek to **moderate (SP = 50)** significance and to **low (SP = 25)** significance at Groenfontein:

- For materials handling operations and transfer points on site:
 - Wet suppression;
 - Drop height reduction; and
 - Shielding by enclosing the drop areas to limit the mobility of dust.
- For waste rock dump, soil and overburden stockpiles:
 - Progressive rehabilitation and re-vegetation should be implemented;
 - Chemical stabilisation; and
 - Facility design and maintenance to exclude and minimise the development of sharp edges that can lead to excessive particulate dust generation due to air eddy and erosive effects below the sharp edge.
- For paved and unpaved roads:
 - Wet suppression with water;
 - Application of salts - hygroscopic compounds such as calcium chloride, magnesium chloride, hydrated lime, sodium silicates, etc. Salts increase roadway surface moisture by extracting moisture from the atmosphere;
 - Application of surfactants - such as soaps and detergents. Surfactants decrease the surface tension of water, which allows the available moisture to wet more particles per unit volume;
 - Application of soil cements - compounds that are mixed with the native soils to form a new surface. Examples are calcium or ammonium lignin sulphonate, cement, etc.;
 - Application of bitumens - compounds derived from coal or petroleum such as coherex penepreme, asphalt, oils, etc.; and
 - Application of films—polymers that form discrete tissues, layers, or membranes such as latexes, acrylics, vinyls, fabrics, etc. These form coherent surface layers that seal the road surface, thereby reducing the quantity of dust generated.
- General transport mitigation measures may include:
 - Reduction in unnecessary traffic volumes;
 - Conversion of the unpaved road surface to a paved surface;
 - Rigorous speed control and the institution of traffic calming measures to reduce vehicle entrainment. A recommended maximum speed of 30 km/h to be set on unpaved roads within the mining area;
 - Wet suppression of materials transported by road (i.e. load spraying) or load covering with tarpaulins to reduce fugitive dust generation; and



- All vehicles and other equipment should be maintained and serviced regularly to ensure that tailpipe particulate emissions are kept to a minimum.
- For blasting:
 - Wet suppression is important in controlling dust generated by blasting activities. The area surrounding the blast should be thoroughly wetted down beforehand. This precaution will prevent dust settled out during previous blasts from becoming airborne.
 - The water used for dust suppression during blasting should be as clean as possible, because the evaporation of dirty water can also release dust;
 - The blast charge should be calculated as accurately as possible and kept to the minimum required as the larger the charge, the higher the potential for dust generation; and
 - Consideration of wind speed and direction in the blasting schedule, particularly where communities live nearby and may be affected by blasting emissions.
- Overburden and waste rock drilling generates most of the respirable dust that affects workers in the mining operations. Mitigation measures could include:
 - Wet suppression systems that pump water through the drill steel into the bailing air. The water droplets in the bailing air trap dust particles as they travel up the annular space of the drilled hole; and
 - Dry collection systems, which require an enclosure around the area where the drill stem enters the ground. This enclosure is typically constructed by hanging a rubber or cloth shroud from the underside of the drill deck. The enclosure is then ducted to a dust collector, the clean side of which has a fan. The fan creates a negative pressure inside the enclosure, capturing dust as it exits the hole during drilling. The dust is removed in the collector, and clean air is exhausted through the fan.

6.3.5 Closure and rehabilitation

The potential for particulate mobilisation during closure and rehabilitation will be similar to that of the construction phase and the same considerations and mitigation measures apply. Accordingly, the air quality impact without mitigation is expected to be of **moderate (SP = 50)** significance, reducing to **very low (SP = 10)** significance upon application of the recommended mitigation measures.

6.4 Ecology

Previous work done on the area surrounding the Ruighoek mine, as referenced in section 3.7, was augmented by fieldwork on the proposed mining areas on Groenfontein, Vlakfontein and Vogelstruisnek (Hudson, A; Kimberg, P., May 2012). The fieldwork was undertaken to:

- Identify general vegetation communities in the study area;
- Identify dominant plant species;
- Identify invader or exotic species;
- Identify sensitive landscapes and habitats including wetland and riparian habitats as these are often intricately linked to the surrounding terrestrial habitats;
- Identify possible impacts of the proposed development during the operation of the mine;
- Identify terrestrial fauna occurring within the study area;
- Record Red Data and protected fauna species;
- Identify any exotic species; and
- Identify possible impacts of the proposed development on fauna populations.



In order to study the vegetation in greater detail, relevés were selected according to the vegetation characteristics identified. A total of 15 sites were selected at which to conduct vegetation surveys. Relevé data was collected in the field by means of point transects (for species occurring in the herbaceous layer) and belt transects (for tree and shrub species). Vegetation data was collected during a field survey that was conducted for five days from the 1st to the 5th of August 2011.

Faunal surveys were conducted at 12 sites. These sites were selected to include all of the possible habitats found on site and to focus on sites which will either be directly affected by the mining or be likely to host increased diversity or protected and Red Data species. Field work was conducted for five days from the 1st to the 5th of August 2011, i.e. at the end of the dry season, when the activity levels of most animal species are low and fewer animals are generally observed than during the summer.

Active searching was conducted at each of the fauna survey sites. Active searching was conducted on foot and included searching all suitable habitats (rocks, logs, artificial cover, leaf litter, artificial litter, bark, pools and streams etc), and scanning basking sites and places where specimens were likely to be found. In addition, the presence of burrows, mounds and nests were also noted.

Small mammals were trapped by means of seven Sherman traps placed in a single grid at each of the fauna survey sites. The data collected during Sherman trapping was augmented by visual observations, surveys of tracks and signs, as well as anecdotal evidence provided by residents and land users.

The mammal sensitivity assessment was based on the suitability of available habitat for species of particular conservation concern such as Red Data and Protected species. The sensitivity of the mapped habitats was then assessed in terms of how the potential impacts of mining would alter the state of the habitat and therefore the continued presence of the particular species.

Bird surveys were conducted by means of point counts of 15 min each at each of the fauna survey sites. Particular attention was paid to suitable roosting, foraging and nesting habitats for Red Data species.

Previous mining activities have impacted heavily upon much of the lower slope and bottomland areas of the study area, resulting in either complete transformation or substantial disturbance. In upper slope areas, the recent cutting of various vehicle access tracks to facilitate mining surveys has also led to disturbance.

Presently, grazing by cattle occurs throughout the study area, however no evidence of overgrazing was noted during the site survey. Field observations indicate that fire is not actively or frequently used as a veld management tool.

6.4.1 Vegetation communities

Based primarily on physiognomy, moisture regime, rockiness, slope, species composition and soil properties, four vegetation communities are recognised in the study area, namely Dwaalboom Thornveld, Zeerust Thornveld, Pilanesberg Mountain Bushveld and Dwarsberg-Zwartruggens Bushveld (Hudson, A; Kimberg, P.; May 2012). Although these communities were recorded during the survey, there is variation, as described below and illustrated in Figure 6-13, within these communities as a result of current and historic anthropogenic disturbance.

6.4.1.1 Bottomland Acacia bushveld

This community occurs in a north-south band on the eastern portion of the study area and shares similar vegetation characteristics to Dwaalboom Thornveld. Noticeable cracks that are characteristic of the shrink-swell properties of clayey vertic soils were observed during the site survey. These soils are poorly drained, have a high water content during the wet season and are dominated by tolerant grass species such as *Setaria incrassata* and *Ischaemum afrum*, *Cymbopogon excavates*, *Themeda triandra* and, in disturbed areas, *Hyparrhenia hirta*.

High clay soils tend to be very fertile, leading high grass biomass and intense fires in the dry season, resulting in open savanna with few trees. Dominant woody species in the bottomland areas include the fine-leaved *Acacia karroo*, *A. tortilis* and *Dichrostachys cinerea*.



A total of 27 plant species were recorded in this vegetation community, of which these 13 were graminoids (grasses), six were herbs/forbs and eight were woody species. No Red Data plant species were recorded and the suitability of this habitat for such species is considered to be low. This vegetation community is susceptible to invasion by exotic species if disturbed.

Although none were recorded in the study area a number of *Boscia albitrunca* specimens were observed approximately three kilometres to the east, adjacent to the Tlhatlaganyane road. This species is listed under the National Forests Act (No. 84 of 1998) as a Protected Tree. The suitability of the bottomland areas within the study area for this species is considered to be high.

6.4.1.2 Footslope mixed bushveld

This vegetation community is characterised by dense to open woodland, dominated by medium to large trees such as *Acacia burkei*, *A. tortilis*, *Scelocarya birrea* and *Combretum molle*, and a dense herbaceous layer. Historic disturbances, probably resulting from agricultural activities, have resulted in certain areas being dominated by dense, tall stands of the grasses *Hyparrhenia filipendula*, *H. hirta* and *Heteropogon contortus*, and thickets of the woody species *Dichrostachys cinerea*. The prevalence of exotic invasive species such as *Tagetes minuta* and *Bidens pilosa* is low.

Floral diversity in this community is relatively high with 55 species (26 woody species, 22 grasses and 7 forbs/herbs) being recorded during the site survey. This community is favoured for cattle grazing, with the grass species *Panicum maximum* being highly selected as a grazing resource.

No Red Data plant species were recorded during the site survey and the suitability of this vegetation community as habitat for such species is considered to be medium. However two species, listed as Protected under the National Forests Act (No. 84 of 1998) were recorded, namely *Sclerocarya birrea* and *Combretum imberbe*.

6.4.1.3 Rehabilitated vegetation

Much of the study area consists of rehabilitated vegetation. Floral diversity in this community is low with a total of 38 species of plant (11 woody species, 18 grass species and 14 species of herbs and forbs) being recorded during the survey.

This vegetation community is dominated by graminoid species such as *Heteropogon contortus*, *Aristida canescens* and *Loudetia simplex*, but woody species have begun to re-colonise the area and the woody layer is dominated by *Acacia* species such as *Acacia caffra* and *Dichrostachys cinerea*. Species such as *Combretum molle*, *Tarconanthus camphorates* and *Mundulea sericea* were also found, but to a much lower extent.

No Red Data plant species were recorded in this vegetation community, and due to its transformed nature, such occurrence is highly unlikely.

6.4.1.4 Degraded *Dichrostachys cinerea* thicket

In areas where rehabilitation of graminoid species has been largely unsuccessful, encroachment of woody species, most notably *Dichrostachys cinerea*, is rife. These areas are very low in plant diversity and are so severely encroached upon by *Dichrostachys cinerea* and some *Acacia* species that it has become impenetrable in areas and thus difficult to assess.

Floral diversity in this community is very low with a total of 21 species of plant being recorded during the survey. Woody species are the highest contributors of this diversity with 8 species, followed by grasses (7 species) and herbs/forbs (6 species).

No Red Data plant species were recorded in this vegetation community, and none are to be expected, due to the degree of transformation that it has undergone.

Other areas of complete or severe transformation and disturbance occur throughout the study area. These include *inter alia*, villages, haul roads, spoil heaps, old pit areas and unrehabilitated areas. These areas were noted, but not surveyed intensively.

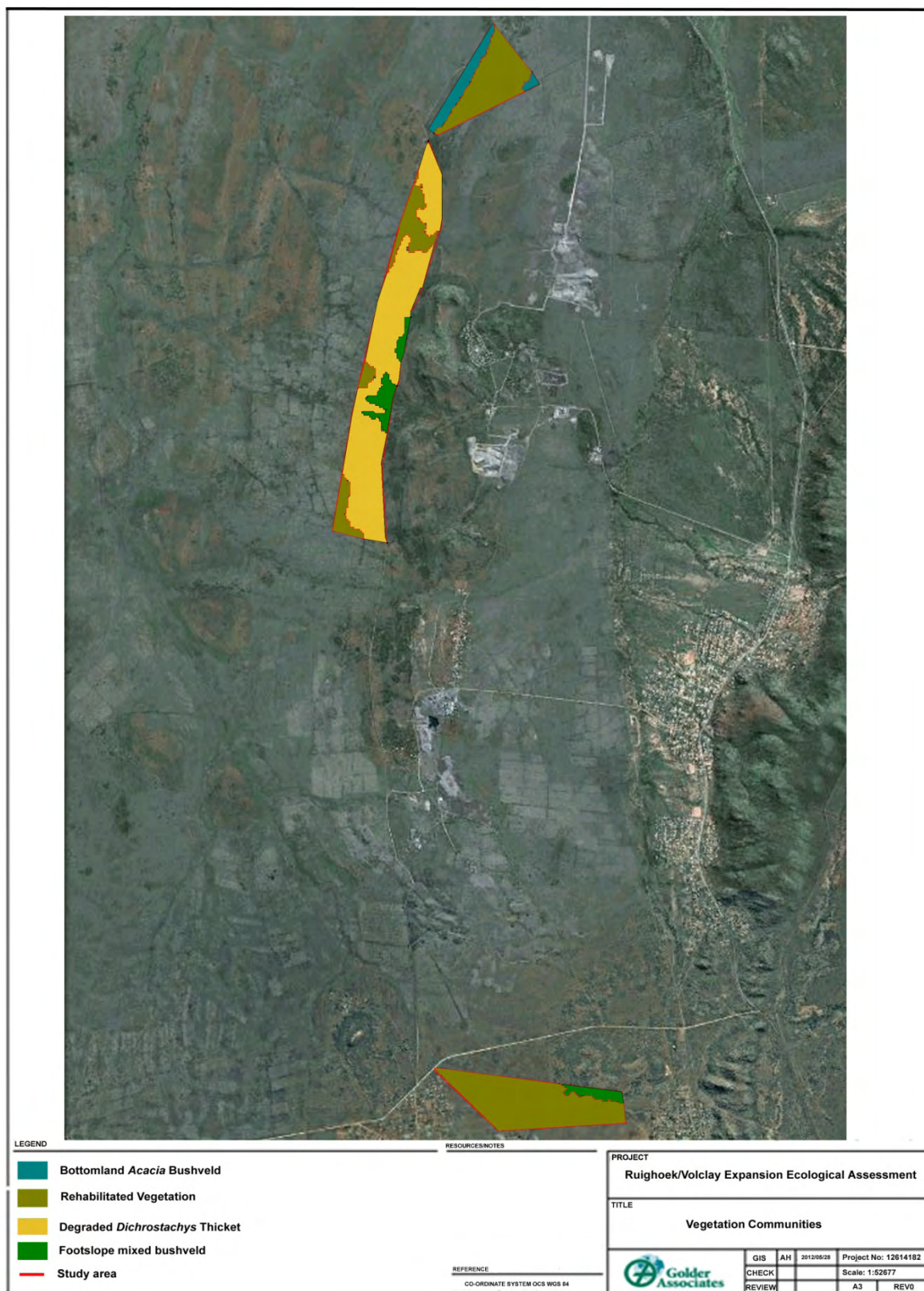


Figure 6-13: Vegetation communities in the study area



6.4.2 Fauna

6.4.2.1 Mammals

The study area has a mammal diversity ranking of medium-high (NW Biodiversity Inventory and Database 2003) and the literature lists 83 species of that could potentially occur, but only 12 species were recorded during the survey. This low count can be attributed to direct and indirect disturbances resulting from mining and associated activities, as well as historic land uses such as agriculture and hunting. In addition, the poaching of small mammals by local communities in the study area and on adjacent land may further reduce the diversity of mammals. None of the species on the *NEM:BA Threatened and Protected Species List (2007)* were observed.

Table 6-13: Mammal species recorded during the 2011 survey

Scientific Name	Common Name	IUCN Red List of Threatened Species (2011)
<i>Lemniscomys rosalia</i>	Striped Mouse	Least concern
<i>Aethomys chrysophilus</i>	Red Veld Rat	Least concern
<i>Mastomys coucha</i>	Multimammate Mouse	Least concern
<i>Saccostomus campestris</i>	Pouched Mouse	Least concern
<i>Lepus saxatili</i>	Scrub Hare	Not listed
<i>Hystrix africaeaustralis</i>	Porcupine	Least concern
<i>Paraxerus cepapi</i>	Tree Squirrel	Not listed
<i>Procavia capensis</i>	Rock Hyrax	Least concern
<i>Cercopithecus aethiops</i>	Vervet Monkey	Least concern
<i>Felis lybica</i>	African Wild Cat	Not listed
<i>Sylvicapra grimmia</i>	Common Duiker	Least concern
<i>Oreotragus oreotragus</i>	Klipspringer	Least concern

6.4.2.2 Avifauna

The NW Biodiversity Inventory and Database (2003) categorises the region in which the study area is located as having low-medium bird diversity. Data presented on SANBI's SIBIS database (SIBIS:SABIF, 2009) indicates that a total of 140 bird species have been recorded in the 2526BB quarter degree grid square. This is substantially more than the 31 bird species recorded during the site survey (Table 6-14). This low diversity can be attributed partly to the time of year (dry season) during which the survey was undertaken, partly to the mining activities in the area, and partly to egg collecting by adjacent land users.

Table 6-14: Bird species recorded during the 2011 survey

Scientific Name	Common Name
<i>Mirafra sabota</i>	Sabota Lark
<i>Dryoscopus cubla</i>	Blackbacked Puffback
<i>Bostrychia hagedash</i>	Hadedda Ibis
<i>Fancolinus swainsonii</i>	Swainson's Spurfowl
<i>Fancolinus sephaena</i>	Crested Francolin
<i>Vanellus coronatus</i>	Crowned Lapwing
<i>Vanellus armatus</i>	Blacksmith Lapwing
<i>Streptopelia senegalensis</i>	Laughing Dove
<i>Streptopelia capicola</i>	Ring-necked Dove



Scientific Name	Common Name
<i>Corthaixoides concolor</i>	Grey Go-away-bird
<i>Urocolinus indicus</i>	Redfaced Mousebird
<i>Coracias caudata</i>	Lilacbreasted Roller
<i>Upupa africana</i>	African Hoopoe
<i>Corvus albus</i>	Pied Crow
<i>Pyconotus nigricans</i>	Black-fronted Bulbul
<i>Pyconotus barbatus</i>	Common Bulbul
<i>Cossypha humeralis</i>	Whitethroated Robin-Chat
<i>Zosterops pallidus</i>	Cape White-eye
<i>Tchagra senegala</i>	Blackcrowned Tchagra
<i>Lamprotornis nitens</i>	Red-shouldered Glossy Starling
<i>Acridotheres tristis*</i>	Indian Myna
<i>Nectarinia talatala</i>	White-breasted Sunbird
<i>Nectarinia mariquensis</i>	Marico Sunbird
<i>Passer domesticus</i>	House Sparrow
<i>Ploceus velatus</i>	Southern Masked Weaver
<i>Pytilia melba</i>	Melba Finch
<i>Estrilda erythronotos</i>	Blackcheeked Waxbill
<i>Uraeginthus angolensis</i>	Blue Waxbill
<i>Lagonosticta senegala</i>	Redbilled Firefinch
<i>Batis molitor</i>	Chinspot Batis
<i>Bubuculus ibis</i>	Cattle Egret

*Exotic species

None of the Red Data and Protected bird species listed as probable for this area were recorded during the 2011 survey. It is unlikely that any of these species, other than the Yellow-throated Sandgrouse (*Pterocles gutturalis*), would actively nest in the study area. This species favours short, open grassland with clay-like soils, similar to that occurring in the Bottomland *Acacia* Bushveld. Considering the proximity of the Pilanesberg National Park the probability of its occurrence is high.

6.4.2.3 *Herpetofauna*

According to the NW Biodiversity Inventory and Database (2003) the region in which the study area is located has a reptile and amphibian biodiversity ranking of medium and, based on the reptile list of the adjacent Pilanesberg National Park, a total of 65 species could potentially occur in the study area. Of these, only the African Rock Python (*Python sebae natalensis*) is categorised as a Protected species, according to the NEM:BA TOPS List (2007). The African Rock Python favours open savannas and rocky areas (Branch, 1994), both of which occur in the study area. The probability of this species being present on site is therefore high.

Only four species, namely the Stripe-bellied Sand Snake (*Psammodphis subtaeniatus*), Puff Adder (*Bitis arietans*), Mozambique Spitting cobra (*Naja mossambica*) and the Variable Skink (*Mabuya varia*) were recorded during the 2011 site survey. All of these species are widely distributed. The Stripe-bellied Sand Snake favours open, dry savanna and Thornveld, while the Variable Skink favours grassland habitats (Branch, 1994). No amphibians were recorded during the site survey.



The amphibian list for the Pilanesberg National Park indicates that 28 species occur in that protected area and could potentially occur in the study area. Of these, only the Giant Bullfrog (*Pyxicephalus adspersus*) is listed as Near Threatened by the IUCN (2011) and categorised as Protected on the NEM:BA TOPS List (2007). This species breeds in the shallows of temporary rain-filled depressions in grasslands and dry savanna, and spends much of the year buried (Carruthers, 2001). Although no evidence of the presence of Giant Bullfrogs was observed during the site survey, there is potential for this species to occur in the bottomland areas. These areas are characterised by poorly drained soils where temporary pools can form during the wet season. The probability of this species is therefore medium-high.

6.4.2.4 Arthropoda

A total of 21 arthropoda taxa were recorded during the 2011 site survey. The low diversity may be attributable to the fact that the site survey was undertaken during the dry season. All recorded species are common to savanna areas and have widespread distributions. These species are generally subtropical and reflect the southern extension of the Afrotropical range.

Table 6-15: Arthropoda species recorded during the 2011 survey

Order	Family	Species Name
Lepidoptera	Nymphalidae	<i>Vanessa cardui</i>
		<i>Danaus chrysippus aegyptius</i>
		<i>Acraea eponina eponina</i>
		<i>Junonia hierta cebrene</i>
	Pieridae	<i>Mylothris rueppellii haemus</i>
		<i>Eurema brigitta brigitta</i>
Coleoptera	Coccinellidae	<i>Henosepilachna bifasciata</i>
Thysanura	Lepismatidae	
Odonata	Protoneuridae	
	Libellulidae	
Blattodea	Blattidae	<i>Periplaneta americana</i>
Isoptera	Hodotermitidae	<i>Hodotermes mossambicus</i>
Orthoptera	Gryllidae	
	Acrididae	
Phasmatodea	Bacillidae	
Diptera	Muscidae	<i>Musca domestica</i>
Hymenoptera	Vespidae	<i>Belonogaster dubia</i>
	Apidae	<i>Apis mellifera</i>
	Anthophoridae	<i>Amegilla caelestina</i>
	Formicidae	<i>Pachycondyla tarsata</i>
		<i>Dorylus helvolus</i>

Four species of Red Data and Protected arthropods may occur within the study area Table 6-16. Both species of flat rock scorpions from the genus *Hadogenes* occur in rocky habitats, such as that found in the study area. The probability of these species occurring in the study area is therefore high.

As the name suggests the Marsh Slyph (*Metisella meninx*) is a wetland specialist favouring marshy grassland (Henning & Roos, 2001). The probability of this species occurring on site is considered low. *Spalia paula* is a savanna species, occurring on the slopes of hills (Henning & Henning, 1989). According to the NW Biodiversity Inventory and Database (2003) this species has been found in Lekubu Mixed Thornveld habitat



type, which characterises eastern portion of the study area. The probability of this species occurring on site is considered high.

Table 6-16: List of Red Data and protected Arthropods that may occur in study area

Scientific Name	Common name	NEM:BA Threatened and Protected Species List (2007)	Probability of occurrence
<i>Hadogenes gracilis</i>	Rock Scorpion	Protected	High
<i>Hadogenes troglodytes</i>	Rock Scorpion	Protected	High
<i>Metisella meninx</i>	Marsh Sylph	Vulnerable	Low
<i>Spialia paula</i>	Mite Sandman	Vulnerable	

6.4.3 Ecological Integrity

Much of the Bottomland *Acacia* bushveld and Foothlope mixed bushveld vegetation communities both within and outside the study area have been disturbed by anthropogenic activities such as agriculture, livestock grazing and mining. Nevertheless, these communities are important dispersal habitats, linking the mountainous Pilanesberg to the hills and ridges located in the study area and to similar Maberskraal Ridge Bushveld habitats located north-west of the study area. Where not transformed or heavily degraded by human activities, the ecological function of these communities remains relatively high.

The rehabilitated areas and *Dichrostachys* thicket are characterised as being transformed vegetation communities and have low ecological integrity. See Figure 6-14.

The conservation importance of the Bottomland *Acacia* bushveld is considered moderate. Although large parts of it have been transformed and disturbed, the presence of the Red Data Yellow-throated sand grouse (*Pterocles gutturalis*), and the protected tree *Boscia albitrunca* cannot be excluded.

The rehabilitated areas and *Dichrostachys* thicket represent transformed vegetation communities and have low conservation importance due to the lack of species of conservation importance being present in, or reliant on these vegetation communities.



Figure 6-14: Ecological integrity map of proposed mining areas



6.4.4 Construction

Stripping of vegetation prior to mining of the first cut and construction of the diesel storage facilities and haul roads will destroy habitat and disturb fauna in the area. Taking the limited area that will be affected into consideration and the fact that most of the area to be mined was mined and rehabilitated about twenty years ago, the impact is assessed as being of **moderate (SP = 50)** significance.

Application of the following mitigation measures are recommended to reduce the significance, but it would still be **moderate (SP = 35)**:

- Prior to construction, an ecologist should check whether any protected species occur on the areas that will be impacted, and, if such occurrence is verified, the necessary permits for the destruction or relocation of such species should be applied for;
- The area to be stripped should be kept to a minimum and should be clearly demarcated;
- Stripped vegetation should not be burned. Leafy parts should be composted and woody parts chipped to serve as mulch during rehabilitation.

6.4.5 Operation

The following impacts are foreseen during the operational phase:

- Cleared and disturbed areas will be susceptible to erosion and invasion by exotic plant species. Initially, these will be confined to areas within the immediate vicinity of the disturbed areas, but invasion of undisturbed areas may occur over time;
- Disturbance of vegetation may result in indigenous yet ruderal species becoming dominant, thereby reducing overall floral diversity. This impact will be confined to disturbed sites;
- The mining activities will make previously remote areas accessible to more people and may lead to increased poaching through the use of snares and dogs;
- Chemical spills can be a major concern in areas of high biodiversity. The relatively low probability, scale and magnitude of the effect of chemical spills, however, would limit this to a low impact;
- Noise and vibration from blasting and other general noise will result in sensitive fauna species migrating away from the vicinity of the mining operations;
- The mining and ore haulage operations will mobilise particulates and cause increased dust fall on plants close to these operations, resulting in reduced photosynthesis and plant growth;
- The mining and hauling operations will represent a barrier to the movement of some animals and the vehicles will be a danger to animals crossing the roads; and
- The clearing of vegetation and the displacement of soil may result in the destruction or disturbance of Red Data and protected species.

Due to their small size and connectivity to similar adjacent undisturbed areas, the impact on the undisturbed areas with high ecological integrity that fall within the mining footprint as shown in Figure 6-14, is assessed as being of **moderate (SP = 70)** significance. The impact on the previously disturbed areas is rated as **low (SP = 25)**.

The mitigation measures listed below are recommended to reduce the ecological impact to **moderate (SP = 55)** significance on the undisturbed areas and **low (SP = 20)** on the previously disturbed areas.

- The area to be stripped ahead of the approaching mining front should be kept to a minimum and should be clearly demarcated;



- Stripped vegetation should not be burned. Leafy parts should be composted and woody parts chipped to serve as mulch during rehabilitation;
- The potential for erosion of stockpiles of topsoil and subsoil should be minimised by:
 - Limiting stockpiles to a maximum height of 3 metres;
 - Limiting stockpile side slopes to a maximum of 25 degrees;
 - Constructing temporary berms downslope of stockpiles to trap soil washed from stockpiles during rain events;
 - Spraying un-vegetated topsoil with water to suppress wind erosion under dry conditions; and
 - Vegetating the topsoil stockpile at the far end of the mine (last cut) until it is needed for closure.
- Backfilling and re-vegetating the mining voids continuously as described in section 5.4.2 and monitoring progress on the re-vegetation process.

6.4.6 Closure and rehabilitation

Rehabilitation of a mined-out area is a slow process that almost never achieves a state close to the original pristine state during a human lifetime. The vegetation community reflects the prevailing soil conditions. The soil conditions found on ecologically pristine land generally developed over millennia and can take hundreds or even thousands of years to return to a state resembling the original. Typically, high potential agricultural land can lose up to half its production potential and may be fit for grazing, but not crop production, for many years after rehabilitation.

If closure and rehabilitation as described in section 5.4.3 is not done with proper care, the vegetation will not re-establish well and the residual impact, relative to the pre-mining state of the ecology will be of **high (SP = 75)** significance on the originally undisturbed areas shown in Figure 6-14 and of **moderate (SP = 60)** significance on the areas that were mined and rehabilitated some twenty years ago.

The following mitigation measures are recommended to reduce the ecological impact to **moderate (SP = 45)** significance on the previously undisturbed areas and **low (SP = 25)** on the previously disturbed areas:

- When stripping and stockpiling, followed by re-placement during backfilling, it is important that topsoil and subsoil be kept separate and not be allowed to mix;
- Topsoil sampling and analysis must be undertaken by a specialist who will advise on appropriate fertilisation and soil conditioning, as well as the amount of compost to be mixed in;
- Profiling should be done to ensure good drainage;
- Avoid compaction by deploying light farming equipment rather than heavy earthmoving equipment. This is especially important when dealing with clayey soils;
- Commission a botanist who specialises in rehabilitation to select the appropriate locally indigenous plant species and to oversee their planting on the disturbed ground;
- Monitor the re-vegetated areas quarterly until the vegetation has become self-sustaining and clear signs of succession have manifested. If any bare patches exceeding 4 m² in area develop, investigate the reasons, take appropriate remediation measures and re-vegetate.



6.5 Visual impact

The zone of theoretical visibility is defined as the sections of the study area from which a proposed development may be visible and was determined for the proposed mining areas by conducting a viewshed analysis using Geographic Information System (GIS) software.

The viewshed analysis showed that the visibility of the Vlakfontein/Groenfontein open pits will increase as the viewer moves away from them and that they will be most visible from approximately 3km onwards. The greatest area of visibility is expected to the north and east of the pits, but the ridgeline directly east of the Vlakfontein open pit interrupts the viewshed of this pit in numerous locations.

The Vlakfontein/Groenfontein pits will be visible from several townships located to the north, east and west, but the viewshed is very fragmented in these locations, due to the local topography. The overall level of visibility of the Vlakfontein/Groenfontein pits is expected to be low, as the pits will not be visible from the greatest part of the study area.

The overall level of visibility of the Vogelstruisnek open pit is expected to be low, as it will not be visible from the greatest part of the study area. The Vogelstruisnek viewshed is largely restricted to the east, west and especially south of the open pit, and it is almost completely screened from view to the north. The mine will be visible from the townships of Witpoortjie/Modimong, Maologane, Batlhalerwa and Thlathlonganyane.

6.5.1 Construction

The proposed activity is that of opencast mining only and no additional plant infrastructure, apart from possibly a diesel tank, will be erected. The land clearing, construction and transport activities will be partially visible from several local villages and roads. Significant dust generation would render the activities more visible. The impact is assessed as being of **moderate (SP = 40)** significance.

The following mitigation measures are recommended to reduce the impact to one of **moderate (SP = 30)** significance:

- Wet suppression, applied as and when necessary, to ensure the absence of visible dust;
- Enforce low vehicle speeds on unpaved roads at the mine (< 30 km/h) and unpaved haul roads between the mine and the ore processing plant at Ruighoek (<60 km/h); and
- Vegetate the disturbed areas with a locally indigenous grass species as soon as possible.

Wet suppression is very effective, but for roads chemical binders such as Dustex or Dust-A-Side could also be used.

6.5.2 Operation

The mining and transport activities will be partially visible from several local villages and roads. Significant dust generation would render the activities more visible. The dust plume generated during a blast would be particularly visible, but of short duration. The impact is assessed as being of **moderate (SP = 45)** significance.

The following mitigation measures are recommended to reduce the impact to one of **moderate (SP = 35)** significance:

- Wet suppression, applied as and when necessary, to ensure the absence of visible dust;
- Enforce low vehicle speeds on unpaved roads at the mine (< 30 km/h) and unpaved haul roads between the mine and the ore processing plant at Ruighoek (<60 km/h); and
- Vegetate disturbed areas with locally indigenous species as soon as possible.



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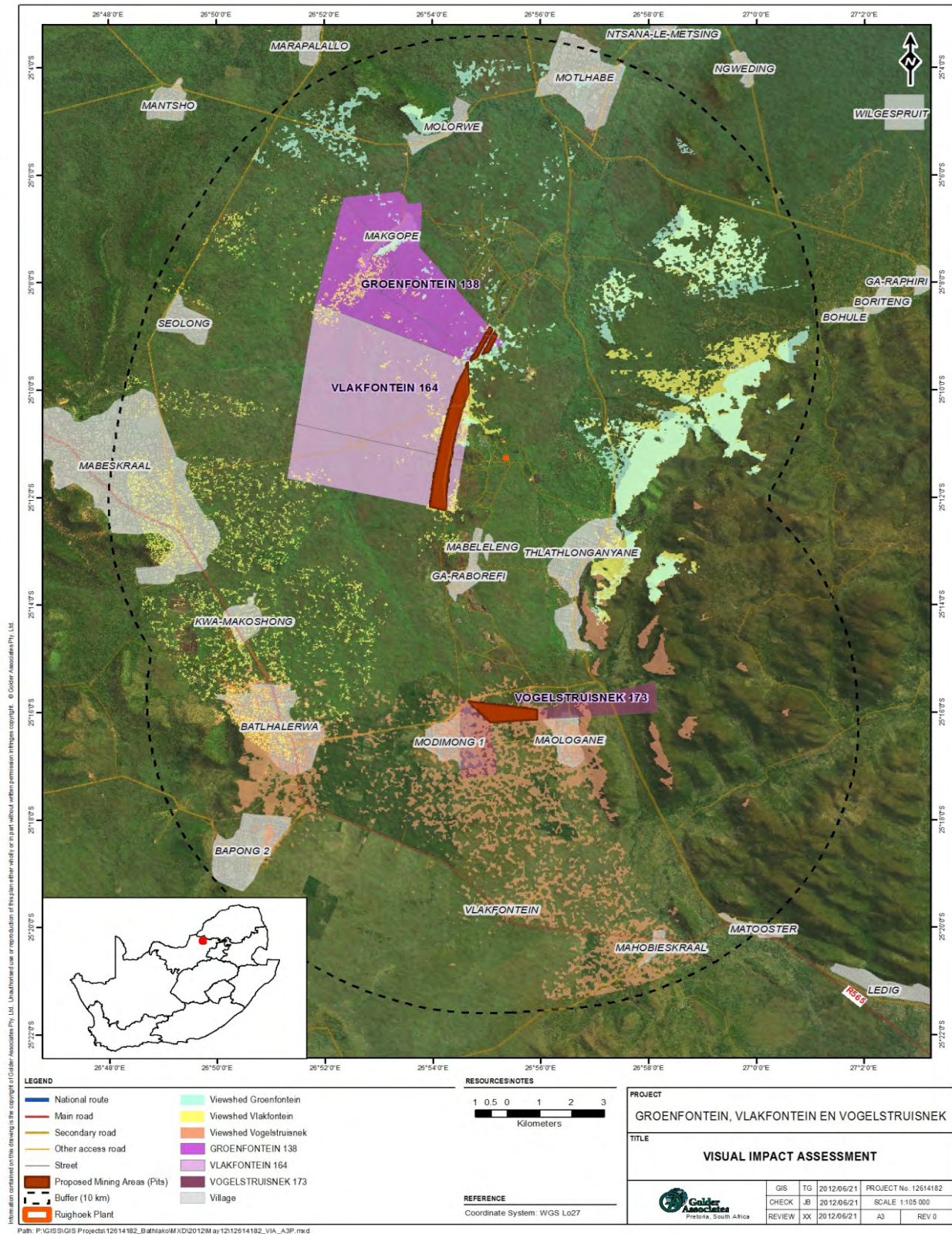


Figure 6-15: Zone of theoretical visibility of proposed opencast mining areas



6.5.3 Closure and rehabilitation

The activities associated with the closure and rehabilitation phase, as described in section 5.4.3, will also be visible from several local villages and roads. The duration will be similar to that of the construction phase, except for post closure monitoring of vegetation and groundwater, which will continue for several years, but will have very low visibility.

The visual impact of the closure and rehabilitation phase is assessed as having **moderate (SP = 40)** significance.

The following mitigation measures are recommended to reduce the impact to one of **moderate (SP = 30)** significance:

- Wet suppression, applied as and when necessary, to ensure the absence of visible dust;
- Enforce low vehicle speeds on unpaved roads at the mine (< 30 km/h) and unpaved haul roads between the mine and the ore processing plant at Ruighoek (<60 km/h);
- Vegetate the disturbed areas with locally indigenous species as soon as possible; and
- Monitor progress until the vegetation has become self-sustaining.

6.6 Noise and vibration

6.6.1 Standards and guidelines

6.6.1.1 Noise

The time-varying characteristics of environmental noise are described using statistical noise descriptors:

- Leq: The Leq is the constant sound level that would contain the same acoustic energy as the varying sound level, during the same period of time;
- LMax: The instantaneous maximum noise level for a specified period of time; and
- LMin: The instantaneous minimum noise level for a specified period of time.

The following relationships occur for increases in A-weighted noise levels:

- The trained healthy human ear is able to discern changes in sound levels of 1 dBA under controlled conditions in an acoustic laboratory;
- It is widely accepted that the average healthy ear can barely perceive noise level changes of 3 dBA;
- A change in sound level of 5 dBA is a readily perceptible increase in noise level; and
- A 10-dBA change in the sound level is perceived as twice as loud as the original source.

The World Bank in its Environmental Health and Safety Regulations applies the following noise level guidelines:

- Residential area – 55 dBA for the daytime and 45 dBA for the nighttime period; and
- Industrial area – 70 dBA for the day- and nighttime periods.

Some of the noise levels that a person is exposed to on a daily basis in the work place and/or in the home environment are listed in Table 6-17.



Table 6-17: General noise levels of daily exposure

Activity	DbA
Whisper	30
Normal conversation	55 – 65
Shouted conversation	90
Baby crying	110
Computer	37 – 45
Radio playing in background	45 – 50
Microwave oven	55 – 60
Washing machine	50 – 75
Clothes dryer	56 – 58
Alarm clock	60 – 80
Television	70
Flush toilet	75 – 85
Ringing telephone	80
Hairdryer	80 – 95
Vacuum cleaner	84 – 89
Maximum output of stereo	100 – 110

In South Africa, the noise impact on human receptors is evaluated in terms of the SANS 10103 guidelines for sound pressure levels as listed in **Table 6-18** and the typical responses as listed in Table 6-19.

Table 6-18: Noise level standards for various districts

Type of District	Equivalent continuous rating level $L_{Req,T}$ for ambient noise - dBA					
	Outdoors			Indoors with windows open		
	Day-night L_{Rdn}	Daytime L_{Rd}	Night time L_{Rn}	Day-night L_{Rdn}	Daytime L_{Rd}	Night time L_{Rn}
Rural districts	45	45	35	35	35	25
Suburban districts with little road traffic	50	50	40	40	40	30
Urban traffic	55	55	45	45	45	35
Urban districts with some workshops, business premises and main roads	60	60	50	50	50	40
Central business districts	65	65	55	55	55	45
Industrial districts	70	70	60	60	60	50

Daytime and night time refer to the hours from 06h00 - 22h00 and 22h00 - 06h00 respectively.



Table 6-19: Typical community response to increase in ambient noise level

Excess $L_{Req,T}$ dBA	Response
0	No reaction
1 -10	Sporadic complaints
5 -15	Widespread complaints
10 - 20	Threats of community/group action
>15	Vigorous community/group action

Excess $L_{Req,T}$ is calculated from the appropriate of the following:

- Excess $L_{Req,T} = L_{Req,T}$ of ambient noise under investigation *minus* $L_{Req,T}$ of the residual noise (determined in the absence of the specific noise under investigation).
- Excess $L_{Req,T} = L_{Req,T}$ of ambient noise under investigation *minus* the typical rating level for the applicable district as determined from Table 6-18

Most people would not notice an increase in noise level of 2 dBA or less. Some people would notice increases of 3-4 dBA, but would not consider them to be serious. Noise increases of 5 dBA and above are very noticeable and, if they occur frequently or are continuous in nature, they could represent a significant disturbance.

6.6.1.2 Vibration

The human body is an excellent detector of vibration and ground vibration is felt at levels far below those that can cause structural damage. Vibration is expressed as the peak particle displacement velocity (PPV), which is approximately correlated to both building damage and annoyance levels to people. The PPV is measured in mm/s. The human body can detect a PPV in the region of 0.2 mm/s and a level of 1.0 mm/s is clearly perceptible.

Structural and/or cosmetic damage to ordinary buildings occurs in the range of 5.0 to 50.0mm/s (*ISO10137* of 1992, British Standards *BS7385* 1993). It is generally accepted that residential buildings of sound construction can safely withstand a peak particle velocity (PPV) in of 50mm/s. Poorly constructed buildings should however not be subjected to PPVs of more than 10mm/s. These levels conform to the British Standards 6472 and the USA Bureau of Mine Standards, RU 8507. Air over pressure levels and PPVs experienced at various distances can be minimised by appropriate blast design.

In addition to ground vibration, surface blasting also causes over pressure. The human response of annoyance to blast vibrations is aggravated by secondary noises such as the rattling of crockery, furniture and walls. Meteorological conditions such as wind speed, direction, temperature, cloud cover and humidity will affect the intensity of the air over pressure levels experienced at a distance from the blasting area. In a motionless atmosphere a doubling of the distance from the blast will result in the air over pressure level (experienced as a shock wave) being attenuated by 6dBA.

A topographic barrier such as an earthen berm or rock face will play an important role in reducing the air over pressure level and the audible effect rather than the concussive effect. Rock formations transmit and generally disperse the vibrations, but in certain configurations they can also direct and focus them.

6.6.2 Assessment of noise and vibration impact

The predicted noise impacts during the various phases of the mining project are discussed below. The type of blasting at the opencast pit will determine the over-air pressure and ground vibration levels experienced at the sensitive receptor areas indicated on Figure 3-10.

Noise levels for typical construction and mining equipment that would be used in the opencast mining operation and the noise level attenuation with distance are shown in Table 6-20.



Table 6-20: Noise level attenuation for typical construction and mining equipment

Equipment	Line-of-Sight Estimated Noise Level Attenuation - dBA						
Distance from Source	5m	15m	35m	75m	155m	315m	635m
Excavator 1200	78.3	68.3	58.3	52.3	46.3	40.3	34.3
Excavator 870	81.4	71.4	61.4	55.4	49.4	43.4	37.4
Excavator 650	81.6	71.6	61.6	55.6	49.6	43.6	37.6
Dozer D11R	89.4	79.4	73.4	76.4	70.4	64.4	58.4
Dozer D10T	88.4	78.4	72.4	66.4	60.4	54.4	49.4
Dozer D9T	96.1	86.1	76.1	70.1	64.1	58.1	52.1
Dozer D155	83.3	73.3	63.3	57.3	51.3	45.3	39.3
Dozer D6R	90.2	80.2	70.2	64.2	58.2	52.2	48.2
Grader 140H	97.4	87.4	77.4	71.4	65.4	59.4	53.4
Tractor-Loader-Backhoe (TLB)	94.4	84.4	74.4	68.4	62.4	56.4	50.4
Tipper Truck	95.0	85.0	75.0	69.0	63.0	57.0	51.0
Terex TR60	99.9	89.9	79.9	73.7	67.7	61.7	55.7
Volvo A40	85.6	75.6	65.6	59.6	53.6	47.6	41.6
HD 325	91.3	81.3	71.3	65.3	59.3	53.3	47.3
Diesel Bowser Hino WHM 503GP	103.4	93.4	83.3	77.3	71.3	65.3	59.3
Lighting Plant	85.8	75.8	65.8	59.8	53.8	47.3	41.3
Bell B40	86.1	76.1	66.1	60.1	54.1	58.1	52.1
Crawler Drill Rand Compressor	96.5	86.5	76.5	70.5	64.5	58.5	52.5
Tornado – Tyre drill	102.0	92.0	82.0	75.0	69.0	63.0	57.0
Drill rig	99.3	89.3	79.3	73.3	67.3	61.6	56.6

The above noise levels represent the maximum levels that will be generated during the construction, operational and closure phases of the mining operations. For health and safety reasons all operators of noisy equipment and all personnel working in areas where the noise level exceeds 85 dBA must wear hearing protection.

There are no residential areas in close proximity to any of the proposed mining areas. The villages closest to the proposed Vogelstruisnek opencast pit are Witrantjies to the west (630m) and Maologane to the east (635m). The villages closest to the proposed mining areas on Groenfontein and Vlakfontein are Thorosane (770m) and Malawi village (960m).

Noise attenuation over distance depends on the topography, vegetation cover, temperature, humidity and wind direction. Greater attenuation occurs over undulating terrain with high vegetation cover. Temperature inversion conditions, which occur mainly during the night-time, can result in higher levels of noise being propagated over longer distances.

The current, pre-project noise levels, as measured on 15 and 16 May 2012 (van der Merwe, B., June 2012) at the residential areas closest to the proposed mining areas are listed in Table 6-21 below.



Table 6-21: Pre-project noise levels at nearest residential areas

Village	Daytime - dBA	Night time dBA
Thorosane	40.4	40.7
Witrantjies	44.1	35.4
Phalane	37.0	29.2
Mabeskraal	42.1	32.8
Maologane	41.9	37.5

6.6.2.1 Construction

6.6.2.1.1 Noise

There will be an increase in earthmoving activities and traffic to and from the proposed mining areas during the construction phase. After construction of the short sections of haul road shown in Figure 6-7, the currently existing haul roads will be used to transport the construction equipment and material to the site. Such transport will add to the existing intermittent noise along the length of the road, caused by current traffic.

The construction activities described in section 5.4.1 will be of short duration, no more than two months at each mining area and the noise will be intermittent. As can be seen from **Table 6-18** and Table 6-20, the use of some items of equipment could result in noise levels at the nearest villages (630 m) that would exceed the recommended daytime limits for rural and suburban districts, but not the guidelines for urban traffic. The use of such equipment during the night could result in unacceptable levels at a distance of 630 m.

Without mitigation, the noise impact is assessed as **moderate to high (SP = 75)**. The following mitigation measures are recommended:

- No construction activities to be undertaken during night-time (22h00 to 06h00)
- Selecting equipment with lower sound power levels;
- Installing silencers for fans;
- Installing suitable mufflers on engine exhausts and compressor components; and
- Installing acoustic enclosures for equipment causing radiating noise.

Application of the recommended mitigation measures are expected to reduce the noise impact to a level of **low (SP = 24)** significance.

6.6.2.1.2 Vibration

The pre-project ground vibration levels recorded at the measuring positions shown in Figure 3-10, which included residential areas in the vicinity, were all below 1.0 mm/s peak particle velocity (PPV) and are considered to be insignificant. The construction activities described in section 5.4.1 will not cause any noticeable vibration levels at any of the measuring positions.

6.6.3 Operation

6.6.3.1.1 Noise

The noise levels during the operational phase of the opencast mine will be more constant than during the construction phase, but similar in nature to that generated by the existing mining activities in the area.

The line of sight attenuation of noise levels with distance over flat, bare terrain is indicated in Table 6-22. Noise propagation from in-pit operations is partially directed upwards and partially absorbed by the



surrounding pit walls. When drilling takes place at the same time as mining, the noise levels increase by about 4 dBA.

The presence of vegetation and variations in terrain, such as stockpiles or earthen berms between the source and the receptor, can reduce the noise level at any given point by about 12 dBA.

Table 6-22: Typical attenuation of mining noise

Distance from source	Noise level (dBA)				
	40m	120m	280m	600m	1800m
(a) Opencast mining activities	65.5	59.5	53.5	47.5	41.5
(b) Core drilling	69.5	63.5	57.5	51.5	46.5
(c) Cumulative noise level for both above activities	70.9	64.9	58.9	52.9	47.6
(d) Noise level corrected for terrain features	58.9	52.9	46.9	40.9	34.9

Hauling of ore from the mining operations to the processing facilities at Ruighoek will not add significantly to the existing traffic noise along the haul roads.

Calculated noise contours for the proposed opencast mining operations during the operational phase are shown in Figure 6-16.

Noise intrusion levels, defined as the increase in noise level above the current pre-project level, were calculated at each of the villages in Table 6-21. Maologane and Witrantjies are predicted to experience intrusion levels of 3.4 and 5.5 dBA respectively during the night-time, which would be expected to lead to complaints (see Table 6-19). No other villages are likely to experience intrusive noise.

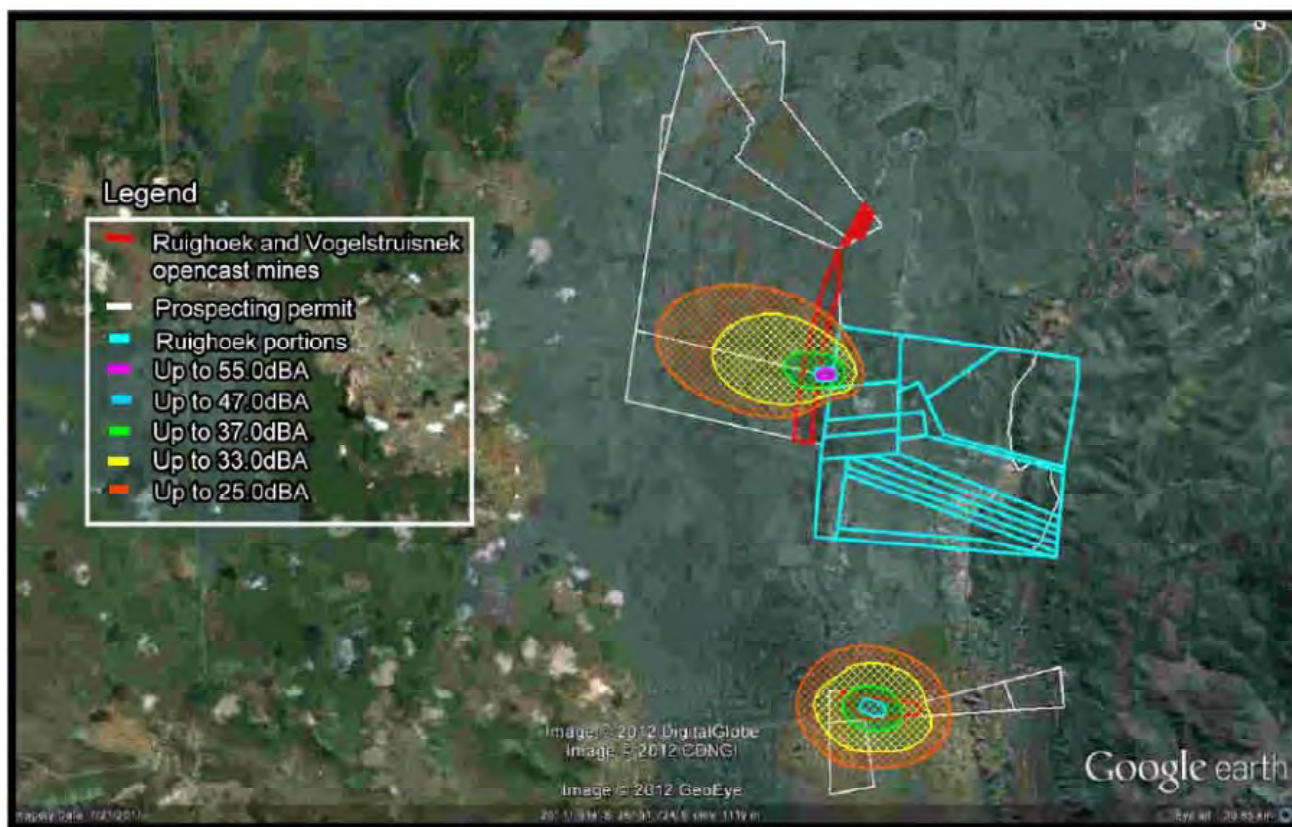


Figure 6-16: Noise contours during the operational phase of the opencast mines



6.6.3.1.2 Vibration

The type of blasting method will determine the air over-pressure and ground vibration levels that people and structures will experience at various locations. During a blast in an opencast mine 20 to 30 percent of the energy is utilised to fragment the rock or other surrounding materials which result in pieces of surface rock becoming airborne (referred to as fly-rock). Some of the remainder of the energy is transmitted through the earth in the form of pulsating waves or vibrations. The rest is dissipated through the air in the form of over-pressure and noise.

Table 6-23: Response of humans and structures to vibration

Measure	Units – mm/s	Comments
Human perception	0.15 to 1.5	
Visible damage	50	Values in excess cause appreciable structural damage
Permissible impulsive vibration at residential property	8.5 to 12.7	British Standard (BS 64722.1992)

With conventional blasting the ground vibration levels may increase to 12 mm/s at a distance of 400m from the blasting site, depending on the explosives used and the blast design.

All the noise sensitive areas indicated in Figure 3-10, including Witrantjies and Maologane, are situated outside the safe distance of 500m designed to protect against damage from fly rock, noxious fumes, air over-pressure and ground vibration. The air over-pressure will increase to 89.0dB at a distance of 700m from the blasting area which will be significant in this area with low prevailing ambient noise levels, although the noise will last for only about 3 seconds. The noise contours resulting from a blast are illustrated in Figure 6-17.

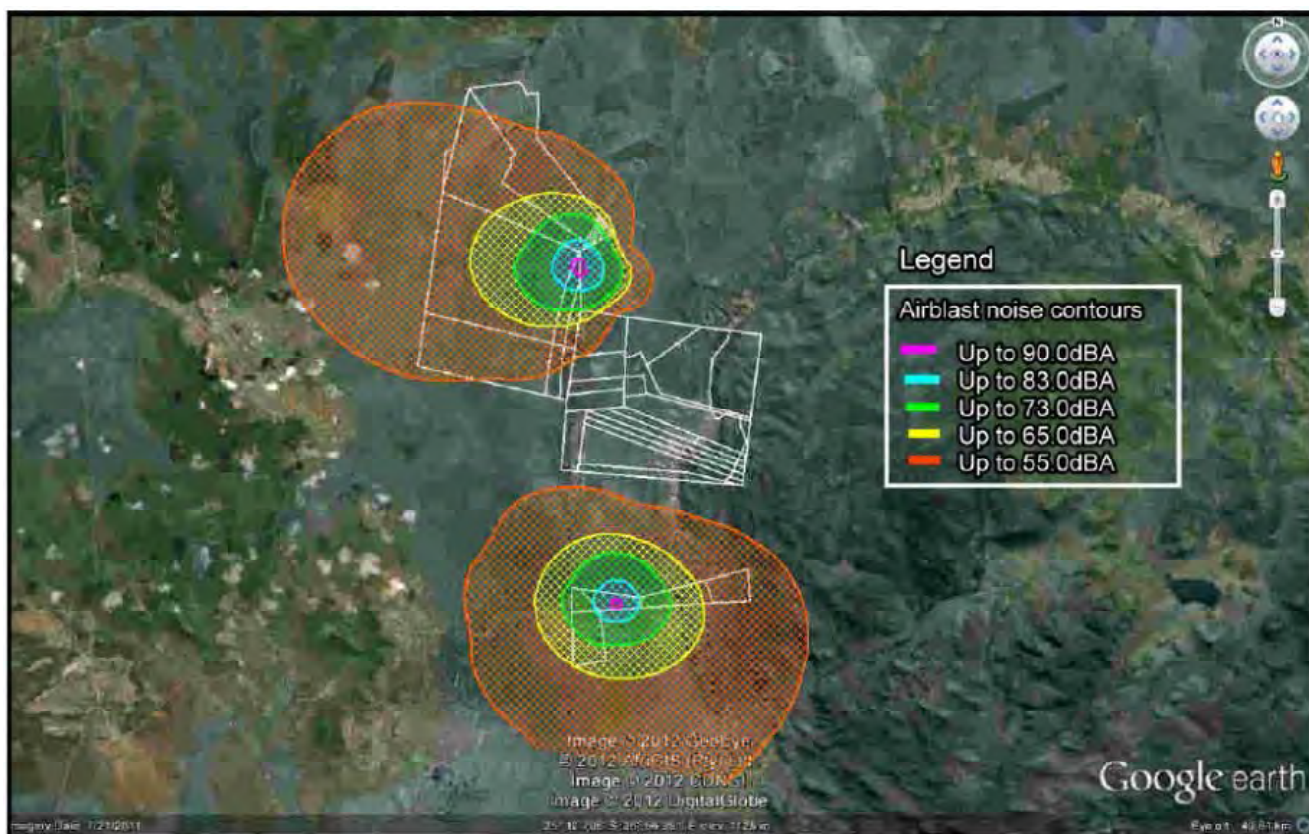


Figure 6-17: Air blast noise contours during blasting at the opencast pits



The noise and vibration impacts are assessed as being of **moderate (SP = 65)** significance before mitigation, reducing to **moderate (SP = 45)** significance upon implementing the following mitigation measures:

- Measuring noise levels at any village closer than 1 000 m to an open pit;
- Maintaining all mining and transport machinery in good condition, with special reference to noise reduction equipment;
- Erecting an earthen berm of up to 15m high between the perimeter of the pit and any village where intrusive noise originating from the mining operations is experienced: and
- If intrusive noise at a residential area persists despite the above measures, night-time (22h00 to 06h00) mining operations should be avoided at the relevant mine.

6.6.4 Closure and rehabilitation

The activities associated with the closure and rehabilitation phase, as described in section 5.4.3, will generate similar, but probably lower, noise and vibration levels than those experienced during the construction phase. The duration will also be similar, except for post closure monitoring of vegetation and groundwater, which will continue for several years, but will not have any noise or vibration impacts.

Without mitigation, the noise impact is assessed as **moderate to high (SP = 60)**. The following mitigation measures are recommended:

- Sound-absorbing berms to be demolished last;
- No noisy activities to be undertaken during night-time (22h00 to 06h00)
- Selecting equipment with lower sound power levels; and
- Maintaining noise abatement equipment in good condition.

Application of the recommended mitigation measures are expected to reduce the noise impact to a level of **low (SP = 24)** significance.

6.7 Cultural and heritage impacts

A Phase I Heritage Impact Assessment (HIA) study, as required in terms of Section 38 of the National Heritage Resources Act, Act 25 of 1999, was done on the portions of the farms Groenfontein 134JP, Vlakfontein 164JP and Vogelstruisnek 174JP that would be affected by Batlhako Minings' proposed mining activities.

Databases kept and maintained at institutions such as the North-West Heritage Resources Agency (SAHRA) in Mafikeng and the Archaeological Data Recording Centre at Museum Africa in Pretoria were consulted to determine whether any heritage resources had been identified during earlier archaeological surveys in the project area. The 2526BD Mabaalstad & 2526BB Mabeskraal, 1: 50 000 topographical maps were also consulted.

The project area was reconnoitred with a vehicle where there were accessible roads, but parts of the proposed new mining areas were covered on foot. The Phase I HIA revealed three examples of the types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act. See Table 6-24 and Figure 6-18.



Table 6-24: Heritage resources within project area

Reference	Stone walled sites	Coordinates	Level of significance
LIA01	Large extended stone-walled site	25° 10.898'S; 26° 54.389'E	High
LIA02	Rudimentary, small stone-walled site	25° 16.003'S; 26° 55.864'E 25° 16.001'S; 26° 55.848'E 25° 15.991'S; 26° 55.821'E	Medium-High
GY01	Graveyard with more than 50 graves near southern perimeter of project area	25° 16' 07.90"S; 26° 56' 04.67"E	High

Archaeological sites are protected by Section 35 of the National Heritage Resources Act. Site LIA01 is of high significance and LIA02 is of medium-high significance when considering criteria such as the following:

- The sites were probably occupied by ancestral Batlhako communities whose descendants may still live in the area;
- The sites may contain graves, which would require certain procedures before the sites may be disturbed;
- These are two of a number of sites that are scattered along the Thlorosane mountain range. Such sites are part of the cultural landscape;
- The sites are relatively pristine and have some research potential. They should not be destroyed before they have been researched.



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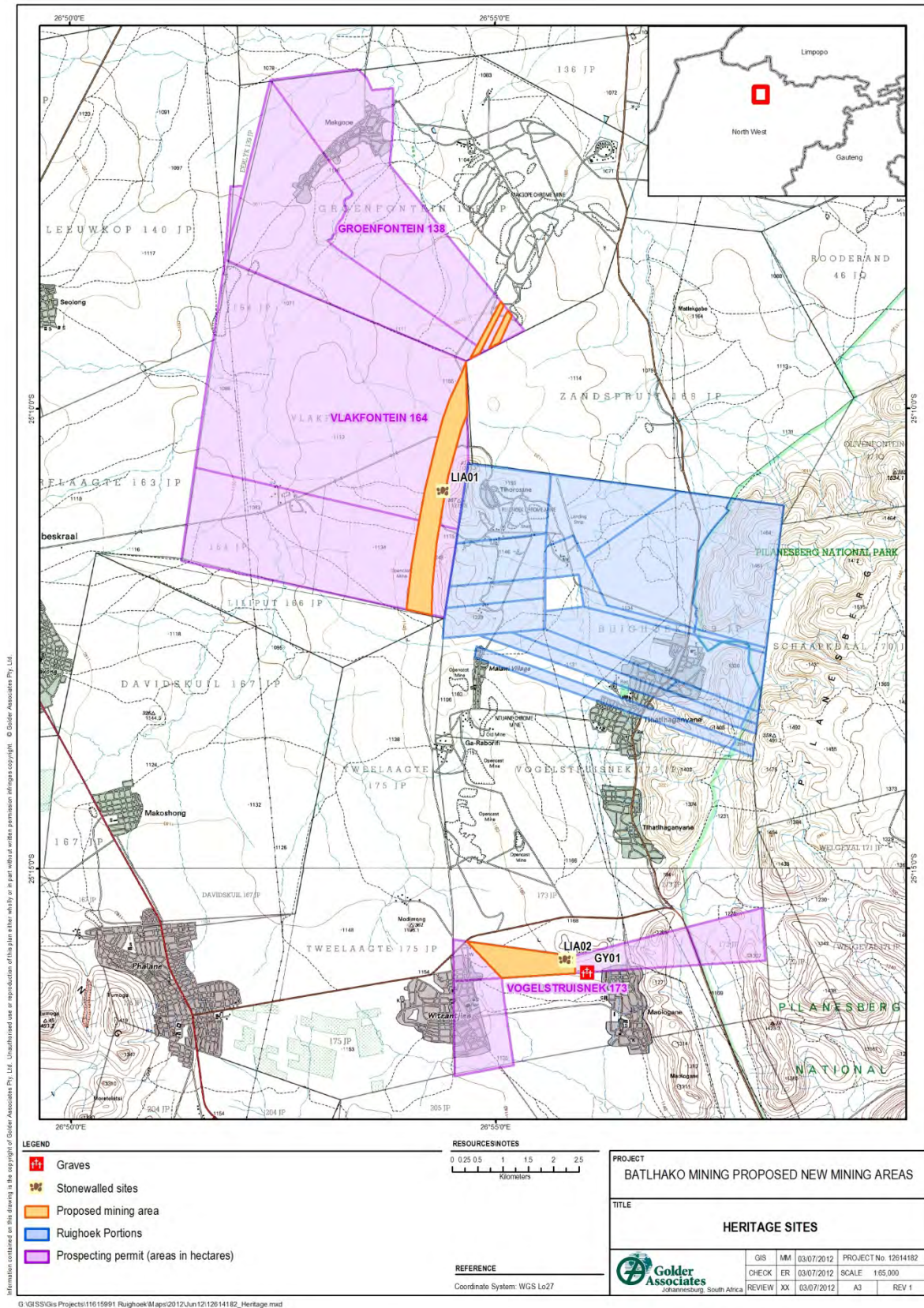


Figure 6-18: Location of identified heritage sites



Site LIA01 occurs along the western foot of the Thlorosane Mountain range on Vlakfontein 168 JP. This site is well preserved and occurs to the east of the dirt road which runs from north to south along the western side of this mountain range. See Figure 6-19.



Figure 6-19: Site LIA01 dating from the Late Iron Age on Vlakfontein 168 JP

Site LIA02 comprises rudimentary stone walls along the southern foot of the low kopje which occurs in the north-eastern corner of the proposed mining area on Vogelstruisnek 173 JP. The site is relatively pristine. It is marked by low walls which were constructed with small stones, but there are also heavy, double row foundation stones.



Figure 6-20: Site LIA02 at the southern foot of a low kopje in the Project area on Vogelstruisnek 173 JP



A formal graveyard (GY01), encompassing more than fifty graves, most of which are decorated with granite headstones and trimmings, is situated near the southern perimeter of the Project Area on Vogelstruisnek 173 JP. See Figure 6-21.



Figure 6-21: Formal graveyard (GY01) near the Project Area on Vogelstruisnek 173 JP

All graves and graveyards hold high significance and are protected by various laws. Legislation with regard to graves includes Section 36 of the National Heritage Resources Act (No 25 of 1999) whenever graves are older than sixty years. The act also distinguishes various categories of graves and burial grounds. Other legislation with regard to graves includes those which apply when graves are exhumed and relocated, namely the Ordinance on Exhumations (No 12 of 1980) and the Human Tissues Act (No 65 of 1983 as amended).

The exhumation of human remains and the relocation of graveyards are regulated by various laws, regulations and administrative procedures. The task must be undertaken by forensic archaeologists or by reputable undertakers who are acquainted with all the administrative procedures and relevant legislation that have to be complied with. This process also includes social consultation with a 60 days statutory notice period for graves older than sixty years. Permission for the exhumation and relocation of human remains has to be obtained from the descendants of the deceased (if known), the National Department of Health, the Provincial Department of Health, the Premier of the Province and the local police.

Ground visibility was low on portions of the study area due to high vegetation growth and steep mountains and the possibility of the occurrence of unmarked or informal graves and subsurface finds cannot be excluded. If any finds are made during the mining activities the operations will have to be stopped and a qualified archaeologist contacted for an assessment of the find.

6.7.1 Construction

Taking the positions of the identified heritage resources as shown in Figure 6-18 into consideration, they need not be affected during the construction phase. However, the stone age sites are not obvious to the layman and careless, unsupervised construction could severely damage or destroy sites LIA01 and LIA02, which would constitute an impact of **high (SP = 90)** significance. It is also possible for sub-terranean resources to be unearthed during excavation activities.



The graveyard is visible, easily recognisable and not within the boundaries of the proposed mining areas. Damage to site GY01 would constitute a wilful act and the perpetrator(s) could face criminal prosecution.

The potential impact could be reduced to one of **very low (SP = 9)** by application of the following mitigation measures:

- Clear demarcation of the three sites;
- Prohibiting access to and any form of interference with the three sites by Batlhako's personnel and contractors;
- Proper briefing of all relevant Batlhako and contractor personnel on the locations of the sites and the importance of avoiding damage to them; and
- Educating relevant Batlhako and contractor personnel on how to recognise a possible heritage site and encouraging them to report any potential site they might find. If any chance finds occur, work in their vicinity must cease until they have been examined by a qualified archaeologist.

6.7.2 Operation

Site LIA01 is located to the east of the dirt road that runs along the western side of the Tlhorosane mountain range. The planned mining area on Vlakfontein 164 JP lies immediately to the west of this dirt road. Site LIA02 is located at the edge of the planned mining area on Vogelstruisnek 173 JP. The graveyard GY01 is not located close to any of the planned mining areas listed in Table 6-24 and indicated on Figure 6-18.

The heritage sites need not be affected by the operational phase of Batlhako's proposed project, but careless mining operations could severely damage or destroy them, which would constitute an impact of **high (SP = 90)** significance. It is also possible for sub-terranean resources to be unearthed during excavation activities.

The graveyard is visible, easily recognisable and not within the boundaries of the proposed mining areas. Damage to site GY01 would constitute a wilful act and the perpetrator(s) could face criminal prosecution.

The potential impact could be reduced to one of **low (SP = 30)** significance by implementing the following mitigation measures:

- Clearly demarcating the three sites;
- Maintaining a buffer zone of at least 50 metres between the graveyard and any mining activities;
- Fencing off site LIA02 and not mining closer than 15 metres to it. Alternatively, to obtain permission to destroy it after having it properly researched and documented;
- Prohibiting access to and any form of interference with the three sites by Batlhako's personnel and contractors;
- Proper briefing of all relevant Batlhako and contractor personnel on the locations of the sites and the importance of avoiding damage to them; and
- Educating relevant Batlhako and contractor personnel on how to recognise a possible heritage site and encouraging them to report any potential site they might find. If any chance finds occur, work in their vicinity must cease until they have been examined by a qualified archaeologist.

6.7.3 Closure and rehabilitation

When this phase commences, the protection measures instituted for sites LIA01 and GY01, as described in sections 6.7.1 and 6.7.2 will have been in place for at least two years and site LIA02 will have either been legally destroyed or protected.



Nevertheless, it is possible that new contractors or Batlhako personnel undertaking the closure and rehabilitation activities may be careless or simply unaware of the heritage sites and the protection measures, and that one or more of the sites is either severely damaged or destroyed. Such an outcome would constitute an impact of **high (SP = 90)** significance.

The potential impact could be reduced to one of **low (SP = 30)** significance by implementing the following mitigation measures:

- Maintaining the demarcation of the sites and the protection measures described in sections 6.7.1 and 6.7.2;
- Maintaining a buffer zone of at least 50 metres between the graveyard and any rehabilitation activities;
- Prohibiting access to and any form of interference with the three sites by Batlhako's personnel and contractors;
- Proper briefing of all relevant Batlhako and contractor personnel on the locations of the sites and the importance of avoiding damage to them; and
- Educating relevant Batlhako and contractor personnel on how to recognise a possible heritage site and encouraging them to report any potential site they might find.

6.8 Soils, land capability and land use

6.8.1 Construction

During the construction operations described in section 5.4.1, topsoil will be stripped from a limited area, where construction will take place and ahead of the first mining cut and stockpiled, separately from subsoil and overburden, for use in the rehabilitation phase. Potential impacts on the topsoil are:

- Degradation of quality due to mixing with subsoil;
- Loss of topsoil due to water and wind erosion;
- Contamination with hydrocarbons and hydraulic fluids; and
- Colonisation of the stockpile by weeds.

The impact is rated as being of **moderate (SP = 35)** significance and can be mitigated to **low (SP = 25)** significance by:

- Careful stripping and stockpiling to avoid mixing topsoil and subsoil as far as possible;
- Limiting the stockpile height to 3 metres and the slope to 1 in 4, and rounding the top edges;
- Keeping the stockpile moist;
- Vegetating the stockpile with locally indigenous grass species; and
- Regular weeding.

6.8.2 Operation

During the operational phase as described in section 5.4.2, a total of about 360 ha of topsoil will be stripped, temporarily stockpiled and re-placed after the void behind the mining front has been backfilled with overburden and subsoil. The same impacts as those pertaining to the construction phase may be expected, but over a much larger area, resulting in an impact of **moderate (SP = 55)** significance.

The following mitigation measures should be applied to reduce the impact to one of **low (SP = 28)** significance:



- Careful stripping and stockpiling to avoid mixing topsoil and subsoil as far as possible;
- Limiting the stockpile height to 3 metres and the slope to 1 in 4, and rounding the top edges;
- Keeping the stockpile moist;
- Vegetating the stockpile with locally indigenous grass species; and
- Regular weeding.

6.8.3 Closure and rehabilitation

Unless due care is taken with the placement of topsoil during closure and rehabilitation, significant loss of soil quality may occur as a result of mixing with subsoil and overburden, contamination with hydrocarbons and hydraulic fluids, erosion and weed infestation, resulting in a long term impact of **high (SP = 75)** significance. The following mitigation measures should be applied to reduce the impact to one of **moderate (SP = 35)** significance:

- The overburden should be spread out and profiled to promote free draining;
- The topsoil should be spread over the overburden and also profiled to promote free draining;
- Use light agricultural machinery and avoid compaction of the topsoil;
- Sample and analyse the soil after placement and add nutrients (compost and fertiliser) as advised by a qualified agronomist;
- Revegetate with local grass, forb, shrub and tree species under the direction of a qualified botanist; and
- Monitor rehabilitation progress three-monthly until the vegetation becomes self-sustaining. Repair any erosion rills that may have developed and, if any bare patches larger than 4 m² are found, they must be re-vegetated after investigating the reasons and taking remedial action.

6.9 Socio-economics

6.9.1 Construction

The construction phase is expected to involve 10 to 15 workers for about 3 months and to require an expenditure of about R2.5 million, resulting in a **low, but positive (SP = +12)** socio-economic impact that could be enhanced to a **low, but positive (SP = +21)** impact by using local contractors and purchasing materials locally.

6.9.2 Operation

The operational phase is expected to create 10 new jobs and to last for about 6 to 8 years. The annual expenditure is estimated at R1.6 million in wages and R38.2 million on materials, goods and services, which would result in a positive socio-economic impact of **low, but positive (SP = +16)** significance that could be enhanced to a **low, but positive (SP = +30)** impact by employing local people and purchasing materials, goods and services locally.

6.9.3 Closure and rehabilitation

Closure, rehabilitation and monitoring will require the occasional services of only two or three people, who would be on the permanent staff of the Ruighoek mine, i.e. the 10 jobs created by the operational phase would be lost and the expenditure that was associated with the operational phase would be reduced significantly. The socio-economic impact would be of **moderate (SP = 40)** significance to Batlhako's workforce. The impact can be reduced to one of **low (SP = 20)** significance by proper planning and training, that would allow 10 jobs to lapse from Batlhako's overall operations by attrition and/or assist retrenched workers to find alternative employment.



7.0 SUMMARY OF ENVIRONMENTAL IMPACTS

7.1 Construction Phase

Table 7-1 below summarises those impacts directly related to the Construction Phase of the proposed project, and provides a significance rating for each impact before and after mitigation.

Table 7-1: Environmental Impact Assessment Matrix for the opencast mining activities on Groenfontein, Vlakfontein and Vogelstruisnek

POTENTIAL ENVIRONMENTAL IMPACT: CONSTRUCTION PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	SP	Rating	M	D	S	P	SP	Rating
<i>1. Geology</i>												
Only surface activities involved – no effect on existing geology	1	1	1	0	0	None	1	1	1	0	0	None
<i>2. Air Quality</i>												
Vegetation clearing, haul road construction and earthmoving activities will cause particulate mobilisation, resulting in increased PM ₁₀ concentrations and dust fall.	6	2	3	5	55	Mod	2	1	2	3	15	Low
<i>3. Soil, land use and capability</i>												
Topsoil can be lost or contaminated, but the construction phase will affect a very limited area at each target mining area.	4	2	1	5	35	Mod	2	2	1	5	25	Low
<i>4. Surface water and drainage</i>												
The removal of vegetation and the hardening of surfaces will result in additional runoff, which could cause local erosion and scour, resulting in the transport of more silt into local watercourses. Spillage of oils, fuel and chemicals could pollute proximal water bodies. The construction and/or use of roads at drainage line crossings could impact on the banks of streams and the flow hydraulics;	8	3	2	4	52	Mod	4	3	2	3	27	Low
<i>5. Groundwater</i>												
Accidental spillage of oil or other hydrocarbons and pollutants from construction vehicles may result in groundwater contamination.	4	4	2	4	40	Mod	2	1	1	2	8	Low



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POTENTIAL ENVIRONMENTAL IMPACT: CONSTRUCTION PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	SP	Rating	M	D	S	P	SP	Rating
6. Ecology: fauna and flora												
Stripping of vegetation prior to mining of the first cut and construction of the diesel storage facilities and haul roads will destroy habitat and disturb fauna in the area.	6	2	2	5	50	Mod	4	2	1	5	35	Mod
7. Noise and vibration												
Increase of noise levels at some public receptor points due to noise generated by construction equipment. Vibration levels remain insignificant.	10	2	3	5	75	Mod	4	2	2	3	24	Low
8. Visual aspects												
The construction activities will be visible from several local villages and roads. Significant dust generation would make them more visible.	4	2	2	5	40	Mod	2	2	2	5	30	Mod
9. Heritage												
Careless, unsupervised construction could severely damage or destroy heritage sites	10	5	3	5	90	High	1	1	1	3	9	Low
10. Socio-economic												
Creation of employment opportunities and local spend on goods, materials and services	1	2	3	2	12	Low	2	2	3	3	21	Low



7.2 Operational Phase

Table 7-2: Environmental Impact Assessment Matrix for the opencast mining activities on Groenfontein, Vlakfontein and Vogelstruisnek

POTENTIAL ENVIRONMENTAL IMPACT: OPERATIONAL PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	SP	Rating	M	D	S	P	SP	Rating
1. Geology												
The topsoil, subsoil and overburden will be displaced from the moving mining front to the void behind it and the chromite ore will be removed. These effects will be permanent	10	5	2	5	85	High	6	5	1	5	60	Mod
2. Air Quality												
Blasting, removing and stockpiling topsoil and overburden, backfilling the mining void, and hauling the ore to Ruighoek for processing will cause particulate mobilisation, resulting in increased PM ₁₀ concentrations and dust fall. At Vlakfontein, exceedance of all standards and at Vogelstruisnek exceedance of the daily PM ₁₀ is expected at significant distances beyond the mine boundaries.	10	2	3	5	75	High	4	3	3	5	50	Mod
No exceedances expected at Groenfontein	2	2	2	5	30	Mod	2	2	1	5	25	Low
3. Soil, Land use and capability												
The topsoil will be stripped over an area of some 360 ha ahead of the moving mining front and stockpiled for later use. Soil degradation, contamination and loss is possible	8	2	1	5	55	Mod	4	2	1	4	28	
4. Surface water and drainage												
Mining of the pits will reduce the catchment area that feeds the local surface water resources and the flow that reports to the river system will be reduced. The reduction is estimated at less than 10%;	10	4	3	5	85	High	6	1	2	2	18	Low
The water collected in the pits will be pumped to a local storage dam, which has the potential to spill mine water into the river system. The mine water could be acidic and could contain high concentrations of dissolved salts, hydrocarbons, toxic metals and suspended solids; and												
The mining process will destroy the perched aquifer system and after rehabilitation the recharge water will report directly to the backfill and then to the pit floor.												
5. Groundwater												
Pit dewatering is likely to reduce local borehole yields moderately and cause minor reductions in baseflow of nearest watercourses	8	3	3	4	56	Mod	6	3	3	4	48	Mod



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POTENTIAL ENVIRONMENTAL IMPACT: OPERATIONAL PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	SP	Rating	M	D	S	P	SP	Rating
6. Ecology: fauna and flora												
Cleared and disturbed areas will be susceptible to erosion and invasion by exotic plant species or dominance by indigenous ruderal species, thereby reducing overall floral diversity												
Mining will make the area accessible to more people and may lead to increased poaching												
Chemical spills and dust fall can damage plants and inhibit growth												
Noise and vibration can drive sensitive fauna species away												
The mining and hauling operations will represent a barrier to the movement of some animals and the vehicles will be a danger to animals crossing the roads; and												
The clearing of vegetation and the displacement of soil may result in the destruction or disturbance of Red Data and protected species.												
The above impacts are rated as follows:												
On undisturbed land:	8	4	2	5	70	Mod	6	4	1	5	55	Mod
On previously disturbed land:	2	2	1	5	25	Low	1	2	1	5	20	Low
7. Noise and vibration												
Night-time mining operations would cause intrusive noise levels in the villages of Maologane and Witrantjies and blasting operations would cause high noise levels of short (3 seconds) duration, but structural damage is unlikely. No other villages will be affected significantly.	10	1	2	5	65	Mod	6	1	2	5	45	Mod
8. Visual aspects												
Mining activities will be visible from several local villages and roads. Significant dust generation would make them more visible.	4	3	2	5	45	Mod	2	3	2	5	35	Mod
9. Heritage												
Careless mining operations could severely damage or destroy heritage sites	10	5	3	5	90	High	4	5	1	3	30	Low
10. Socio-economic												
Operational phase will create about 10 new jobs and result in annual expenditure of about R39.8 million for 6 – 8 years.	2	3	3	2	16	Low	4	3	3	3	30	Low



7.3 Closure and rehabilitation Phase

Table 7-3: Environmental Impact Assessment Matrix for the opencast mining activities on Groenfontein, Vlakfontein and Vogelstruisnek

POTENTIAL ENVIRONMENTAL IMPACT: CLOSURE AND REHABILITATION PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	SP	Rating	M	D	S	P	SP	Rating
<i>1. Geology</i>												
Filling of the last-mined void will result in the displacement of the first-mined topsoil, subsoil and overburden material	6	5	2	5	65	Mod	4	5	1	5	50	Mod
<i>2. Air Quality</i>												
No air quality impacts expected from operation of IWWM project												
<i>3. Soil, land use and capability</i>												
Incorrect procedures can cause long term loss of soil and soil quality	10	4	1	5	75	High	2	4	1	5	35	Mod
<i>4. Surface water and drainage</i>												
Groundwater will seep into the pits from the sidewalls and precipitation will percolate through the topsoil and subsoil. The pits will fill and polluted mine water may decant to the river system.	10	5	3	5	90	High	6	1	2	2	18	Low
<i>5. Groundwater</i>												
As in the construction phase, accidental spillage of oil or other hydrocarbons and pollutants from construction vehicles may result in groundwater contamination.	4	4	2	4	40	Mod	2	1	1	2	8	Low
<i>6. Ecology: fauna and flora</i>												
Residual impacts will remain for many years after mining has ceased. They can be minimised, but not eliminated by the mitigation measures recommended in section 6.4.6												
Residual impacts on previously undisturbed areas	8	5	2	5	75	High	4	4	1	5	45	
Residual impacts on areas that were mined and rehabilitated some 20 years ago	6	4	2	5	60	Mod	2	2	1	5	25	



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POTENTIAL ENVIRONMENTAL IMPACT: CLOSURE AND REHABILITATION PHASE	ENVIRONMENTAL SIGNIFICANCE											
	Before mitigation						After mitigation					
	M	D	S	P	SP	Rating	M	D	S	P	SP	Rating
7. Noise												
Closure and rehabilitation activities will probably generate less noise and vibration than the construction activities	8	2	2	5	60	Mod	4	2	2	3	24	Mod
8. Visual aspects												
The closure and rehabilitation activities, including travel along local dirt roads, will be visible from local villages and roads .	4	2	2	5	40	Mod	2	2	2	5	30	Mod
9. Heritage												
Lack of awareness of heritage sites or lack of care when undertaking closure and rehabilitation activities could lead to severe damage or destruction of heritage sites	10	5	3	5	90	High	4	5	1	3	30	Low
10. Socio-economic												
Monitoring and maintenance will require occasional services of 2 – 3 personnel at Ruighoek mine. Ten operational phase jobs will be lost.	2	4	2	5	40	Mod	1	1	2	5	20	Mod



8.0 PUBLIC PARTICIPATION PROCESS

This section provides an overview of the public participation process undertaken to date in this EIA.

8.1 Announcement and Scoping Phase

The details of the Scoping Phase completed for Batlhako Mining's proposed project are provided below.

Information Gathering, Issues Identification, and Report Writing

Preliminary findings of the Scoping Phase were integrated into a Draft Scoping Report, which was made available to the public for comment from 10 May and 19 June 2012. The public participation process undertaken during the Scoping Phase is described in the next section.

8.1.1 Public Participation during Scoping

Objectives of public participation

The principles that determine communication with society at large are included in the principles of the National Environmental Management Act (NEMA) (Act 107 of 1998, as amended), and the Environmental Impact Assessment (EIA) Regulations GN R.543, R.544 R.545 and R.546.

Public participation is an essential and regulatory requirement for an environmental authorisation process, and is guided by Regulations under the NEMA; specifically the EIA Regulations (GN R.543 of June 2010). Regulation R.543 states: "*Public participation process means a process in which potential interested and affected parties (I&APs) are given an opportunity to comment on, or raise issues relevant to, specific matters.*" Public participation is also a process leading to a joint effort by stakeholders, technical specialists, the authorities and the proponent/developer who work together to produce better decisions than if they had acted independently.

The public participation process is designed to provide sufficient and accessible information to Interested and Affected Parties (I&APs) in an objective manner to assist them to:

During the scoping phase:

- raise issues of concern and suggestions for enhanced benefits;
- verify that their issues have been recorded;
- assist in identifying reasonable alternatives; and
- contribute relevant local information and traditional knowledge to the environmental assessment.

Opportunities for Comment

Documents were available at various stages during the EIA process to provide stakeholders with information, further opportunities to identify issues of concern and suggestions for enhanced benefits and to verify that the issues raised have been considered.

During the impact assessment phase:

- contribute relevant information and local and traditional knowledge to the environmental assessment;
- verify that their issues have been considered in the environmental investigations; and
- comment on the findings of the environmental assessments.

During the decision-making phase:

- Advise I&APs of the outcome, i.e. the authority decision, and how and by when the decision can be appealed.



Identification of Interested and Affected Parties

I&APs were initially identified through a process of networking and referral, obtaining information from Golder's existing stakeholder; conducting title deed searches; liaison with potentially affected parties in the study area; newspaper advertisements; and a registration process involving completion of a registration and comment sheet. The registration sheet encouraged I&APs to indicate the names of their colleagues and friends who may also be interested in participating/registering as stakeholders.

The initial stakeholder database for Batlhako Mining's proposed project for the application for a mining right on the Groenfontein, Vlakfontein and Vogelstruisnek near Pilanesberg comprised a total of 131 I&APs (APPENDIX A). This database was used to announce the proposed project to I&APs.

- Government (national, provincial and local);
- Environmental NGOs;
- Conservation agencies;
- Community representatives and Community Based Organisations (CBOs);
- Business and commerce; and
- Other.

During the Scoping Phase, a total of 67 I&APs (APPENDIX D) registered as stakeholders on the project. In line with the 2010 EIA Regulations, future consultation will take place only with registered I&APs. The relevant authorities, directly affected I&APs, those within a radius of 100 m of the proposed development and key I&APs are registered stakeholders by default.

Register of I&APs

The NEMA Regulations (GN R.543) distinguish between I&APs and registered I&APs.

I&APs, as contemplated in Section 24(4)(d) of the NEMA include: "(a) any person, group of persons or organisation interested in or affected by and activity; and (b) any organ of state that may have jurisdiction over any aspect of the activity".

In terms of the Regulations "registered interested and affected parties" means:

"A...party whose name is recorded in the register opened for that application."

For that purpose, an EAP managing an application must open and maintain a register which contains the names, contact details and addresses of:

- (a) *All persons who; have submitted written comments or attended meetings with the applicant or EAP;*
- (b) *All persons who; have requested the applicant or EAP managing the application, in writing, for their names to be placed on the register; and*
- (c) *All organs of state which have jurisdiction in respect of the activity to which the application relates.*

A Register for I&APs was opened and comprises 67 registered I&APs (see APPENDIX D).

All stakeholders on the initial database received a letter in May 2012 inviting them to register as I&APs. During the initial announcement of the Scoping Phase of the proposed project, few stakeholders have registered formally as I&APs. To ensure that all I&APs received sufficient opportunities to register, they were again invited to register as stakeholders during the public review period of the Draft Scoping Report. Stakeholders were advised that future consultation during the Impact Assessment and Decision-making Phases would only take place with **registered I&APs**, and that unless otherwise indicated, I&APs would be assumed no longer interested. Stakeholders that were involved in the initial consultation and attended the Open Houses that were convened during the Scoping and Impact Assessment Phases were added to the register.



Public participation during Scoping Phase

This section provides a summary of the public participation process followed during the Scoping Phase of the EIA.

Announcement of Proposed Project

The proposed project was announced in May 2012. During the announcement of the proposed project, stakeholders were invited to participate in the EIA and public participation process, to pass on the information to friends/colleagues/neighbours who may be interested and to register as I&APs.

The proposed project was announced as follows:

- Distribution of a Draft Scoping Report (DSR) and a letter of invitation to participate to all I&APs on the database, accompanied by a registration, comment and reply sheet mailed/emailed to the entire stakeholder database. Copies of these documents are attached as APPENDIX B.
- The abovementioned documents were made available at the public places listed on page ii of this report and posted to the Golder website www.golder.com/public;

Public Place	Contact Person	Telephone number
Ruighoek Mine Security Gate Mine	Security guard on duty	
Ba-Leema Clinic	Sister in charge	014 513 0013
Community Leader: Ga-Raborife Village	Mr Raborife	
Community Leader: Morogong Village	Mr Molwana	
Community Leader: Ba-Leema Tribe, Tlhatlhaganyane	Mr F. F. Ntuane	
Golder Associates Africa, Midrand	Ms Nomthi Mnisi	011 313 1072

- An advertisement published in two local newspapers, the Bonus (Monday 7 May 2012) and the Rustenburg Herald (Thursday 10 May 2012) (APPENDIX C); and
- Three (3) A2-size site notices were erected within the 100 meter radius of the proposed project site.



Figure 8-1: Site notices erected around project site

Obtaining Initial Comment

Initial comment was based on the DSR and verbal explanations of the proposed project during telephonic consultations with stakeholders and Open House with I&APs. I&APs could contribute issues either in writing by completing and returning comment sheets, or verbally by phone.



Open House

Stakeholders were invited to attend an Open House on Wednesday 23 May 2012 at the Ruighoek Mine Village Club from 10:00 am until 14:00 am, to discuss questions they may have relating to the Draft Scoping Report. 20 I&APs attended the Open House.

The key objectives of the Open House were to:

- Present the contents of the Draft Scoping Report and Plan of Study for Impact Assessment to I&APs;
- Invite further contributions/comments for consideration in the environmental specialist studies;
- Provide I&APs with an opportunity to verify that their issues were captured correctly; and
- Invite further contributions/comments.

Information was displayed visually and on detailed maps and, where required, explained in the local languages. Copies of the various reports and supporting documents were made available in hard copy and on CD. Relevant legislation, guidelines and other publications were also made available for I&APs' easy reference. Comments and suggestions raised at the Open House were recorded and captured in the Comment and Response Report.



Figure 8-2: Photos of the Open House

Comment and Response Report

Issues raised during announcement of the proposed project in the EIA Scoping and Impact Assessment Phases from 10 May until 6 August 2012 were captured in a Comments and Response Report (CRR), appended to the Final EIA Report as APPENDIX F. This report was updated to include additional contributions received from I&APs up to the end of the Impact Assessment Phase. Proceedings of the open houses (see below) and written comments were captured in the form of a CRR and incorporated into the CRR that is accompanying this report.



Final Scoping Report

The DSR was updated and made available as a Final Scoping Report (FSR) for public review for a period of 21 days, from Wednesday 20 June until Tuesday 10 July 2012. The FSR was submitted to the Department of Mineral Resources (DMR) and the North West Department of Economic Development, Environment, Conservation and Tourism (DEDECT).

As per the requirements of the EIA Regulations, the Final Scoping Report was made available for public review for a period of 21 days, from Wednesday 20 June until Tuesday 10 July 2012. Stakeholders were advised to submit their comment directly to the NWDEDECT with a copy to the Public Participation Office.

8.1.2 Impact Assessment Phase

8.1.2.1 Technical Assessment

The technical assessment during the Impact Assessment Phase of the EIA involved:

- The undertaking of specialist studies identified during the Scoping Phase;
- Compiling the Draft Environmental Impact Report (EIR); and
- Compiling the Environmental Management Plan (EMP).

Impact identification and assessment and detailed in Section x.

8.1.2.2 Public Participation during Impact Assessment

Public participation during the Impact Assessment Phase of the EIA entailed a review of the findings of the EIA that were presented in the Draft EIA Report/ Environmental Management Programme (EMP), and the volume of Specialist Studies. These reports were available for public comment from **27 June to 6 August 2012**. Another Open House (see below) was held on Tuesday 24 July 2012 at the Ruighoek Mine Village Club, from 10:00am until 14:00pm. Open House

Stakeholders were invited to attend an Open House on Tuesday 24 July 2012 at the Ruighoek Mine Village Club from 10:00 am until 14:00 pm. 13 I&APs attended the Open House.

Overlap in commenting periods

Stakeholders would have noticed an overlap between the comment period of the Final Scoping Report and the Draft EIA/EMP Report. This was necessitated by the limited timeframes supplied by the Department of Mineral Resources in order to comply with the requirements of the Mineral and Petroleum Resources Development Act (MPRDA) (Act 28 of 2002).

The key objectives of the Open House event were to:

- Present the findings of the specialist studies presented in the Draft EIA Report/EMP to stakeholders;
- Provide I&APs with an opportunity to verify that the issues raised during the Scoping Phase were considered during the environmental specialist studies in the EIA; and
- Invite further contributions/comments.

Similar to the Open House convened during the Scoping Phase, information was displayed visually and on detailed maps and, where required, explained in the local languages. Copies of the various reports and supporting documents were made available in hard copy and on CD. Relevant legislation, guidelines and other publications were also made available for I&APs' easy reference. Comments and suggestions raised at the Open House were recorded and captured in the Comment and Response Report.



Figure 8-3: Photos of the Open House

8.1.2.3 Final EIA Report

The Draft EIA Report and the Comment and Response Report were updated. All the issues, comments and suggestions raised during the comment period on the Draft EIA Report/EMP were added to the Comment and Response Report (APPENDIX F) of the Final EIA Report/EMP. As per the requirements of the EIA Regulations, the Final EIA Report was made available for public review for a period of 21 days, from **Tuesday 7 August 2012 to Monday 27 August 2012**. Stakeholders were advised by letter of the public review period and opportunity to comment on the report before submission of the report to the competent authorities for a decision on whether or not the proposed project may be implemented.

Golder wishes to express sincere appreciation, on behalf of the entire EIA team, for the time and on-going participation by stakeholders in this EIA.



The Final EIA Report/EMP was submitted to the Department of Mineral Resources (DMR) and the North West Department of Economic Development, Environment, Conservation and Tourism (DEDECT) for a decision about the proposed project.

8.2 Lead Authority's decision

Once the North West DEDECT and DMR have taken a decision about the proposed project, the Public Participation Office will immediately notify I&APs of this decision and of the opportunity to appeal. This notification will be provided as follows:

- A letter will be sent, personally addressed to all registered I&APs, summarising the authority's decision and explaining how to lodge an appeal should they wish to; and
- An advertisement to announce the authorities' decisions will be published in the Rustenburg Herald and Bonus newspapers.

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