APPENDIX H

Environmental Management Programme

August 2012
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June 2012

BATLHAKO MINING (PTY) LTD

Environmental Management Programme for Mining Operations on Groenfontein, Vlakfontein and Vogelstruisnek

DMR Reference Number: **NW 30/5/1/2/2/10007 MR**

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

REPORT

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Department of Mineral Resources
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Batlhako Mining (Pty) Ltd
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EXECUTIVE SUMMARY

This report lists the environmental aspects and potential impacts of planned mining operations by Batlhako Mining on Groenfontein, Vlakfontein and Vogelstruisnek, as described in the EIA Report (Roux, E; Perry, E;, June 2012) submitted in support of a mining right application. The mitigation and monitoring measures that must be implemented to manage the impacts within acceptable limits are also described. These limits are defined in terms of South African and international guidelines, standards and current best practice.

The report also identifies the parties responsible for implementing the mitigation measures, and the monitoring actions required to evaluate environmental performance, which will be the responsibility of Batlhako's Environmental Manager.

This EMP is intended to guide management activities at the mining areas towards best environmental practices and compliance with current environmental legislation. The EMP is a living document which will be reviewed and updated on a regular basis to take into account new developments and new Government and legal requirements as and when they occur.

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1.0 PREAMBLE

This Environmental Management Plan was prepared by Etienne Roux, a senior environmental consultant at Golder Associates Africa (Pty) Ltd, with the following credentials:

Qualifications:

BSc (Chemistry, Physics, Mathematics), Pretoria University, 1961,

MSc (Physical Chemistry), Pretoria University, 1966.

MBL, University of South Africa, 1974.

Experience

Research and development in the fields of industrial chemistry and mineral processing: 12 years

Management of geological exploration teams, research laboratories, pilot plants, and analytical chemistry laboratories: 8 years

Operational management of mining, mineral processing and metallurgical plants, including environmental management and strategic corporate planning: 11 years.

Management of environmental impact assessments, development of environmental management programmmes, environmental, health and safety (EHS) policy development, EHS risk assessment and management, execution of soil and groundwater remediation programmes: 19 years.

2.0 INTRODUCTION

This Environmental Management Plan (EMP) pertains to the construction, operation and eventual closure and rehabilitation phases of new mining operations on Groenfontein, Vlakfontein and Vogelstruisnek. The EMP is based upon the findings of an Environmental Impact Assessment (EIA) Report submitted in support of a mining right application (Roux, E; Perry, E;, June 2012).

The EMP conforms to the requirements of Regulation 51 of the Mineral and Petroleum Resources Development Regulations GN R.527 under the Mineral and Petroleum Resources Development Act (MPRDA, Act 28 of 2002, as amended). It contains a range of general and specific measures to be implemented by Batlhako Mining Ltd (Batlhako) to minimise the adverse and enhance the positive environmental and social impacts of the project during its life cycle. Batlhako is responsible for the undertaking of the specified measures, the monitoring of the results and updating of the EMP as and when required by changing circumstances or legislation.

3.0 PROJECT DESCRIPTION

Batlhako applied for mining rights on the areas on the farms Groenfontein 138 JP, Vlakfontein 168 JP and Vogelstruisnek 173 JP indicated in . 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.

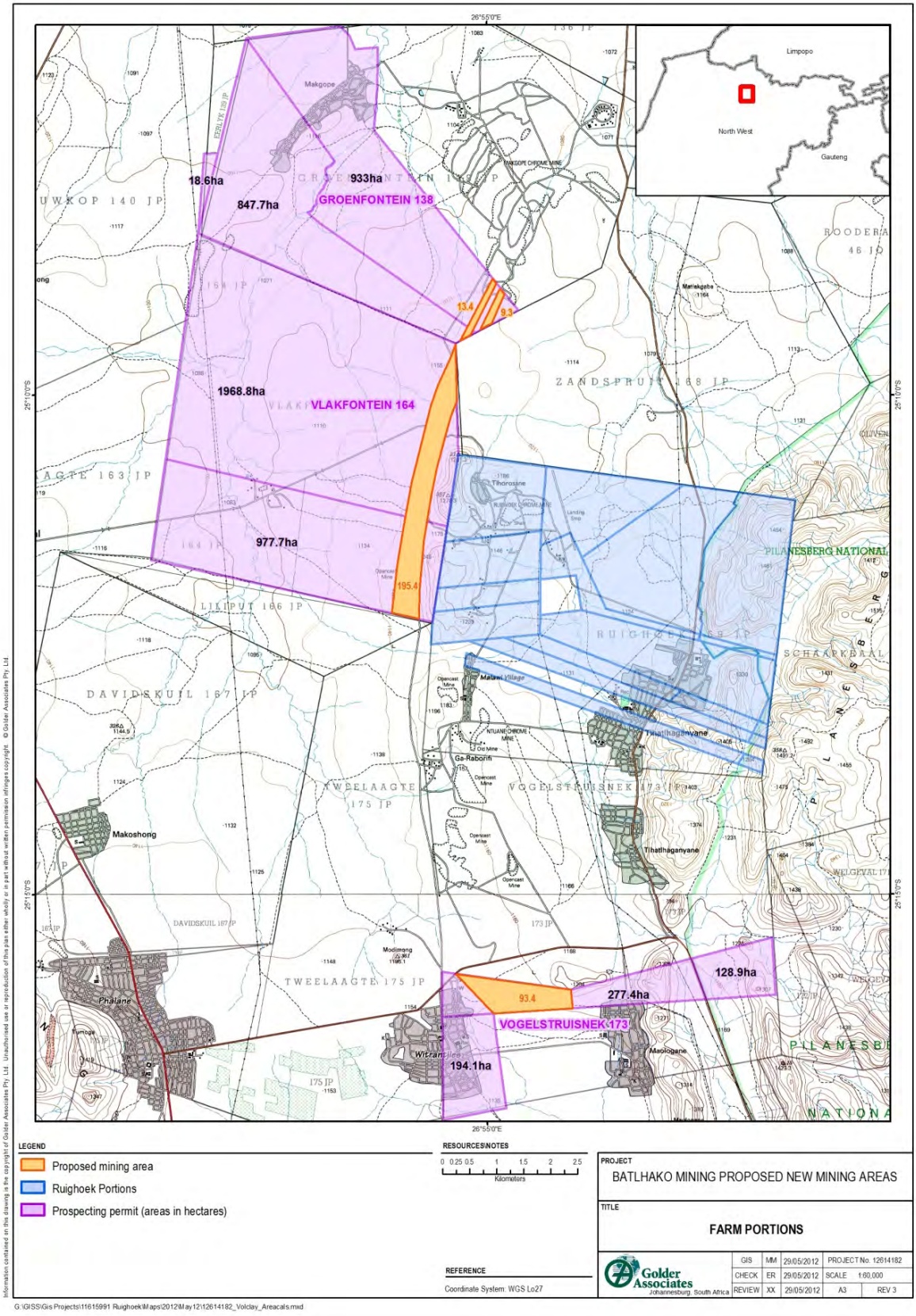

Figure 3-1: New mining areas

The overall objective of the Environmental Management Plan (EMP) is to provide Batlhako and its contractors with practical guidance for the environmentally and socially responsible construction, operation and eventual closure of the mining areas by listing South African and international guidelines and standards and describing the actions to be taken to achieve them.

Batlhako has a legal obligation to comply with the EMP and to procure compliance from its contractors and agents, where relevant.

Batlhako will appoint an Environmental Coordinator (EC) who will be responsible for ensuring acceptable environmental performance of the project throughout its life cycle, from the construction phase, through the operational phase, to the decommissioning and closure phase. Specific responsibilities of the EC will be to:

1) Verify the implementation of the mitigation measures;

2) Monitor the results of the mitigation measures;

3) Provide regular reports on the environmental performance of the development to the appropriate level of management within Batlhako;

4) Evaluate and report on material and reputational risks to Batlhako, arising from inadequate environmental performance; and

5) Amend the Environmental Management Plan as and when necessary to improve environmental performance and/or to accommodate changes in legislation, guidelines, standards and current best practice.

4.0 CLOSURE GOAL AND OBJECTIVES

A closure costing estimate was undertaken (Hattingh, R; Brown, S A P;, May 2012). The overall closure goal for the planned mining areas is to progressively re-instate areas that are safe, stable and non-polluting as these become available for rehabilitation, and to remain aligned to the greater Mankwe Magisterial District spatial development framework, as well as current agricultural, eco-tourism (Pilansberg) and economic initiatives of the region, aimed at leaving behind a positive post-mining legacy.

The above closure goal is underpinned by the more specific objectives listed below. These objectives are stated qualitatively and become more specific as the actual closure measures are devised. The objectives apply to the mine site in its final closed state and not whilst it is transformed towards this state.

4.1 Physical stability

To remove and/or stabilise surface infrastructure and open pits on and to facilitate the implementation of the planned land use, by:

- Closing, dismantling, removing and disposing of all surface infrastructure that has no beneficial post-closure use; and
- Ripping, shaping, and vegetating of reclaimed footprint areas as well as haul roads with no beneficial post-closure use and integrating them into the surrounding areas.

4.2 Environmental quality

To ensure that local environmental quality is not adversely affected by possible physical effects and chemical contamination arising from the mining areas and to sustain post-closure catchment yield as far as possible by:

- Controlling dust generation on the rehabilitated infrastructural areas that could cause nuisance and/or health effects to surrounding landowners/communities;
- Conducting dedicated soil surveys over the operational footprint area and removing any pockets of contaminated soil;
- Cleaning up the sources of possible soil contamination still present on the respective sites to protect the downstream receiving environment;
- Providing the required measures to limit at source the generation of contaminants which could adversely affect local groundwater quality; and
- Ensuring that the respective rehabilitated sites are free-draining and run-off is routed to local/natural drainage lines as far as possible.

4.3 Health and safety

To limit the possible health and safety threats to humans and animals using the rehabilitated areas as they become available, by:

- Demonstrating by means of suitable sampling and analysis that the threshold levels of salts, metals and other potential contaminants over the rehabilitated areas in terms of the long-term land use planning for human and animal habitation are acceptable;
- Removing, for safe disposal, all potential process-related contaminants to ensure that no hazardous waste is present on the mining sites once they have been rehabilitated; and
- Demonstrating through a review of monitoring data that no possible surface and/or groundwater contaminant sources remain on the rehabilitated sites that could compromise the planned land use and/or pose health and safety threats.

4.4 Land capability/land-use

To re-instate suitable land capabilities over the affected areas to facilitate progressive implementation of the planned land use, by:

- Upfront zoning of the overall area and obtaining agreement with stakeholders on this;
- Upfront materials balancing and handling to ensure that the soil types are stockpiled separately and subsequently placed, during site rehabilitation, to allow the desired land capability and end land use to be achieved;
- Ensuring that the respective rehabilitated sites are safe and stable in the long-term;
- Cleaning-up and rehabilitating contaminated soil areas; and
- Limiting the possible loss of topsoil by committing the available topsoil to key pre-determined rehabilitation areas.

4.5 Aesthetic quality

To leave behind a rehabilitated site that, in general, is not only neat and tidy, giving an acceptable overall aesthetic appearance, but which in terms of this attribute is also aligned to the respective land use/s, by:

- Tidying-up the rehabilitated site from demolition waste, rubble, etc.;

- Shaping and levelling rehabilitated areas to create landforms that emulate the surroundings and would facilitate drainage;
- Ensuring that the rehabilitated site is free draining;
- Ensuring that all other remaining embankments are shaped and trimmed and that these are free draining;
- Shaping and levelling and ripping of access roads and hard stands to roughly emulate the surrounding surface topography; and
- Re-establishing vegetation on the above rehabilitated areas, as required, to be aesthetically pleasing.

4.6 Biodiversity

To encourage, where appropriate, the re-establishment of native vegetation on the rehabilitated areas such that the terrestrial biodiversity is largely re-instated over time, by:

- Stabilising disturbed areas to prevent erosion in the short- to medium-term until a suitable vegetation cover has established;
- Establishing viable self-sustaining vegetation communities that will encourage the re-introduction of local fauna as far as possible;
- Assessing whether the rehabilitated facilities, with limited intervention and change, could be adapted to provide suitable habitats for small mammals, improving the overall biodiversity;
- Identifying those aspects/obstacles, once site rehabilitation has been completed, which could inhibit and/or deter animal life from returning to the rehabilitated sites; and
- Removing the identified obstacles without compromising the adopted final land use(s).

4.7 Socio-economic aspects

To ensure that the infrastructure transfers, measures and/or contributions made by the mine towards the long-term socio-economic benefit of the local communities are sustainable, by:

- Identifying buildings and other infrastructure that will be of commercial and/or other value/benefit to the local community and transferring these to third parties as agreed between the mine and these parties and/or the stakeholders;
- Communicating and negotiating with local communities and related civil structures on the closure of the mine and the possible transfer of surface infrastructure to them;
- Ensuring effective hand-over of pre-determined mining-related surface infrastructure for future use by other parties;
- Providing, until hand-over of the mining-related surface infrastructure, training and awareness creation to empower the community to effectively manage the financial and/or commercial resources transferred from the mine; and
- Clearly defining the roles of the parties responsible for future management of the transferred facilities.

5.0 CLOSURE COST ESTIMATE

Scheduled closure cost estimates were undertaken for the planned mining operations on the farms Groenfontein, Vlakfontein and Vogelstruisnek are summarized in Table 5-1.

Table 5-1: Closure costs - Scheduled closure (after 2023)

Batlhako Mining: Scheduled Summary Spreadsheet – April 2012		Open cast operations on Groenfontein, Vlakfontein and Vogelstruisnek
1.0	**INFRASTRUCTURAL AND RELATED ASPECTS**	
1.1	Infrastructural aspects	R 5 233 000.00
1.2	Mining aspects	R1 561 920.00
1.3	General surface reclamation	R -
1.4	Water management	R 1 220 000.00
	SUB-TOTAL 1 (for infrastructure and related aspects)	**R8 014 920.00**
5	Post-closure aspects	R1 254 660.00
	SUB-TOTAL 2 (for post-closure aspects)	**R 1 254 660.00**
6	**ADDITIONAL ALLOWANCES**	
6.1	Preliminary and general	R961 790.40
6.2	Contingencies	R801 492.00
	SUB-TOTAL 3 (for additional allowances)	**R 1 763 282.40**
	Grand-Total (for sub-total 1+2+3)	**R 11 032 862.40**

The closure cost assessment will be updated annually, taking cognisance of any changes and/or amendments to mining plans or associated infrastructure/facilities, as well as to the identified closure objectives and rehabilitation approach.

6.0 SCOPE OF THE EMP

The EMP covers the construction, operational and decommissioning phases of the project to mine chrome ore on Groenfontein, Vlakfontein and Vogelstruisnek.

6.1 Construction phase

The following activities will be undertaken during the construction phase:

- Surveying and pegging out of the areas where construction of roads and diesel storage facilities are to take place and where opencast mining will commence;
- Stripping of vegetation 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.

The EMP covers the implementation of mitigation measures related to the following construction activities and their impacts:

- Location and preparation of construction laydown and storage areas;

- Increased traffic on local roads due to transport of personnel, machinery and construction materials;
- Atmospheric emissions caused by construction activities;
- Rehabilitation of temporary working areas;
- Disposal of waste produced as a result of the work in general;
- Potential contamination of the surface water, underlying soil and groundwater;
- Control of erosion and watercourse sedimentation;
- Disturbance of fauna (birds and animals);
- Social interaction between construction workers and local communities;
- Access to jobs created by the construction phase;
- Availability of proper medical care for construction workers;
- Generation of dust and noise; and
- Changes in visual appearance of the landscape.

6.2 Operational phase

The following activities will be undertaken during the operational phase:

- Opencast mining will commence and continue until all the economically viable chromite ore has been mined;
- Drilling and blasting wil 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.

The EMP deals with the implementation of mitigation measures to address impacts related to the operational phase of the project on the following environmental aspects:

- Geohydrology;
- Surface hydrology;
- Air Quality;
- Ecology;
- Visual resources;
- Noise and vibration;

- Cultural and heritage resources;
- Soil, land use and land capability;
- Socio-economics; and
- Increased traffic on local roads due to transport of ore to Ruighoek.

6.3 Closure and rehabilitation phase

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.

The EMP deals with the implementation of mitigation measures to address impacts of the closure and rehabilitation phase on the following environmental aspects:

- Socio-economics and sustainability;
- Soil, land capability and end use of closed mining areas;
- Atmospheric emissions during demolition and site rehabilitation;
- Visual resources;
- Ecology;
- Disposal of waste generated by decommissioning activities;
- Surface water contamination;
- Contamination of underlying soil and groundwater;
- Generation of noise; and
- Disposal of waste resulting from demolition of structures.

7.0 ENVIRONMENTAL MANAGEMENT ACTIONS

This section sets out the environmental guidelines and standards as well as the management actions and measures required to achieve them during the construction, operation and decommissioning phases of the project.

7.1 Construction phase

The construction EMP will form an integral part of the contractual arrangements between Batlhako and its construction contractors, who must budget for its implementation and who will be legally obliged to adhere to it.

7.1.1 Geology

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)**.

7.1.2 Geohydrology

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;
- 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, Ca, Mg and nitrate levels;
- The main source of groundwater recharge was identified as high-lying ground in the Pilanesberg Mountains and low-lying areas of the Motlhabe River catchment;
- The fractured/weathered rock aquifers are described as “minor”. Safe sustainable yields of boreholes are about 0.5 l/s. The weathered zone aquifer 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

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

A piezometric map of the project area, showing groundwater levels, was drawn up from available hydrocensus information and is shown in Figure 7-1. 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.

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.

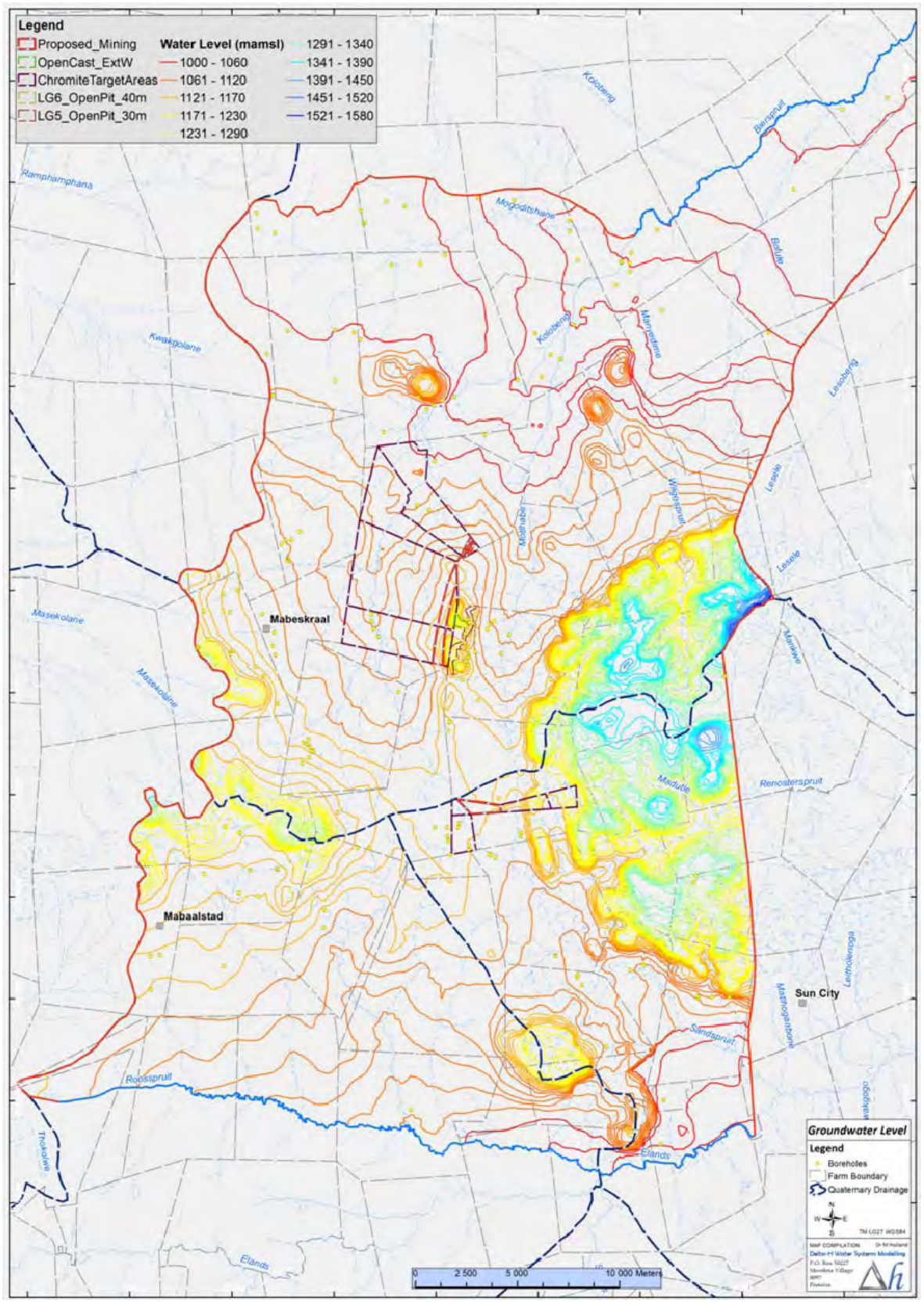

Figure 7-1: Piezometric map of project area

7.1.2.1 Impacts and mitigation measures

The construction activities described in section 6.1 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 Will be implemented:

- 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.

7.1.3 Surface hydrology

Climatic data was used to estimate 24-hour storm rainfall depths, mean annual runoff and flow rates from local catchments into local watercourses.

A preliminary, high level dynamic water balance to estimate pit water make was developed from the limited available data(Bursey & Coleman, May 2012). It should be updated prior to the commencement of mining.

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 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 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.

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.

7.1.3.1 Impacts and mitigation measures

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. The following mitigation measures will be implemented to reduce the impact to one of ***low (SP = 27)*** significance:

- The stormwater management conduit systems and local pollution control dams will be constructed before the development of the mine to prevent stormwater from entering the site;
- The runoff from the construction areas will 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 will be sized to accommodate the 50 year flood peak without overtopping;
- Appropriate erosion protection will be provided upstream and downstream of the crossings;
- Excavated material that cannot be used as topsoil, for road-building or for other construction purposes will be mixed with the overburden when backfilling the mine voids;
- New and used oils will be stored in bunded areas;
- No co-handling of reactive liquids or solids will be allowed;
- Chemicals held on site will be inventoried;
- Hazardous or toxic substances will be stored securely and their use controlled; and
- HAZOP sheets of all chemicals will be available and accessible.

7.1.4 Air quality

A site-specific air quality study was undertaken(Allan, C; Bennett, A;, June 2012). The construction activities will give rise to the mobilisation of particulates (dust and PM_{10}) and emission of exhaust gases from construction vehicles.

7.1.4.1 Ambient air quality standards

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 for PM_{10} are shown in Table 7-1.

Table 7-1: 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 7-2**.

Table 7-2: 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/m^3.

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 the guideline values in

Table 7-3 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 7-3: 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/m^2/day averaged over 30 days in residential and light commercial areas, measured in accordance with reference method ASTM D1739; or
  - 1200 mg/m^2/day averaged over 30 days in areas other than residential and light commercial areas, measured in accordance with reference method ASTM D1739.

People experience dust deposition as a nuisance effect, but 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.

7.1.4.2 Baseline conditions

Potential air pollution sources of local significance include:

- Fugitive emissions from existing chrome mining operations such as clearing operations (scraping, 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, SO_2, methane and CO_2 gases.
- Vehicle tailpipe emissions. These include CO_2, CO, SO_2, 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:

- 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.

Batlhako 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.

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 µg/m^3 for PM_{10} and numerous exceedances of the 2015 national daily standard of 75 µg/m^3. These mines are located approximately 40km to 80km south-east of the proposed mining operations at Groenfontein, Vlakfontein 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 the proposed mining areas 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.

The Waterberg in Limpopo and the Bojanala district in North West have been declared a national priority area in terms of the National Environmental Management: Air Quality Act (Act 39 of 2004) and Batlhako Mining should install dust fall buckets and a PM_{10} monitoring system and undertake ambient air quality monitoring.

7.1.4.3 Impacts and mitigation measures

The construction activities described in section 6.1 will give rise to the mobilisation of particulates (dust and PM_{10}) and emission of exhaust gases from construction vehicles. Considering the number of vehicles involved in comparison to the existing level of vehicular activity in the area and the relatively short duration of the construction period, the exhaust emissions from the construction vehicles will make a negligible contribution to the ambient air quality.

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. There is likely to be a degeneration of the ambient air quality due to increased TSP and PM_{10} levels.

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 achieving 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 will be implemented to reduce the impact to one of ***very low (SP = 10)*** significance:

- Wet suppression, applied sparingly, to ensure the absence of visible dust;
- Enforcement of low vehicle speeds on unpaved roads (< 30 km/h); and
- Re-vegetation of 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 will also be considered.

7.1.5 Ecology

The previously mined and rehabilitated areas and *Dichrostachys* thicket areas 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. The ecological survey did not find any Red Data or endangered species of fauna or flora within the project area, but two species listed as Protected under the National Forests Act (No. 84 of 1998) were recorded, namely *Sclerocarya birrea* and *Combretum imberbe,* were found within footslope mixed bushveld areas on Vlakfontein and Vogelstruisnek(Hudson, A; Kimberg , P;, May 2012).

7.1.5.1 Impacts and mitigation measures

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.

The following mitigation measures will be implemented to reduce the impact, but it would still be ***moderate***

(SP = 35):

- Prior to construction, an ecologist will 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 will be applied for;
- The area to be stripped will be clearly demarcated and will be kept to a minimum;
- Stripped vegetation will not be burned. Leafy parts will be composted and woody parts chipped to serve as mulch during rehabilitation.

7.1.6 Visual

The viewshed analysis (Bothma, J;, February 2012) 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

7.1.6.1 Impacts and mitigation measures

The project involves 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 will be implemented 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;
- Low vehicle speeds will be enforced 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
- Disturbed areas will be vegetated with a locally indigenous grass species as soon as possible.

7.1.7 Noise and vibration

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

7.1.7.1 Baseline conditions

The 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 as follows:

Table 7-4: 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

Village	Daytime - dBA	Night time dBA
Mabeskraal	42.1	32.8
Maologane	41.9	37.5

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 pre-project ground vibration levels recorded at the residential areas in the vicinity were all below 1.0 mm/s peak particle velocity (PPV) and are considered to be insignificant.

7.1.7.2 Standards and guidelines

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

Table 7-5: : 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.

The following relationships hold 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 may result in complaints; and
- A 10-dBA change in the sound level is perceived as twice as loud as the original source and is likely to provoke vigorous community complaints and actions.

The human body is an excellent detector of vibration and ground vibration is felt at levels far below those that can cause structural damage. The human body can detect a peak particle displacement velocity (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.

7.1.7.3 Impacts and mitigation measures

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 required, 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 6.1 will be of short duration, no more than two months at each mining area, and the noise will be intermittent. 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 will be implemented to reduce the noise impact to a level of ***low (SP = 24)*** significance:

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

The construction activities will not cause any noticeable vibration levels at any of the residential areas.

7.1.8 Cultural and heritage resources

A Phase I Heritage Impact Assessment found three examples of the types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act. See Table 7-6.

Table 7-6: Heritage resources within project area

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

Archaeological sites are protected by Section 35 of the National Heritage Resources Act.

7.1.8.1 Impacts and mitigation measures

The identified heritage resources 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 following mitigation measures will be implemented to reduce the potential impact to one of ***very low (SP = 9)*** significance:

- 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.

7.1.9 Soils, land capability and land use

7.1.9.1 Baseline conditions

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 7-2 and the summarized results are presented in Table 7-7.

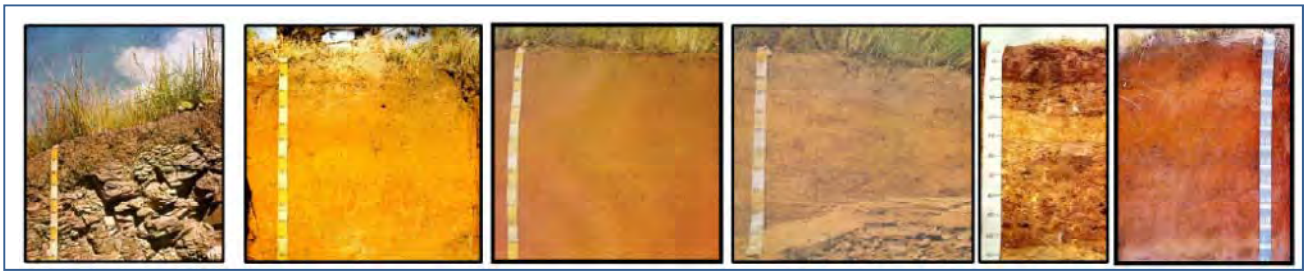

Figure 7-2: Soil types: Mispah, Avalon, Hutton, Clovelly, Witbank and Bainsvlei (left to right).

Table 7-7: 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
Vogelstruisnek	Mispah	Low	Low	22.255	Wilderness
	Avalon	Low	Medium	19.959	Grazing

Farm	Soil Type	Agricultural Potential		Area (ha)	Current Land
	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.

7.1.9.2 Impacts and mitigation measures

During the construction operations described in section 6.1, 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 the following mitigation measures will be implemented to reduce the impact to one of ***low (SP = 25)*** 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.

7.1.10 Socio-economic

7.1.10.1 Baseline conditions

The Moses Kotane Local Municipality has a population of about 237 000 with 15% being economically active and 51% unemployed. 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.

The surrounding areas outside the 500 m blasting buffer zone of Ruighoek Mine are used for small-scale agriculture and livestock farming.

Batlhako Mining developed a Social and Labour Plan for Ruighoek Chrome Mine, North West Province in (Golder, May 2008) and submitted it to the DMR. The main provisions of the plan are summarised in Table 7-8 andTable 7-9. The SLP is in the process of being updated in the light of the planned expansions at Ruighoek mine and the mining operations on Groenfontein, Vlakfontein and Vogelstruisnek.

Table 7-8: Financial provision for the HRD Programme

Annual HRD expenditure (R)	2009	2010	2011	2012	2013	TOTAL
ABET	200 000	200 000	200 000	200 000	200 000	1 000 000
Learnerships	175 000	175 000	175 000	175 000	175 000	875 000
Skills programmes	55 000	55 000	55 000	55 000	55 000	275 000
Portable skills	58 500	58 500	58 500	58 500	58 500	292 500

Annual HRD expenditure (R)	2009	2010	2011	2012	2013	TOTAL
Bursaries	40 000	40 000	40 000	40 000	40 000	200 000
Total	**528 500**	**528 500**	**528 500**	**528 500**	**528 500**	**2 642 500**

Table 7-9: Financial Provision for the LED Programme

Annual HRD expenditure (R)	2009	2010	2011	2012	2013	TOTAL
Project 1: Trees	60 000	300 000	40 000	100 000	100 000	600 000
Project 2: Broilers	60 000	300 000	40 000	150 000	50 000	600 000
Project 3: Sanitation	70 000	100 000	140 000	180 000	110 000	600 000
Total	**190 000**	**700 000**	**220 000**	**430 000**	**260 000**	**1 800 000**

7.1.10.2 Impacts and mitigation measures

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

7.2 Operational phase

7.2.1 Geology

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 will be implemented to reduce the impact to one of ***moderate (SP = 60)*** significance:

- Careful stripping and separate storing of topsoil to avoid mixing with subsoil;
- The subsoil will be stripped and stored separately from the overburden and mixing will be avoided;
- When backfilling the mining void, the overburden will be placed first and levelled, then the subsoil, and finally the topsoil. The surface will be profiled to be free-draining.

7.2.2 Geohydrology

The steady-state pit inflow rates estimated from the groundwater model are shown in Table 7-10.

Table 7-10: Estimated groundwater flowrates into proposed opencast pits

Open Cast	Mine Inflows	
	ℓ/s	m^3/d
Pit North-West (Groenfontein)	1.9	170

Open Cast	Mine Inflows	
	ℓ/s	m^3/d
Pit West (Vlakfontein)	4.7	408
Pit South (Vogelstruisnek)	11.2	967

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. The model predictions will be verified once initial pit inflow rates and more monitoring data become available.

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 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.

7.2.2.1 Impacts and mitigation measures

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 (Motlhabe River).

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

The following mitigation measures will be implemented 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 areas.
- Installation and testing of groundwater monitoring boreholes around the pit areas and along the Motlhabe River. The boreholes around the pit areas will extend at least to 10 metres below the pit bottom, but the borehole depths along the river will 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 will be applied according to best practice (e.g. boreholes will be purged prior to sampling and samples for metal analyses will be filtered and acidified on site).
- 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 updating as necessary.

7.2.3 Surface hydrology

A system of diversion conduits will be constructed 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. 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 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 7-11. The Manning's 'n' coefficient for the earthen channels was 0.03.

Table 7-11: 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

7.2.3.1 Impacts and mitigation measures

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 contain elevated concentrations of dissolved salts, hydrocarbons, toxic metals and suspended solids, but is unlikely to be acidic, as seepage from chromite ore tailings at Ruighoek had a relatively high pH of 8.45, which indicates an absence of acid mine drainage.; 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.

The following mitigation measures will be implemented to 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.

7.2.4 Air quality

The following activities will cause particulate mobilisation and result in increased concentrations of $PM_{2.5}$, PM_{10} 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 to Ruighoek on haul roads.

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 7-12, with exceedances shaded in grey.

Table 7-12: 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

Pollutant	Averaging period	Ambient air quality standard	Groenfontein	Vlakfontein	Vogelstruisnek
$PM_{2.5}$	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

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 7-3 to Figure 7-7. 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. Significant mitigation measures be implemented at the Vlakfontein mine.

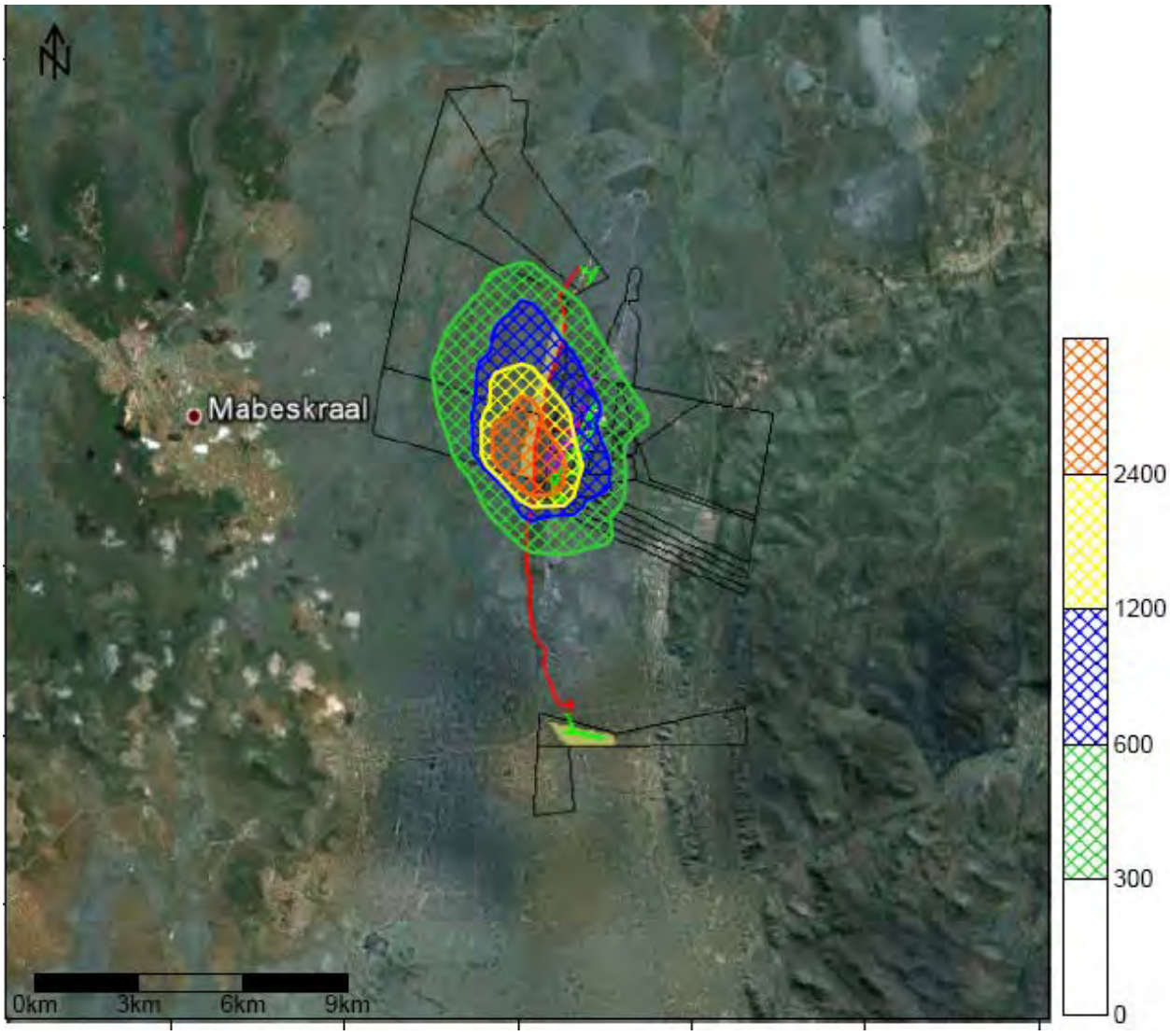

Figure 7-3: Modelled dust fallout (mg/m2/day) as a result of the Vlakfontein mining operations

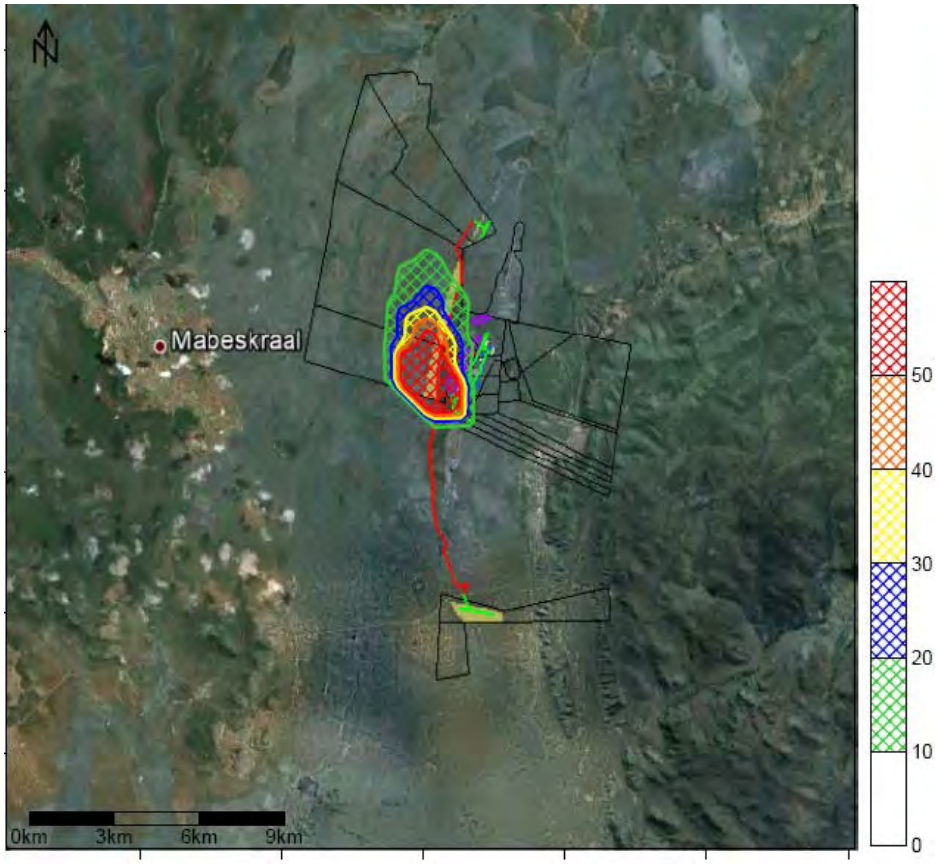

Figure 7-4: Annual average PM10 (µg/m3) at Vlakfontein mining operations

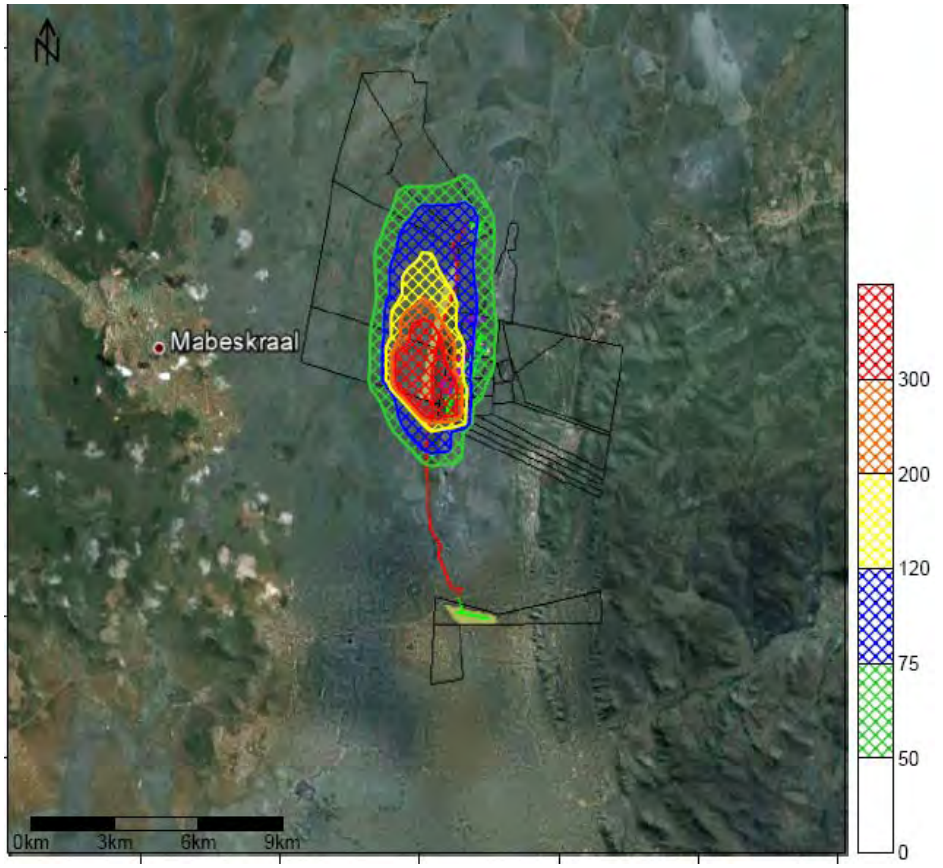

Figure 7-5: Daily average PM10 concentrations (µg/m3) at Vlakfontein operations.

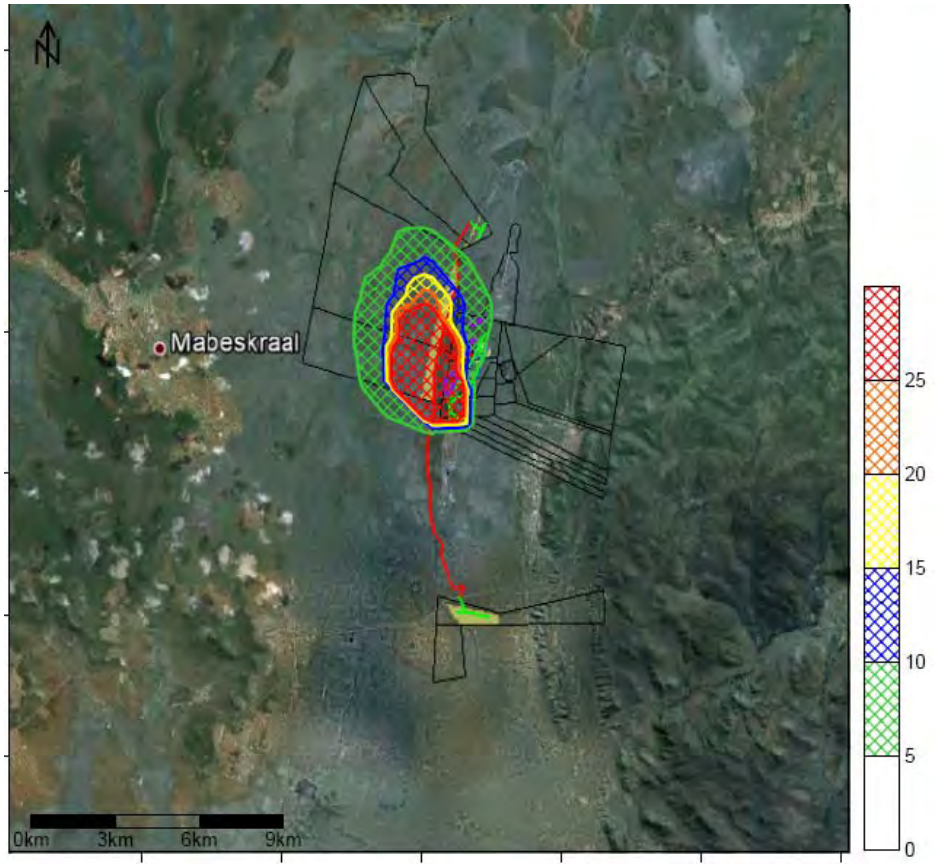

Figure 7-6: Annual average PM2.5 (µg/m3) at Vlakfontein operations

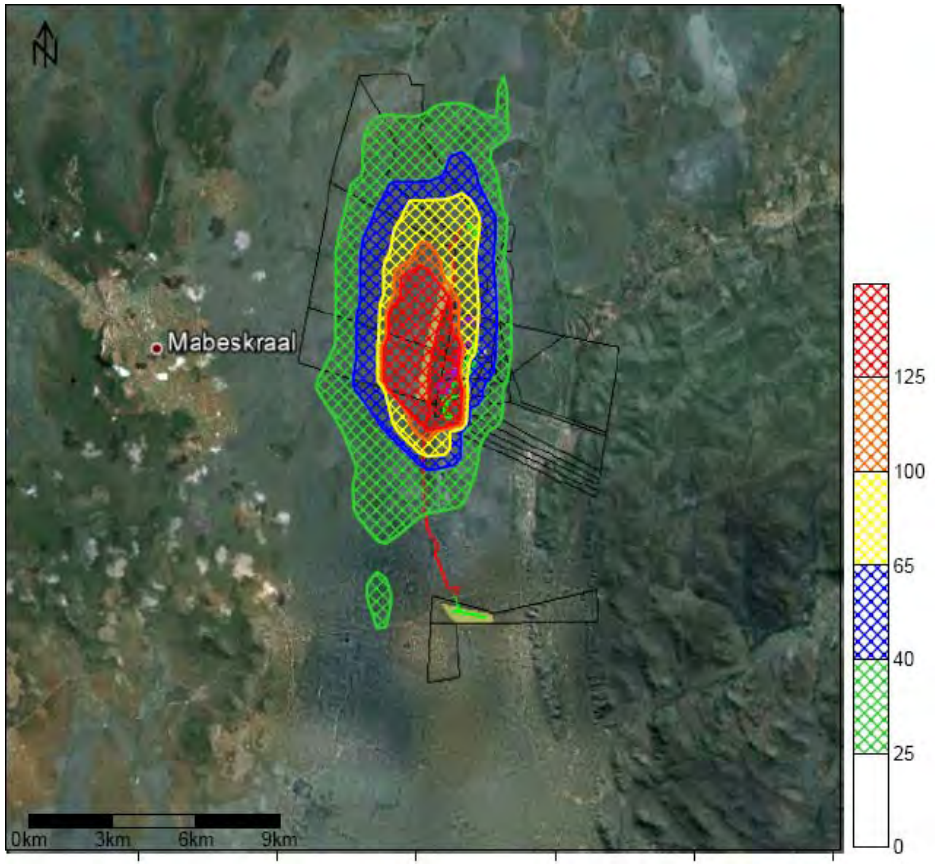

Figure 7-7: Daily average PM2.5 (µg/m3) at Vlakfontein operations

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 will be implemented 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; and
  - Drop height reduction.
- For waste rock dump, soil and overburden stockpiles:
  - Progressive rehabilitation and re-vegetation will be implemented; 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; and
  - Enforcement of speed limits.
- General transport mitigation measures will include:
  - Reduction in unnecessary traffic volumes;
  - Rigorous speed control and the institution of traffic calming measures to reduce vehicle entrainment. A recommended maximum speed of 30 km/h will 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 will be maintained and serviced regularly to ensure that tailpipe particulate emissions are kept to a minimum.
- For blasting:
  - The area surrounding the blast will 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 will be as clean as possible, because the evaporation of dirty water can also release dust;
  - The blast charge will 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
  - Wind speed and direction will be taken into account 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 will 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; or preferably
  - 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.

7.2.5 Ecology

The following impacts are foreseen during the operational phase (Hudson, A; Kimberg , P;, May 2012):

- 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, 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 will be implemented 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 will be kept to a minimum and should be clearly demarcated;
- Stripped vegetation will not be burned. Leafy parts will be composted and woody parts chipped to serve as mulch during rehabilitation;
- The potential for erosion of stockpiles of topsoil and subsoil will 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 6.3 and monitoring progress on the re-vegetation process.

7.2.6 Visual

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 will be particularly visible, but of short duration. The impact is assessed as being of ***moderate (SP = 45)*** significance.

The following mitigation measures will be implemented 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;
- Enforcement of 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
- Re-vegetation of disturbed areas with locally indigenous species as soon as possible.

7.2.7 Noise and vibration

7.2.7.1.1 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 7-13. 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 7-13: 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 planned opencast mining operations during the operational phase are shown in Figure 7-8 and community response to increases in noise is indicated in Table 7-14.

Table 7-14: 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:

a) 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).

b) 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 7-5.

Noise intrusion levels, defined as the increase in noise level above the current pre-project level, were calculated at each of the nearby villages. 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 7-15). No other villages are likely to experience intrusive noise.

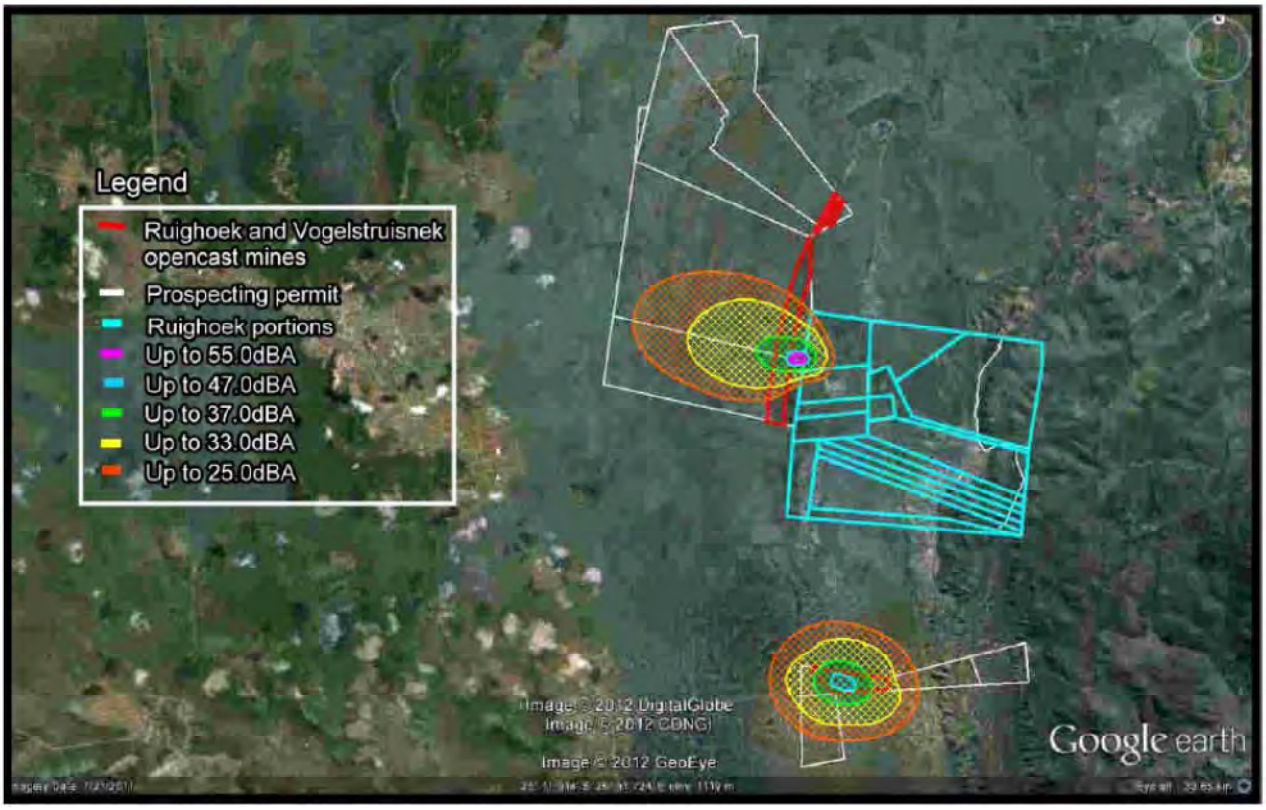

Figure 7-8: Noise contours during the operational phase of the opencast mines

7.2.7.1.2 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.

Table 7-15: 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 identified noise sensitive areas, 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 7-9.

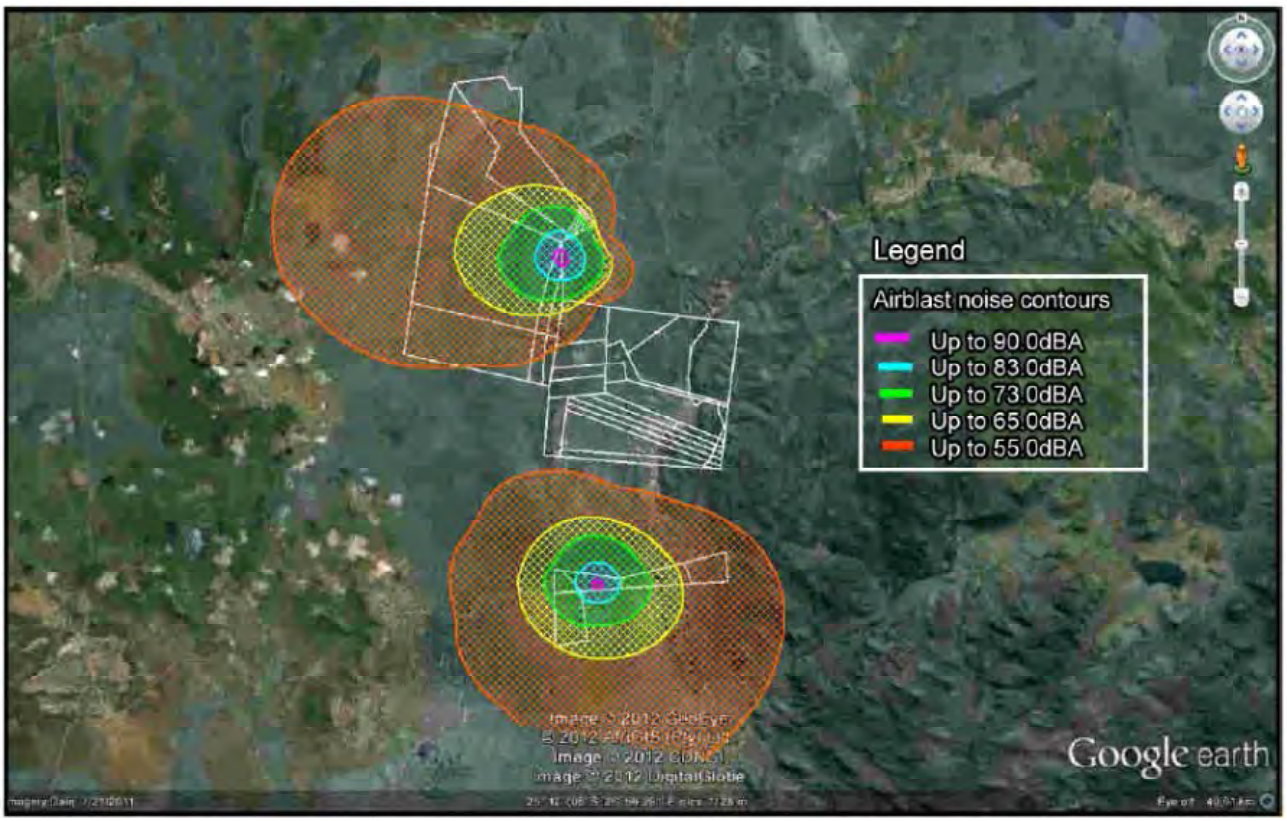

Figure 7-9: Air blast noise contours during blasting at the opencast pits

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:

- Maintaining all mining and transport machinery in good condition, with special reference to noise reduction equipment;
- Measuring noise levels at any village closer than 1 000 m to an open pit;
- 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 will be avoided at the relevant mine.

7.2.8 Cultural and heritage resources

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 proposed mining area on Vogelstruisnek 173 JP. The graveyard GY01 is not located close to any of the planned mining areas listed in Table 7-6.

The heritage sites need not be affected by the operational phase of the planned 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 planned mining areas. Damage to site GY01 would constitute a wilful act and the perpetrator(s) could face criminal prosecution.

The following mitigation measures will be implemented to reduce the potential impact to one of ***low (SP = 30)*** significance:

- The three sites will be clearly demarcated;
- A buffer zone of at least 50 metres will be maintained 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;
- All relevant Batlhako and contractor personnel will be properly briefed on the locations of the sites and the importance of avoiding damage to them; and
- Relevant Batlhako and contractor personnel will be educated on how to recognise a possible heritage site and encouraged 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.

7.2.9 Soils, land capability and land use

During the operational phase as described in section 6.2, 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 will 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.

7.2.10 Socio-economic

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.

7.2.11 Traffic

The hauling of 100 000 tpa of ore from the mining areas on Groenfontein, Vlakfontein and Vogelstruisnek will require 3 333 truck trips per year, if 30-ton trucks are used. This would equate to 9 truck trips per day or one every 2.63 hours, if the transport operation carried on 24/7. However, if it were confined to daylight hours on working days, it would equate to one truck trip every 53 minutes.

This is a very low frequency and will not cause congestion or inconvenience to local road users. Accordingly, daylight trucking on working days will be implemented for safety reasons.

7.3 Closure and rehabilitation phase

7.3.1 Geology

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 will be mitigated to one of ***moderate (SP = 50)*** significance by placing and levelling the overburden first, then the subsoil and finally the topsoil.

7.3.2 Geohydrology

Ore and tailings at the Ruighoek mine show 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, which will be reduced to a ***very low (SP = 8)*** significance by implementing the following mitigation measures:

- 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 site; and
- All spillages must be cleaned up immediately and the contaminated soil must be disposed of at an appropriately licensed site.

7.3.3 Surface hydrology

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 SO_4 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 will be implemented to reduce the impact to one of ***low (SP = 18)*** significance:

- A monitoring borehole will be constructed up-gradient of and within each back-filled pit at the down-gradient end;
- The boreholes will be monitored bi-annually 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.

7.3.4 Air quality

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 following mitigation measures:

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

7.3.5 Ecology

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. If closure and rehabilitation as described in section 6.3 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 and of ***moderate (SP = 60)*** significance on the areas that were mined and rehabilitated some twenty years ago.

The following mitigation measures will be implemented 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, care will be taken to avoid mixing of topsoil and subsoil;
- Topsoil sampling and analysis will 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;
- The surface will be profiled to ensure good drainage;
- To avoid compaction, light farming equipment will be used rather than heavy earthmoving equipment. This is especially important when dealing with clayey soils;
- A botanist who specialises in rehabilitation will be commissioned to select the appropriate locally indigenous plant species and to oversee their planting on the disturbed ground;
- The re-vegetated areas will be monitored quarterly until the vegetation has become self-sustaining and clear signs of succession have manifested. If any bare patches exceeding 4 m^2 in area develop, the reasons will be investigated, appropriate remediation measures will be taken and the area will be re-vegetated.

7.3.6 Visual

The activities associated with the closure and rehabilitation phase, as described in section 6.3, 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 will be implemented 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;
- Enforcement of 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);
- Re-vegetation of the disturbed areas with locally indigenous species as soon as possible; and
- Monitoring of progress until the vegetation has become self-sustaining.

7.3.7 Noise and vibration

The activities associated with the closure and rehabilitation phase, as described in section 6.3, 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 will be implemented to reduce the noise impact to a level of ***low (SP = 24)*** significance:

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

7.3.8 Cultural and heritage resources

When the closure phase commences, the protection measures instituted for sites LIA01 and GY01, as described in sections 7.1.8 and 7.2.8 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 following mitigation measures will be implemented to reduce the potential impact to one of ***low (SP = 30)*** significance:

- The demarcation of the sites and the protection measures described in sections 7.1.8 and 7.2.8 will be kept in place;
- A buffer zone of at least 50 metres will be maintained 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; and
- All relevant Batlhako and contractor personnel will be properly briefed on the locations of the sites and the importance of avoiding damage to them;

7.3.9 Soils, land capability and land use

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 will be implemented to reduce the impact to one of ***moderate (SP = 35)*** significance:

- The overburden will be spread out and profiled to promote free draining;
- The topsoil will be spread over the overburden and also profiled to promote free draining;
- Light agricultural machinery will be used to avoid compaction of the topsoil;

- The soil will be sampled and analysed after placement and nutrients (compost and fertiliser) will be added as advised by a qualified agronomist;
- The area will be re-vegetated with local grass, forb, shrub and tree species under the direction of a qualified botanist; and
- Rehabilitation progress will be monitored three-monthly until the vegetation becomes self-sustaining. Any erosion rills that may have developed will be repaired and, if any bare patches larger than 4 m^2 are found, they will be re-vegetated after investigating the reasons and taking remedial action.

7.3.10 Socio-economic

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

8.0 SUMMARY OF MITIGATION AND MONITORING MEASURES

This section summarises the potential impacts of various aspects of the development in all its stages, from construction, through operations to eventual decommissioning, together with the appropriate mitigation measures to manage the identified impacts. Responsibilities for implementing the mitigation measures are identified and the frequencies with which the results of the various measures are to be monitored are stated. The responsibility for monitoring and reporting the results to the appropriate level of management within Batlhako Mining rests with the Environmental Coordinator (EC)

Note:
This section can be printed and used as a field guide during each phase of the project

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
CONSTRUCTION PHASE								
7.1.1	Geology	None – activities confined to surface	Geology remains intact	N/A	None required	Batlhako Mining, EC, Contractors	Duration of Construction Activities (2-3 months per mining area)	
7.1.2	Geo-hydrology	Potential spillage of hydrocarbons	No pollution of groundwater	No change in GW quality down-gradient of site	Construct water management system first Maintenance of vehicles in workshops, not in field Place drip trays under parked vehicles Spill kit and trained personnel available at site; and Clean spillages up immediately and dispose of contaminated soil at a licensed site.	Batlhako Mining , EC, Contractors	Duration of Construction Activities (2-3 months per mining area)	
7.1.3	Surface Hydrology	Erosion, more silt in local watercourses Potential spillage of hydrocarbons and chemicals	No pollution of water courses No impact on stream banks and flow hydraulics	No change in SW quality, flow hydraulics and condition of stream banks	Capture site runoff in a local sump and allow solids to settle transferring to pollution control dam; Release water not needed for dust control to river system in a controlled manner if water	Batlhako Mining, EC, Contractors	Duration of Construction Activities (2-3 months per mining area)	

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
		Impacts on banks of streams and flow hydraulics at drainage line crossings			quality meets TWQR; Road crossings over drainage lines to be sized to accommodate 50 year flood peak without overtopping; Provide erosion protection upstream and downstream of crossings; Excavated material that cannot be used as topsoil, for road-building or for other construction purposes to be mixed with overburden when backfilling mine voids; Store new and used oils in bunded areas; No co-handling of reactive liquids or solids to be allowed; Chemicals held on site will be inventoried; Hazardous or toxic substances will be stored securely and their use controlled; and HAZOP sheets of all chemicals will be available and accessible.			

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
7.1.4	Air Quality	Dust fallout, PM_{10} and exhaust fumes	To remain within national standards at mine perimeter and at sensitive receptors	See Table 7-1 to Table 7-3	Wet suppression to ensure absence of visible dust; Enforcement of low vehicle speeds on unpaved roads (< 30 km/h); and Re-vegetation of disturbed areas with locally indigenous grass species as soon as possible. Chemical binders such as Dustex or Dust-A-Side to be considered for roads; Dust fall to be monitored by dust collection buckets located downwind of construction area. Monitoring in accordance with SANS 2004.	Batlhako Mining, EC, Contractors	Duration of Construction Activities (2-3 months per mining area)	
7.1.5	Ecology	Stripping of vegetation will destroy habitat and disturb fauna in the area.	To limit vegetation stripping and disturbance of fauna to the minimum necessary	No unnecessary ecological impact	If protected species occur on areas to be stripped, apply for permission to relocate or destroy; Minimise and demarcate area to be stripped; Leafy parts to be composted and woody parts chipped to serve as mulch during rehabilitation.	Batlhako Mining, EC, Contractors	Duration of Construction Activities (2-3 months per mining area)	

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
7.1.6	Visual	Activities will be partially visible from several local villages and roads, especially if significant dust generation occurs	To minimise visual intrusion and degradation of visual resource	No visible dust and no complaints about visual impact	Wet suppressionto ensure absence of visible dust; Enforcement of low vehicle speeds on unpaved roads at the mine (< 30 km/h); Disturbed areas to be vegetated with locally indigenous grass species as soon as possible.	Batlhako Mining, EC, Contractors	Duration of Construction Activities (2-3 months per mining area)	
7.1.7	Noise and vibration	Noise levels at nearest villages (630 m) could exceed daytime limits for rural and suburban districts, but could result in unacceptable levels during the night.	To remain compliant with standards and guidelines at sensitive receptors;	No complaints about unacceptable noise levels; See Table 7-5 for standards.	No construction activities to be undertaken during night-time (22h00 to 06h00); Selecting equipment with lower sound power levels; Installing suitable mufflers on engine exhausts and compressor components; Installing acoustic enclosures around equipment causing radiating noise.	Batlhako Mining, EC, Contractors	Duration of Construction Activities (2-3 months per mining area)	
7.1.8	Cultural and heritage	Unsupervised construction could severely damage or destroy Stone Age sites LIA01 and LIA02 and cause damge to Graveyard			Clearly demarcate the three sites; Prohibit access to and any form of interference with the three sites by Batlhako's personnel and contractors; Properly brief all relevant Batlhako and contractor	Batlhako Mining, EC, Contractors	Duration of Construction Activities (2-3 months per mining area)	

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
		GY01			personnel on the locations of the sites and the importance of avoiding damage to them; and Educate relevant Batlhako and contractor personnel on how to recognise a possible heritage site and encourage them to report any potential site they might find.			
7.1.9	Soils, land capability and land use	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 topsoil stockpile by weeds.	To maintain quality of topsoil until it is needed for rehabilitation	No deterioration in topsoil quality	Careful stripping and stockpiling to avoid mixing of topsoil and subsoil; 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.	Batlhako Mining, EC, Contractors	Duration of Construction Activities (2-3 months per mining area)	

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
7.1.10	Socio-economic	Construction phase will involve 10 to 15 workers for about 3 months and estimated expenditure of about R2.5 million	Maximise benefits for local residents	Jobs and money spent remain local	Use local contractors and purchase materials locally, as far as this is feasible.	Batlhako Mining, EC, Contractors	Duration of Construction Activities (2-3 months per mining area)	
General	Dangerous activities	Worker safety	To maintain safe work practices in a safe environment and to avoid personnel injuries and damage to assets	Documentation of all unplanned incidents and achievement of target safety performance statistics	Toolbox talks/staff briefing sessions Site workers training programme Training in the use and handling of equipment	Batlhako Mining, EC, Contractors	Duration of Mining Activities, all phases	
OPERATIONAL PHASE								
7.2.1	Geology	Temporary disturbance of topsoil, subsoil and overburden, but removal of ore will be permanent.	Avoid mixing of topsoil with subsoil or overburden	No mixing of layers	Careful stripping and separate storing of topsoil, subsoil and overburden; When backfilling the mining void, the overburden will be placed first and levelled, then the subsoil, and finally the topsoil. The surface will be profiled to be free-draining.	Batlhako Mining, EC	Duration of Construction Activities (2-3 years per mining area)	

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
7.2.2	Geohydrology	Minor to moderate reduction of BH yields depending on location; Drawdown of water table in vicinity of the mine; Partial loss of baseflow in Motlhabe River.	Draw water table down only as far as necessary	No complaints from groundwater users	Regional hydrocensus to establish water levels and groundwater users in the vicinity of the mining areas. Installation and testing of groundwater monitoring boreholes around the pit areas and along the Motlhabe River. The boreholes around the pit areas will extend to at least 10 metres below the pit bottom, but the borehole depths along the river will 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). Apply SOP according to best practice (e.g. boreholes will be purged prior to sampling and samples for metal analyses will be filtered and acidified on	Batlhako Mining, EC	Duration of Construction Activities (2-3 years per mining area)	

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
					site). A hydraulic testing of aquifers to assess aquifer parameters and enable more accurate model calibration. Annual review of model updating as necessary			
7.2.3	Surface hydrology	Reduced catchment and water flow (about 10% less) to local river system Potential spillage of contaminated mine water into the river system. Mining will destroy the perched aquifer system and after rehabilitation the recharge water will report	No spillage of contaminated mine water Restoration of perched aquifer layer	No deterioration of water quality in local streams	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 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 maintaining a freeboard of at	Batlhako Mining, EC	Duration of Construction Activities (2-3 years per mining area)	

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
		directly to the backfill and then to the pit floor.			least 0.8 metres during the wet season			
7.2.4	Air quality	Mobilisation of particulates Exceedance of all standards at and beyond perimeter of Vlakfontien mining area Exceedance of 24 hr PM_{10} concentration at and beyond perimeter of Vogelstruisnek mining area Potential health and nuisance impacts on sensitive receptors	Meeting of AQ standards and guidelines No health risk or nuisance impact to sensitive receptors No complaints	See Table 7-1 to Table 7-3	Wet suppression Drop height reduction Progressive re-vegetation Limit height and side slopes of stockpiles to 3m and 1:4 Speed limits of 30 km/h on unpaved roads in mining areas and 60 km/h on haul roads to Ruighoek Appropriate blast design Dust suppression or collection when drilling	Batlhako Mining, EC	Duration of Construction Activities (2-3 years per mining area)	

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
7.2.5	Ecology	Erosion and invasion of disturbed areas by exotic plant species; Ruderal species may become dominant, thereby reducing floral diversity; Potential increased poaching, using snares and dogs; Chemical spills; Migration of fauna away from noise and vibration; Reduced photosynthesis and plant growth due to increased dust fall on plants; Barrier to the	Minimisation of ecological impacts	Creating conditions that will facilitate rehabilitation	The area to be stripped ahead of the approaching mining front will be kept to a minimum and will be clearly demarcated; Stripped vegetation will not be burned. Leafy parts will be composted and woody parts chipped to serve as mulch during rehabilitation; Limit stockpiles to a maximum height of 3 metres; Limit 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; 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 and monitoring progress on the re-vegetation process	Batlhako Mining, EC	Duration of Construction Activities (2-3 years per mining area)	

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
		movement of some animals and danger of collision with vehicles; and Potential destruction or disturbance of Red Data and protected species.						
7.2.6	Visual	Mining and transport activities will be partially visible from several local villages and roads, especially with dust generation.	To reduce visual impact of operations as much as practicable	Lack of complaints about visual impacts	Wet suppression to ensure the absence of visible dust; Enforcement of 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 Re-vegetation of disturbed areas with locally indigenous species as soon as possible	Batlhako Mining, EC	Duration of Construction Activities (2-3 years per mining area)	
7.2.7	Noise and vibration	Maologane and Witrantjies are predicted to experience noise intrusion levels of 3.4 and 5.5 dBA	To avoid intrusive noise levels at sensitive receptors To reduce air overpressure at	No intrusive noise levels experienced by sensitive receptors No complaints	All mining and transport machinery to be maintained in good condition, with special reference to noise reduction equipment; Measure noise levels at any	Batlhako Mining, EC	Duration of Construction Activities (2-3 years per mining area)	

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
		respectively during the night-time, which could lead to complaints The air over-pressure will increase to 89.0dB at a distance of 700m from the blasting area	sensitive receptors as much as practically possible	from local residents	village closer than 1 000 m to an open pit; Erect 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: If intrusive noise at a residential area persists despite the above measures, night-time (22h00 to 06h00) mining operations will be avoided at the relevant mine.			
7.2.8	Cultural and heritage	Careless mining operations could severely damage or destroy the 3 heritage sites (see Table 7-6)	To avoid damage to heritage sites, alternatively to obtain permission to relocate or destroy them	No damage to heritage sites without proper authorisation	The three sites will be clearly demarcated; A buffer zone of at least 50 metres will be maintained 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	Batlhako Mining, EC	Duration of Construction Activities (2-3 years per mining area)	

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
					personnel and contractors; All relevant Batlhako and contractor personnel will be properly briefed on the locations of the sites and the importance of avoiding damage to them; and Relevant Batlhako and contractor personnel will be educated on how to recognise a possible heritage site and encouraged to report any potential site they might find.			
7.2.9	Soils, land capability and land use	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 topsoil stockpile by weeds.	To maintain quality of topsoil until it is needed for rehabilitation	No deterioration in topsoil quality	Careful stripping and stockpiling to avoid mixing of topsoil and subsoil; 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.	Batlhako Mining, EC	Duration of Construction Activities (2-3 years per mining area)	

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
7.2.10	Socio-economic	Creation of 10 new jobs for 6 to 8 years. Annual expenditure of about R1.6 million on wages and R38.2 million on materials, goods and services	Maximise benefits for local residents	Jobs and money spent remain local	Employ local people and purchase materials, goods and services locally.	Batlhako Mining, EC	Duration of Construction Activities (2-3 years per mining area)	
7.2.11	Traffic	One 30-ton truck trip every 2.63 hours for a 24/7 operation One truck trip every 53 minutes if operation confined to daylight hours on working days.	To make ore transport as safe as possible and avoid inconvenience to other road users	No accidents, no near misses, no complaints from other road users	Confine operation to daylight hours on working days for safety reasons	Batlhako Mining, EC	Duration of Construction Activities (2-3 years per mining area)	

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
CLOSURE AND REHABILITATION PHASE								
7.3.1	Geology	Incorrect closure procedures could mix topsoil, subsoil and overburden	Restore original condition, except for permanent removal of chrome ore	No mixing of topsoil, subsoil and overburden	Carefully placing and levelling the overburden first, then the subsoil and finally the topsoil			
7.3.2	Geohydrology	Potential spillage of hydrocarbons	No pollution of groundwater	No change in GW quality down-gradient of site	Vehicle maintenance in workshops, not in the field; Place drip trays under parked vehicles; Spill kit and trained personnel must be available; Clean up spillages immediately and dispose of contaminated soil at a licensed site.			
7.3.3	Surface hydrology	Potential that polluted mine water will decant to the river system when the pits fill up			A monitoring borehole will be constructed up-gradient of and within each back-filled pit at the down-gradient end; The boreholes will be monitored bi-annually for water level and water quality; If the water quality in the down-gradient part of the pit is worse			

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
					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 will be treated until it is fit for release.			
7.3.4	Air quality	Dust fallout, PM_{10} and exhaust fumes	To remain within national standards at mine perimeter and at sensitive receptors	See Table 7-1 to Table 7-3	Wet suppression; Enforcement of low vehicle speeds on unpaved roads (< 30 km/h); Re-vegetation of the disturbed areas with locally indigenous species as soon as possible.			
7.3.5	Ecology	If closure and rehabilitation is not done properly, vegetation will not re-establish well	To establish a self-sustaining diversity of locally indigenous flora; Re-colonisation of area by indigenous fauna	Vegetation becomes self-sustaining within five years; Area is re-colonised by indigenous fauna	Avoid mixing of topsoil and subsoil; Topsoil sampling and analysis will 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; The surface will be profiled to ensure good drainage; To avoid compaction, light			

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
					farming equipment will be used rather than heavy earthmoving equipment. This is especially important when dealing with clayey soils; A botanist who specialises in rehabilitation will be commissioned to select the appropriate locally indigenous plant species and to oversee their planting on the disturbed ground; The re-vegetated areas will be monitored quarterly until the vegetation has become self-sustaining and clear signs of succession have manifested. If any bare patches exceeding 4 m^2 in area develop, the reasons will be investigated, appropriate remediation measures will be taken and the area will be re-vegetated.			

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
7.3.6	Visual	The closure and rehabilitation activities will be visible from several local villages and roads	Minimise visual impact of activities and improve visual appearance of mined-out areas	No complaints about visual impact	Wet suppression to ensure the absence of visible dust; Enforcement of 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); Re-vegetation of disturbed areas with locally indigenous species as soon as possible; and Monitoring of progress until the vegetation has become self-sustaining.			
7.3.7	Noise and vibration	Similar to construction phase for 2 – 3 months; Post closure monitoring of vegetation and groundwater will continue for several years, but will have no noise or vibration impacts	To remain compliant with standards and guidelines at sensitive receptors;	No complaints about unacceptable noise levels; See Table 7-5 for standards.	Sound-absorbing berms will be demolished last; No noisy activities will be undertaken during night-time (22h00 to 06h00) Selection of equipment with lower sound power levels; and Maintaining noise abatement equipment in good condition.			

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
7.3.8	Cultural and heritage	New contractors or Batlhako personnel undertaking closure and rehabilitation may be careless or unaware of the heritage sites and may severely damage or destroy one or more of the	No damage to any of the three sites, unless properly authorised	No damage to any of the three sites, unless properly authorised	The demarcation of the sites and the protection measures described in sections 7.1.8 and 7.2.8 will be kept in place; A buffer zone of at least 50 metres will be maintained between the graveyard and any activities; Fencing off site LIA02 and not mining closer than 15 metres to it. Alternatively, obtaining 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; All relevant Batlhako and contractor personnel will be properly briefed on the locations of the sites and the importance of avoiding damage to them; and Relevant Batlhako and contractor personnel will be educated on how to recognise			

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
					a possible heritage site and encouraged to report any potential site they might find.			
7.3.9	Soils, land capability and land use	Significant loss of topsoil quality may occur as a result of mixing with subsoil and overburden, contamination with hydrocarbons and hydraulic fluids, erosion and weed infestation	Preservation of topsoil quality	No loss of topsoil or deterioration in quality	The overburden will be spread out and profiled to promote free draining; The topsoil will be spread over the overburden and also profiled to promote free draining; Light agricultural machinery will be used to avoid compaction of the topsoil; The soil will be sampled and analysed after placement and nutrients (compost and fertiliser) will be added as advised by a qualified agronomist; The area will be re-vegetated with local grass, forb, shrub and tree species under the direction of a qualified botanist; and Rehabilitation progress will be monitored three-monthly until the vegetation becomes self-			

NO	Aspect (of Activity Service or Product)	Potential impact	Objectives	Performance Criteria	Mitigation measure(s)	Responsible person / party	Time-frame	For Monitoring Purposes only – Successfully Implemented / Corrective action required (To be completed by EC)
					sustaining. Any erosion rills that may have developed will be repaired and, if any bare patches larger than 4 m^2 are found, they will be re-vegetated after investigating the reasons and taking remedial action.			
7.3.10	Socio-economic	The 10 jobs created by the operational phase will be lost and the expenditure that was associated with the operational phase will be reduced significantly	Minimise negative impact	Socio-economic impact acceptable to personnel and local communities	Proper planning, that will allow 10 jobs to lapse from Batlhako's overall operations by attrition.			

9.0 ENVIRONMENTAL AWARENESS PLAN

Batlhako Mining will establish a procedure for Environmental Awareness Training as part of its Environmental Management System (EMS).

The procedure will include:

- Induction and awareness training for contractors and employees;
- Job specific training – training for personnel performing tasks which could cause potentially significant environmental impacts;
- Assessment of extent to which personnel are equipped to manage environmental impacts;
- Basic environmental training;
- EMS training;
- Comprehensive training – on emergency response, spill management, etc;
- Specialised skills;
- Training verification and record keeping; and
- Periodic re-assessment of training needs, with specific reference to new developments, newly identified issues and impacts and associated mitigation measures.

10.0 UNDERTAKING

UNDERTAKING BY BATLHAKO MINING

I,_____, the undersigned and duly authorised thereto by the Company Batlhako Mining (Pty) Ltd. have studied and understand the contents of this document in its entirety and hereby duly undertake to adhere to the conditions as set out therein including the amendment(s) agreed to by the Regional Manager and approved on ……

Signed at._____. On this …… day of …….. 2012.

..... **.....**

Signature of applicant **Designation**

AGENCY DECLARATION: **THIS DOCUMENT WAS COMPLETED BY GOLDER ASSOCIATES ON BEHALF OF BATLHAKO MINING (PTY) LTD.**

APPROVAL

Approved in terms of Section 39(4) of the Mineral and Petroleum Resources Development Act, 2002 (Act 29 of 2002)

Signed at.....on this.....day of.....2012.

.....
REGIONAL MANAGER

REGION:

11.0 BIBLIOGRAPHY

Allan, C; Bennett, A;. (June 2012). *Report No 12614182- 11447 - 1: Air Quality Impact Assessment for Bathlako Mining Ltd: Groenfontein, Vlakfontein and Vogelstruisnek Open Cast Mines.* Johannesburg: Golder Associates Africa (Pty) Ltd.

ARC. (February 2007). *Soil survey of a portion of the Farm Ruighoek 169JP, Near Pilanesberg for Ruighoek Chrome Mine. Agricultural Research Council (ARC)-Institite for Soil, Climate and Water, Report No GW/A/2007/13 .* Pretoria: Agricultural Research Council (ARC)-Institite for Soil, Climate and Water.

ARC. (February 2007). *Soil survey of a portion of the Farm Ruighoek 169JP, Near Pilanesberg for Ruighoek Chrome Mine. Report No GW/A/2007/13.* Pretoria: Agricultural Research Council (ARC)-Institite for Soil, Climate and Water.

Armitage, N; Roux, E;. (August 2011). *Report Number12694-9960-10: Proposed Arnot Mooifontein Opencast Expansion Project onto Portions 1, 6, 7 & REM of Mooifontein 448 JS - Environmental Impact Assessment and Environmental Management Programme Report Addendum.* Johannesburg: Golder Associates Africa (Pty) Ltd.

Bennet, A; Heath, R;. (March 2012). *Air Quality Assessment for Ruighoek Chrome Mine Expansion.* Johannesburg: Golder Associates Africa.

Bothma, J L; Brown, S A P;. (June 2011). *Propsed Arnot Mooifontein Expansion Project onto Portions 1, 6, 7 and REM of Mooifontein 448 JS - Rehabilitation Plan.* Johannesburg: Golder Associates Africa.

Bothma, J;. (February 2012). *Visual Impact Assessment for the proposed mining of additional opencast and underground areas at Ruighoek Chrome Mine, North West Province.* Johannesburg: Golder Associates Africa (Pty) Ltd.

Branch, B. (1994). *Field guide to snakes and other reptiles of Southern Africa.* Cape Town: Struik Publishers.

Brink, D; Canahai, G;. (February 2012). *Volclay SA Ruighoek Chrome Mine. Groundwater and Geochemistry Investigation - Phase I.* Johannesburg: Golder Associates Africa (Pty) Ltd.

Bursey, K., & Coleman, T. (May 2012). *Report No 12614182-11445-4: BatlhakoMining. Surface Water Study. Groenfontein, Vlakfontein and Vogelstruisnek.* Johannesburg: Golder Associates Africa (Pty) Ltd.

Bursey, K; Coleman, T;. (June 2011). *Report No 12694-10458-19: Proposed Arnot Mooifontein Opencast Expansion Project onto Portions 1, 6, 7 & REM of Mooifontein 448 JS - Surface Water Specialist Report.* Johannesburg: Golder Associates Africa (Pty) Ltd.

Carruthers, V. (2001). *Frogs and Frogging in South Africa.* Cape Town : Struik Publishers.

DEA. (2010). *Air Quality Management Plan for the Highveld Priority Area - Air Quality Basleine Assessment. .* Department of Environmental Affairs.

Department of Minerals and Energy;. (n.d.). *South African Policy and regulatory Review .* Retrieved October 29, 2010, from http://www.dme.gov.za/ministry/whatwedo_dme.stm

Digby Wells & Associates. (2008). *ECOLOGICAL ASSESSMENT: Wetlands and Aquatic Ecosystems associated with the Arnot Colliery Mooifontein opencast, Mpumalanga.* Johannesburg, South Africa: Digby Wells & Associates.

Digby Wells. (July 2010). *Amendment to Environmental Impact Assessment Report and Environmental Management Programme for Arnot Coal Opencast Pit and Associated Infrastructure on Portions 4 & 5 of the Farm Mooifontein 448 JS and Portions 3 & 4 of the Farm Tweefontein 458 JS.* Johannesburg: Digby Wells and Associates.

Digby Wells. (July 2010). *Amendment to Environmental Impact Assessment Report and Environmental Management Programme for Arnot Coal Opencast Pit and Associated Infrastructure on Portions 4 & 5 of the*

Farm Mooifontein 448 JS and Portions 3 & 4 of the Farm Tweefontein 458 JS. Johannesburg: Digby Wells and Associates.

DME. (2008). *Department of Minerals and Energy. South Africa's Minerals Industry (2008). Directorate: Mineral Economics.*

DMR. (2009). *Environmental Programme Report Template.* Department Of Mineral Resources.

DWAF;. (2005). *A practical field procedure for identification and delineation of wetlands and riparian areas.* Pretoria: Department of Water Affairs and Forestry.

Eskom. (2008). *Eskom Annual Report 2008.* Retrieved October 31, 2010, from www.Eskom.co.za: http://www.eskom.co.za/annreport08/

Ferret Mining. (2004). *Environmental Impact Assessment for the Proposed Opencast Mining on the Farm Mooifontein 448 JS.* Pretoria: Ferret Mining and Environmental Services (Pty) Ltd.

Fey, M. (2010). *Soils of South Africa.* Cape Town: Cambridge University Press.

Fourie, W;. (2009). *Archaeological Impact Assessment on Portions 4 and 5 of the farm Mooifontein 448 JS and Portions 3 and 4 of the farm Tweefontein 458 JS.* Pretoria: Professional Grave Solutions (Pty) Ltd.

Golder Associates Africa (Pty) Ltd. (2011). *Aquatic Ecology Report for the proposed Arnot Mooifontein expansion project on portion 1, 6, 7 & Rem of the farm Mooifontein 448 JS.* Johannesburg, South Africa: Golder Associates Africa (Pty) Ltd.

Golder Associates Africa. (2011). *Proposed Expansion of the Mooifontein Opencast Mine - Aquatic Ecology Study.* Johannesburg, South Africa: Golder Associates Africa (Pty) Ltd. Report No. 12694-9989-12.

Golder Associates Africa Pty Ltd. (2011). *Terrestrial Ecology Report for the proposed Arnot Mooifontein expansion project on portion 1, 6, 7 & Rem of the farm Mooifontein 448 JS.* Pretoria: Exarro Coal.

Golder Associates Africa. (2011). *Wetland ecosystems baseline and impact assesment for the Arnot: Mooifontein expansion project on portions 1, 6, 7 and REM of the farm Mooifontein 448JS: Report No. 12694-10167-15.*

Golder. (2011). *Groundwater Report - Exxaro Arnot Coal .*

Golder. (May 2008). *Report No 11707SLP: Social and Labour Plan for Ruighoek Chrome Mine, North West Province .* Johannesburg: Golder Associates Africa (Pty) Ltd.

Golder. (May 2007). *Report No 8459/9425/3/G - Report on Hydrogeology of the Proposed Ruighoek Open Cast Mine. .* Johannesburg: Golder Associates Africa (Pty) Ltd.

Hattingh, R; Brown, S A P;. (May 2012). *Closure Objectives and Associated Closure Costs for Ruighoek Chrome Mine, as at April 2012.* Johannesburg: Golder Asociates Africa (Pty) Ltd.

Henning, G., & Roos, P. (2001). Threatened butterflies of South African wetlands. *Metamorphosis* .

Henning, S., & Henning, G. A. (1989). South African Red Data Butterflies. *South African National Scientific Programmes: Report Number 159* .

Hudson, A; Kimberg , P;. (May 2012). *Ecological assessment for proposed mining of areas on Groenfontein, Vlakfontein and Vogelstruisnek.* Johannesburg: Golder Associates Africa (Pty) Ltd.

IUCN. (2010). *IUCN Red List of Threatened Species*. Retrieved November 2010, from www.iucnredlist.org: http://www.iucnredlist.org

Jongens, A. (April 2007). *Noise Impact Assessment of the Planned Ruighoek Chrome Mine. Report No JKA348r002.* Cape Town: Jongens Keet Associates.

Kornelius, G; Bornman, R;. (March 2009). *Air Quality Impact Assessment for Proposed Coal Handling Modifications at Arnot Coal near Middelburg, Mpumalanga. Report No.: APP/09/DWA-01 Rev 0.0. .* Johannesburg: Airshed Planning Professionals (Pty) Ltd.

Kornelius, G; Bornman, R;. (May 2011). *Report No. APP/09/GAA-12. Air Quality Assessment for the Proposed Arnot Mooifontein Opencast Expansion Project onto Portions 1, 6, 7 and Rem of Mooifontein 448 JS.* Johannesburg: Airshed Planning Professionals (Pty) Ltd.

Panaino, R; Kimberg, P;. (July 2011). *12694-10167-15 Proposed Arnot Mooifontein Opencast Expansion Project onto Portions 1, 6, 7 & REM of Mooifontein 448 JS - Wetland Ecology Study.* Johannesburg: Golder Associates Africa (Pty) Ltd.

Pistorius, J. (May 2010). *Poposed Anot Mooifontein Opencast Expansion Projecrt onto Portions 1, 6, 7 and REM of Mooifontein 448 JS - Phase I Heritage Impact Assessment (HIA) Study.* Pretoria: Julius CC Pistorius.

Regional Manager, Department of Mineral Resources. (2012, March 02). Acceptance of Application for a Mining Right . Klerksdorp: Department of Mineral Resources.

Roux, E. (September 2010). *12694-9946-9 - Identification of Activities on Mooifontein Portions 4 & 5 Requiring Authorisation in terms of the National Environmental Management Act.* Johannesburg: Golder Associates Africa (Pty) Ltd.

Roux, E; Perry, E;. (June 2012). *12614182 - 11448 - 6: Draft EIA Report and EMP: Mining Right Application on Groenfontein, Vlakfontein and Vogelstruisnek.* Johannesburg: Golder Associates Africa (Pty) Ltd.

Roux, E;. (January 2012). *Report No 10612694-10985-26. Exxaro Arnot Coal EIA/EMP Amendment for NEMA Activities on Portion 4 of Mooifontein 448 JS. Draft EIA Report and EMP Addendum.* Johannesburg: Golder Associates Africa (Pty) Ltd.

Steenekamp, P I;. (March 2012). *Report No: RG/2011/02/16/1. Soil, land capability and land use assessment of areas to be affected by proposed open pits and new infrastructure at Ruighoek Mine, situated on portions 5, 11, 12 and the remaining extent of the farm Ruighoek 169 JP.* Pretoria: Rehab Green.

Steve Tshwete Local Municipality. (2009). *Integrated Development Plan 2009/2010.* Middelburg: Steve Tshwete Local Municipality.

Steve Tshwete Local Municipality. (2010). *Steve Tshwete Local Municipality Annual Report 2009/10*. Retrieved June 9, 2010, from Steve Tshwete Local Municipality : http://www.middelburgsa.co.za/: http://www.middelburgsa.co.za/

Stoop, A; Roux, E;. (May 2012). *11615991-11380-1 EIA Draft Scoping Report: Ruighoek Chrome Mine Expansion.* Johannesburg: Golder Associates Africa (Pty) Ltd.

Stoop, A; Thomas, M;. (August 2010). *Report No 12427-9821-2. Environmental Impact Assessment for the Amendment of the existing Environmental Management Programme to reflect the new processing plant at Batlhako Mining's Ruighoek Open Cast Chrome Mine Near Pilanesburg, North West Province.* Johannesburg: Golder Associates Africa.

van der Merwe, B;. (June 2012). *Bathlako Mining Limited: Environmental Noise and Vibration Impact Assessment.* Johannesburg: dBAcoustics.

van der Merwe, B;. (October 2011). *Reprt No 085/2011. Environmental Noise Impact Assessment. Baseline Noise Survey 13023 Arnot Colliery.* Johannesburg: dBAcoustics.

van der Walt, J; du Preez, L;. (November 2011). *Archaeological Impact Assessment. Ruighoek Chrome Mine Pilanesberg, North West Province.* Johannesburg: Heritage Contracts and Archaeological Consulting CC.

van der Walt, J; Marais, A;. (January 2011). *Report No 10-042: Groundwater Study for the proposed mining activities on Portions 1, 6, 7 and Remainder of Mooifontein 448 JS.* Johannesburg: GCS.

Viljoen, C;. (May 2012). *Report No P274 - Batlhako Mining Soil, Land Use and Land Capability Assessment.* Viljoen & Associates.

Witthüser, K; Holland, M;. (May 2012). *Report No Delh.2012.006-1b: Batlhako Mining Target Areas (Groenfontein, Vlakfontein and Vogelstruisnek) - Numerical Flow and Transport Model.* Pretoria: Delta H Water Systems Modelling (Pty) Ltd.

Young, G;. (January 2007). *Specialist Report on Visual Assessment for proposed Ruighoek Chrome Mine.* Johannesburg: Newtown Landscape Architects.

Zinn, A; Hudson, A. (February 2012). *Report no 11615991-11248-1. Terrestrial Ecology Assessment of proposed opencast pit expansion areas at Ruighoek Chrome Mine, North West Province.* Johannesburg: Golder Associates Africa (Pty) Ltd.

Etienne Roux
Senior Environmental Practitioner

Ed Perry
Reviewer

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Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Africa (Pty) Ltd.
PO Box 6001
Halfway House, 1685
Thandanani Park
Matuka Close
Halfway Gardens
Midrand
South Africa
T: [+27] (11) 254 4800

Golder Associates