APPENDIX I

Noise Assessment

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Proposed Turfvlakte Mining establishment at the Grootegeluk Mine, Lephalale Local Municipality, Limpopo Province

Project No: 190/2019
Compiled by: B v/d Merwe
Date: 3 September 2019

DECLARATION OF INDEPENDENCE

I, **Barend J B van der Merwe,** as duly authorised representative of **dBAcoustics**, hereby confirm my independence and declare that I have no interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which **Golder Associates Africa (Pty)Ltd** was appointed as Environmental Assessment Practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act) for the **compilation of an EIA and EMP for the mining of the Farm Turfvlakte 463 LQ which lies on the south-eastern border of the Grootegeluk Mine Rights Area which is situated in the Lephalale Local Municipality, Limpopo Province – Noise Impact Assessment**. I further declare that I am confident in the results of the studies undertaken and conclusions drawn as a result of it. I have disclosed, to the environmental assessment practitioner, in writing, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act. I have further provided the environmental assessment practitioner with written access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not. I am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 and any other specific and relevant legislation (national and provincial), policies, guidelines and best practice.

Signature: 

Full Name: Barend Jacobus Barnardt van der Merwe

Date	:	3 September 2019
Title / Position	:	Environmental noise and vibration specialist
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Experience	:	17 years
Registration(s)	:	SAAI, NACA, IAIASA and SAIG

Details of specialist and expertise

I, Barend JB van der Merwe of 43 6th Street, Linden Johannesburg have been an environmental noise and ground vibration specialist for the last 15 years. I have been instrumental in the pre-feasibility studies of proposed projects which may have an impact on the environment and noise sensitive areas. I am also involved with the noise and ground vibration impact assessments and the environmental management plans compilation of large projects such as wind farms, mining, roads, trains (primarily the Gautrain) and various point noise sources. As a post-graduate student in Environmental Management at the University of Johannesburg, I obtained an MSc degree with the research project concentrating on the impact of noise and ground vibration on a village close to a new underground mine. I have played a major role in the identification, evaluation and control of physical factors such as noise and ground vibration in the following projects – wind farms, various platinum and coal mines and the quarterly noise evaluation of the Gautrain, the decommissioning of the N11 near Mokopane, construction of the P166 near Mbombela, design of the Musina by-pass, noise mitigatory measures at the N17 road near Trichardt, establishment of the weigh bridge along the N3 near Pietermaritzburg, George Western by-pass. The following large environmental companies are amongst my clients: Gibb, Royal Haskoning DHV, Coffey Environmental, Golder Associates Africa (Pty) Ltd, GCS Environmental (Pty) Ltd, Globesight Environmental Consulting, Knight Piesold Environmental (Pty) Ltd, MattMcdonold Engineering (Pty) Ltd and SRK Engineering (Pty) Ltd.

Qualifications

1. MSc Environmental Management – University of Johannesburg;
2. BSc Honours in Geography and Environmental Management – University of Johannesburg;
3. National Higher Diploma in Environmental Health - Witwatersrand Technikon;
4. National Diploma in Public Health - Cape Town Technikon;
5. National Certificate in Noise Pollution - Technikon SA;
6. National Certificate in Air Pollution - Technikon SA;
7. National Certificate in Water Pollution - Technikon SA;
8. Management Development Diploma - Damelin Management School; and
9. Advanced Business Management Diploma - Rand Afrikaans University.

Membership

- South African Institute of Acoustics (SAAI);
- International Association of Impact Assessment (IAIA);
- National Association of Clean Air (NACA);
- South African Association of Geographers (SAAG);
- South African Institute of Occupational Hygiene (SAIOH).

Experience

- Noise impact assessment of different mine establishments;
- Noise Control Officer i.t.o. Noise Control Regulations;
- Compilation of noise management plans;
- Annual and quarterly baseline noise surveys;
- Moderator Wits Technikon – Environmental Pollution III.
- Various road projects for SANRAL.
- Compilation of the Integrated Pollution strategy for Ekurhuleni Town Council.
- Represent clients at Town Planning Tribunals.
- Represent clients at Housing Board tribunals.
- Determine residual noise levels in certain areas as required by clients.
- Noise attenuation at places of entertainment.
- Design and implementation of sound attenuators.
- Noise projections and contouring.
- Advisory capacity regarding noise related cases to local authorities: - Sandton, Roodepoort, Randburg, Krugersdorp, Alberton, Centurion, Vereeniging. Due to my previous experience in Local Government I provide a service to these Local government departments on the implementation of the Noise Control Regulations and SANS 10103 of 2008 – The measurement and rating of environmental noise with respect to land use, health annoyance and to speech communication.
- Identification, Evaluation and Control of noise sources in industry.

I was involved in the following noise impact assessments during the Environmental Impact Assessment process (Noise and/or Vibration):

- Airlink BID for landing in Kruger National Park;
- Coal gasification plant in Theunissen;
- Langhoogte and Wolseley wind farms;

- Widening of N3 at Howick, KZN;
- Tulu Kapi Mine, Ethiopia;
- Boabab Iron Ore Mine, Mozambique;
- N11 Decommissioning Mokopane;
- Baseline noise survey for NuCoal Mines, Woestalleen, Vuna and Mooiplaats Collieries;
- Baseline noise monitoring Mooinooi mine;
- Leeuwpan coal mine;
- N17 Road at Trichardt for KV3 Engineers;
- N17 Road in Soweto;
- Proposed new by-pass road at Musina;
- George Western By-pass road between George Airport and Outeniqua Pass;
- Gautrain baseline monitoring;
- Upgrade of Delmas Road extensions in Moreletta Park, Pretoria;
- Proposed weigh bridge, N3, Pietermaritzburg:
- Tonkolili Manganese mine, Sierra Leone;
- Proposed wind turbines in the Western Cape – Caledon;
- Extension of works at the PPC factory in Piketberg;
- Exxaro Arnot Colliery – Mooifontein;
- Hydro power plant – 2 Sites in Durban;
- Coal export terminal in Beira, Mozambique;
- Site selection for new Power Station – Kangra Mine, Piet Retief;
- Gas exploration at Ellisras;
- Noise survey and assessment of future mine shafts at various mines;
- Mining exploration at Potgietersrus – Lonmin Akani;
- New coal mines in Witbank – Dorstfontein Expansion Project;
- New coal mines in Middelburg and Ermelo;
- New Vanadium Manganese mine in Potgietersrus;
- Xolobeni mining project in Transkei;
- Glynn mines in Sabie;
- Rezoning of properties for housing at Burgersfort, Shosanguve, Hammanskraal;
- Various noise impact assessment for clients in and around Centurion;
- Relocation of night races from Newmarket racecourse to Turfontein racecourse;
- Rezoning applications for private clients.

Indemnity and Conditions Relating to this Report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information supplied by Golder Associates Africa (Pty) Ltd. The accuracy of the results and conclusions are entirely reliant on the accuracy and completeness of the supplied data. dBAcoustics does not accept responsibility for any errors or omissions in the supplied data and information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions and the findings apply to the site conditions as they existed at the time of the field survey. These opinions do not necessarily apply to conditions that may arise after the date of the field survey and subsequent noise impact assessment report. The report is based on scientific and recommended survey and assessment techniques. This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

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Executive summary

Introduction

dBAcoustics was appointed by Golder Associates Africa (Pty)Ltd to determine and assess the potential environmental noise impact of the proposed open cast mining activities, hauling of coal overland to the processing plant and other infra-structure associated with mining activities on the Farm Turfvlakte. The proposed Turfvlakte mining pits will be situated inside the current Exxaro Coal (Pty) ltd - Grootegeluk mining rights area within the Lephalale district, Limpopo Province, South Africa. Grootegeluk Coal mine is situated approximately 20km west of Lephalale / Ellisras. The proposed development of these additional opencast pits and associated infrastructure will be situated on the eastern portion of the Turfvlakte farm.

The noise survey was carried out during the summer period on 14 and 15 November 2017.

The following mining establishment is proposed for the project:

- Construction of open cast pits 1 and 2;
- Haul roads;
- Contractor laydown area;
- Water pipeline from Turfvlakte pit/s to Grootegeluk mining area;
- Infra-structure associated with opencast mining activities; and
- Stockpiles and waste rock dumps.

The study area covered the boundaries of the proposed Turfvlakte mining site and at the abutting residential areas, access road/s, along the main feeder roads and at the noise receptors. The residents of the different identified noise receptors in the vicinity of the proposed Turfvlakte open cast mine are exposed to distant power plant and mining activities, train activities, agricultural activity noise, distant traffic noise, domestic noise and natural noises such as insects, wind and animal noises. The above noise sources contribute to the prevailing environmental ambient noise level of the study area.

The following observations were made in and around the study area:

- There was a constant flow of traffic along the feeder roads (Grootegeluk to Lephalale and Medupi and Lephalale) during the day and intermittent during the night;
- Grootegeluk mine and the two power stations (Matimba & Medupi power stations) were operational during the time of the noise survey;

- The wind and weather conditions play an important role in noise propagation.

The following are noise sources in the vicinity of and the boundaries of the study area:

- Grootegeluk mine;
- Matimba and Medupi Power stations;
- Heavy duty vehicles and motor vehicles;
- Agricultural activities;
- Railroad activities;
- Light industrial activities;
- Insects;
- Birds;
- Wind noise.

Noise Impact Assessment

In terms of the Noise Regulations a noise disturbance is created when the prevailing ambient noise level is exceeded by 7.0dBA or more. Noise is part of our daily exposure to different sources which is part of daily living and some of these physical attributes which may at times be part of the ambient levels that people get used to without noticing the higher levels.

Two aspects are important when considering potential impacts of a project:

- The increase in the noise levels, and;
- The overall noise levels which will be created by the activities of the pits.

The proposed changes during the construction, operational and decommissioning phases will require approved management measures and ongoing noise surveys will have to be carried out to ensure compliance to the relevant noise regulations and/or standards.

Conclusion and Recommendations

There will be a slight upwards shift in the immediate environmental noise levels during the construction phase (temporary basis) and a more permanent basis during the operational phase. The noise increase will however be insignificant during the construction, operational and decommissioning phases as it will be below the threshold value of 7.0dBA.

The potential noise increase from the proposed Turfvlakte mining establishment can however be controlled by means of approved acoustic screening measures, state of the art equipment, proper noise management principles and compliance to the Local Noise Regulations, and the International Finance Corporation's Environmental Health and Safety Guidelines. The proposed noise management plan must be in place during the construction and operational phases so as to identify any noise increase on a pro-active basis.

The proposed Turfvlakte mining establishment will comply with the relevant Noise Control Regulations, 1994 and SANS 10103 of 2008 provided that the noise mitigatory measures are in place and that the noise management plan be adhered to at all times.

Barend van der Merwe – MSc UJ
Environmental noise specialist

Contents

Declaration of Independence 2
Details of specialist and expertise 3
Executive summary 7
1. Introduction 13
2. Background to environmental noise 15
3. Study methodology 19
3.1 Instrumentation 19
3.2 Measuring points 19
3.3 Site Characteristics 21
3.4 Current noise sources 22
3.5 Atmospheric conditions during the noise survey 22
4. Regulatory and Legislative Requirements 23
4.1 Noise Control Regulations of 1994 23
4.2 SANS 10103 of 2008 24
4.3 SANS 10210 of 2004 24
4.4 Environmental Health and Safety Guidelines of the World Bank 24
5. Description of the receiving environment 24
6. Results of the noise survey 27
7. Noise impact levels at the different residential areas 29
8. Noise impact assessment Analysis 31
8.1 Construction phase 31
8.2 Operational Phase 35
8.3 Decommissioning phase 42
9. Calculation of road traffic noise 43
10. Assumptions and Limitations 44
11. Recommendations 46
12. Conclusion 49
13. List of definitions and abbreviations 51
14. References 54
Appendix A 55
Appendix B 56

Figures

Figure 1-1: Location of the proposed Turfvlakte mine 14
Figure 3-1: Measuring points 20
Figure 5-1: Noise receptors in the vicinity of the proposed mining area 27
Figure 8-1: Noise contours during operations at Pit 1 and other infra-structure 35
Figure 8-2: Noise contours during operations at Pit 2 and other infra-structure 36
Figure 11-1: Noise management plan 44
Figure 11-2: Proposed measuring points during the operational phase of the mine 45

Tables

Table 2-1: Recommended noise levels for different districts 18
Table 2-2: Response when ambient noise level is exceeded 19
Table 3-1: Measuring points and co-ordinates for the study area 21
Table 5-1 Distances between the different mine activities and the residential areas 26
Table 6-1: Noise levels for the day and night in the study area 26
Table 6-2: Sound pressure levels of construction machinery 29
Table 7-1: Noise intrusion level criteria 30
Table 8-1: Noise intrusion levels during construction of Pit 1 32
Table 8-2: Noise intrusion levels during construction of Pit 2 32
Table 8-3 to 8-7: Construction phase impact assessment 32-33

Table 8-8: Calculated noise levels during the Operational phase 34
Table 8-9 to 8-14: Operational phase impact assessment 38-39
Table 8-15: Noise intrusion levels during the decommissioning phase 39
Table 8-16 to 8-17: Decommissioning phase 40
Table 10-1: Different noise levels in and around the house and workplace 43
Table 11-1: Recommended acoustic screening measures 44
Table 11-2: Geographical information of the measuring points 45
Table 12-1: Environmental noise management plan 47

This report was prepared in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 – Regulation 982 and the following aspects are dealt with in the report:

No.	Requirement	Section in report
1a)	Details of -	
(i)	The specialist who prepared the report	P3-P5
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	P3-P5
b)	A declaration that the specialist is independent	P3-P5
c)	An indication of the scope of, and the purpose for which, the report was prepared	P15
d)	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	P7
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process	P19
f)	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	P21
g)	An identification of any areas to be avoided, including buffers	P24
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	P14
i)	A description of any assumption made and any uncertainties or gaps in knowledge	P44
j)	A description the findings and potential implication\s of such findings on the impact of the proposed activity, including identified alternatives on the environment	P33-P43
k)	Any mitigation measures for inclusion in the EMPr	P46
l)	Any conditions for inclusion in the environmental authorisation	P46
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	P47-P48
n)	A reasoned opinion -	
(i)	As to whether the proposed activity or portions thereof should be authorised	P49
(ii)	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	P49
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	N/A
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q)	Any other information requested by the competent authority	N/A

1. Introduction

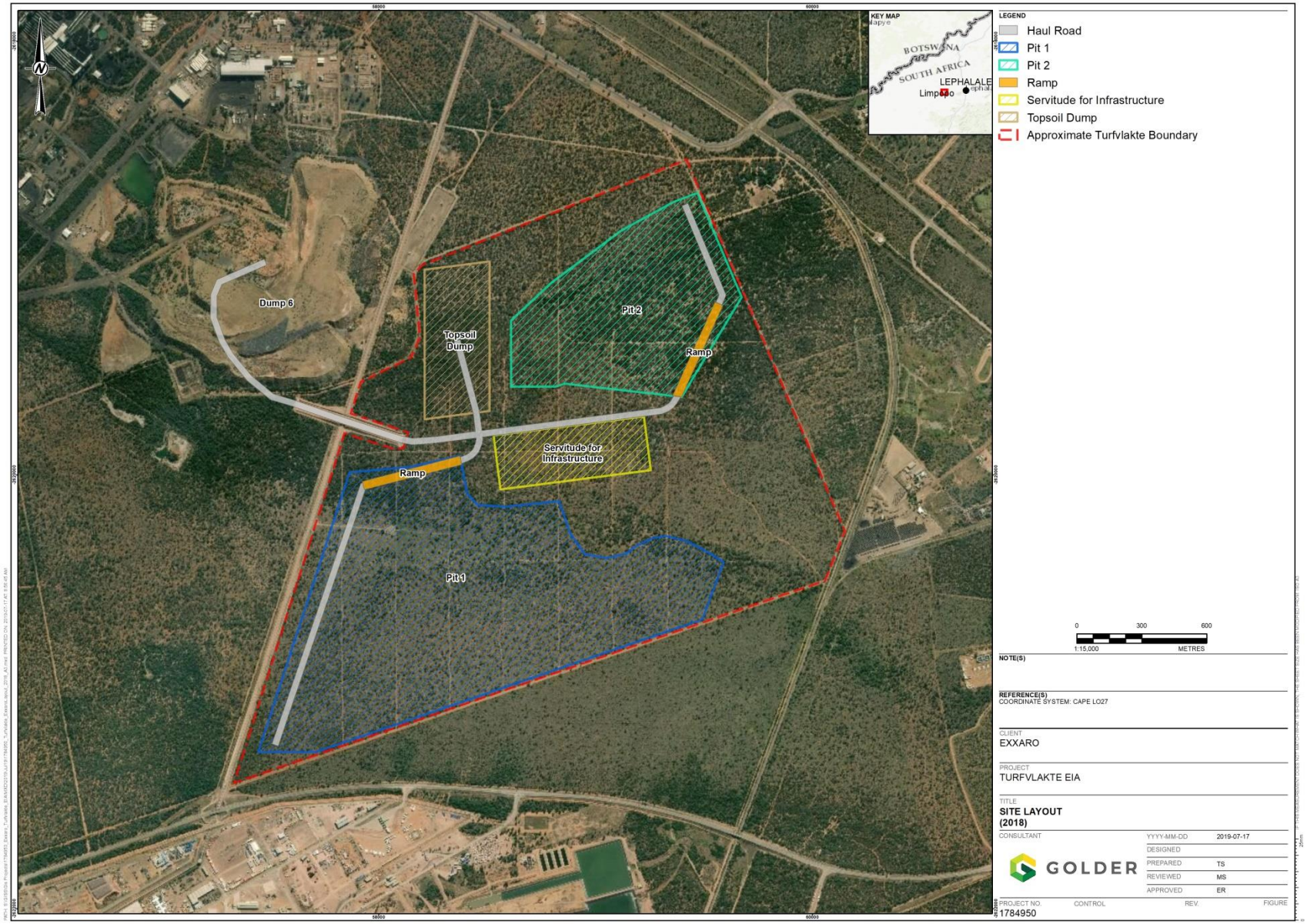
dBAcoustics was appointed by Golder Associates Africa (Pty) Ltd to determine and assess the potential environmental noise impact of the proposed open cast mining activities, hauling of coal overland to the processing plant and other infra-structure associated with mining activities on the Farm Turfvlakte. The proposed Turfvlakte mining pits will be situated inside the current Exxaro Coal (Pty) Ltd - Grootegeluk mining rights area within the Lephalale district, Limpopo Province, South Africa. Grootegeluk Coal mine is situated approximately 20km west of Lephalale / Ellisras. The proposed development of these additional opencast pits and associated infrastructure will be situated on the eastern portion of the Turfvlakte farm. Access routes, pipelines and power lines will run through the remaining Grootegeluk Mining Rights area so as to link up to the existing mine infrastructure.

The proposed mining establishment will take place in an area where there are mining activities, a guesthouse (Manketti Lodge), Matimba Power station (to the east), rail road and feeder roads. Maropeng residential area will be the closest formal residential area to the proposed mining establishment and some 1.3km to the east of the centre of the proposed mining area whereas Lephalale is some 9.1km to the south. The noise impact assessment will consider and evaluate the additional sound levels from the following proposed mining activities into abutting areas. All of these activities will take place within the Grootegeluk mining area and will consist of the following:

- Mine pits 1 & 2;
- Haul roads;
- Roads for light vehicles;
- An area to store overburden material until backfilling can commence;
- Contractor lay-down areas;
- Power lines and substations;
- A small fuel facility for the contract miner;
- Waste rock and material will be back-filled into the Grootegeluk pit some 4 650m to the west.

The noise survey was carried out during the summer season on 14 and 15 November 2017 during the day and night time periods. The location of the Proposed Turfvlakte open cast pit, proposed Thabametsi mine and Grootegeluk mine is illustrated in Figure 1.1.

Figure 1-1: Location of the proposed Turfvlakte mine



The purpose of the environmental noise study and impact assessment was:

- To determine the environmental baseline noise levels along the boundaries of the mining areas and residential areas in the vicinity of the Turfvlakte study areas.

The environmental noise baseline information will be used to calculate the potential noise intrusion levels at the abutting noise receptors.

2. Background to environmental noise

Sound is a wave motion, which occurs when a sound source sets the nearest particles of air in motion. The movement gradually spreads to air particles further away from the source. Sound propagates in air with a speed of approximately 340 m/s.

The sound pressure level in free field conditions is inversely proportional to the square of the distance from the sound source – inverse square law. Expressed logarithmically as decibels, this means the sound level decreases 6 dB with the doubling of distance. This applies to a point source only. If the sound is uniform and linear then the decrease is only 3 dB per doubling of distance. The decibel scale is logarithmic, therefore decibel levels cannot be added in the normal arithmetic way, for example, two sound sources of 50.0dB each do not produce 100.0dB but 53.0dB, nor does 50.0dB and 30.0dB equal 80.0dB, but remains 50.0dB. Air absorption is important over large distances at high frequencies and it depends on the humidity but is typically about 40.0dB/km @ 4000 Hz. Traffic noise frequencies are mainly mid/low and will be unaffected below 200m.

When measuring the intensity of a sound, an instrument, which duplicates the ear variable sensitivity to sound of different frequency, is usually used. This is achieved by building a filter into the instrument with a similar frequency response to that of the ear. This is called an A-weighting filter because it conforms to the internationally standardized A-weighting curves. Measurements of sound level made with this filter are called A-weighted sound level measurements, and the unit is dB.

Sound propagation is affected by wind gradient rather than the wind itself. The profile of the ground causes such a gradient. The sound may be propagated during upwind conditions upwards to create a sound shadow. A downwind refracts the sound towards the ground producing a slight increase in sound level over calm isothermal conditions. The velocity of sound is inversely proportional to the temperature therefore a temperature gradient produces a velocity gradient and a refraction of the sound. Temperature decreases with height and the sound is refracted upwards.

For a source and receiver close to the ground quite large attenuation can be obtained at certain frequencies over absorbing surfaces, noticeably grassland. This attenuation is caused by a change in phase when the reflected wave strikes the absorbing ground and the destructive interference of that wave with the direct wave. The reduction in sound tends to be concentrated between 250 Hz and 600 Hz.

Noise screening can be effective when there is a barrier between the receiver and the source i.e. walls, earth mounds, cuttings and buildings. The performance of barriers is frequency dependent. To avoid sound transmission through a barrier the superficial mass should be greater than 10 Kg/m^2.

There is a complex relation between subjective loudness and the sound pressure level and again between annoyance due to noise and the sound pressure level. In general the ear is less sensitive at low frequencies and the ear will only detect a difference in the sound pressure level when the ambient noise level is exceeded by 3.0-5.0dBA.

There are certain effects produced by sound which, if it is not controlled by approved acoustic mitigatory measures, seem to be construed as undesirable by most people and they are:

- Long exposure to high levels of sound, which may damage the hearing or create a temporary threshold shift – in industry or at areas where music is played louder than 95.0 dBA. This will seldom happen in far-field conditions;
- Interference with speech where important information by the receiver cannot be analyzed due to loud noises;
- Excessive loudness;
- Annoyance.

A number of factors, for example clarity of speech, age of listener and the presence of noise induced threshold displacement, will influence the comprehensibility of speech communication.

The effect of noise (with the exception of long duration, high level noise) on humans is limited to disturbance and/or annoyance and the accompanying emotional reaction. This reaction is very difficult to predict and is influenced by the emotional state of the complainant, his attitude towards the noisemaker, the time of day or night and the day of the week.

Types of noise exposure:

- Continuous exposure to noise – The level is constant and does not vary with time e.g. traffic on freeway and an extractor fan;

- Intermittent exposure to noise – The noise level is not constant and occurs at times e.g. car alarms and sirens;
- Exposure to impact noise – A sharp burst of sound at intermittent intervals e.g. explosions and low frequency sound.

Noise affects humans differently and the new noise which will be coming from the mine establishment and the associated activities will depend upon the intensity of the sound, the length of time of exposure and how often over time the ear is exposed to it. Urban dwellers are besieged by noise, not only in the city streets but also in the busy workplaces and household noises.

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

- Leq: The Leq is the constant sound level that would contain the same acoustic energy as the varying sound level, during the same period of time.

- L_{Max}: The instantaneous maximum noise level for a specified period of time.

- L_{Min}: The instantaneous minimum noise level for a specified period of time.

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

- The trained healthy human ear is able to discern changes in sound levels of 1.0dBA under controlled conditions in an acoustic laboratory;
- It is widely accepted that the average healthy ear can barely perceive noise level changes of 3.0dBA;
- A change in sound level of 5.0dBA is a readily perceptible increase in noise level;
- A 10.0dBA change in the sound level is perceived as twice as loud as the original source.

The World Bank in the Environmental Health and Safety Regulations has laid down the following noise level guidelines:

- Residential area – 55.0dBA for the daytime and 45.0dBA for the nighttime period;
- Industrial area – 70.0dBA for the day- and nighttime periods.

The difference between the actual noise and the ambient noise level and the time of the day and the duration of the activity, will determine how people will respond to sound and what the noise impact will be. In order to evaluate such, there must be uniform guidelines to evaluate each scenario. SANS 10103 of 2008 has laid down sound pressure levels for specific districts and has provided the following continuous noise levels per district as given in Table 2.1.

Table 2-1: Recommended noise levels for different districts.

Type of district	Equivalent continuous rating level ($L_{Req.T}$) for ambient noise - dBA					
	Outdoors			Indoors, with open windows		
	Day-night L_{Rdn}	Daytime L_{Reqd}	Night-time L_{Reqn}	Day-night $L_{R.dn}$	Daytime $L_{Req.d}$	Night-time $L_{Req.n}$
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with some workshops, with business premises and with main roads	60	60	50	50	50	40
e) Central business district	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

For industrial districts, the $L_{R.dn}$ concept does not necessarily hold. For industries legitimately operating in an industrial district during the entire 24h day/night cycle, $L_{Req.d} = L_{Req.n} = 70$dBA can be considered as typical and normal.

The response to noise can be classified as follows:

- An increase of 1.0dBA to 3.0dBA above ambient noise level will cause no response from the affected community. For a person with normal hearing an increase of 0dBA to 3.0dBA will not be noticeable
- An increase between 1.0dBA – 10.0dBA will elicit little to sporadic response. When the difference is more than 5.0dBA above the ambient noise level a person with normal hearing will start to hear the difference.
- An increase between 5.0dBA and 15.0dBA will elicit medium response from the affected community.
- An increase between 10.0dBA and 20.0dBA will elicit strong community reaction.

Because there is no clear-cut transition from one community response to another as well as several variables, categories of responses can overlap. This should be taken into consideration during the evaluation of a potential noise problem. There is therefore a mixture of activities and higher noise levels as per the above recommended continuous rating levels within i.e. residential, industrial and feeder roads in close proximity of each other. The ambient noise level will therefore differ throughout

the study area, depending on the region and the measuring position in relation to areas with existing mining activities. People exposed to an increase in the prevailing ambient noise level will react differently to the noise levels and the response is given in Table 2.2.

Table 2-2: Response when ambient noise levels is exceeded

Excess dB	Estimated community/group response	
	Category	Description
0	None	No observed reaction
0-10	Little	Sporadic complaints
5-15	Medium	Widespread complaints
10-20	Strong	Threats of community/group action
>15	Very strong	Vigorous community/group action

3. Study methodology

3.1 Instrumentation

The noise survey was conducted in terms of the provisions of the Noise Control Regulations, 1994 and the SANS 10103 of 2008 (The measurement and rating of environmental noise with respect to annoyance and to speech communication) using a digital Larson Davis 831 – Class 1 meter with Logging, Environmental 1/1, 1/3 Octave Band and percentiles Sound Level Meter (Class 1). On taking measurements the device-meter scale was set to the “A” weighed measurement scale which enables the device to respond in the same manner as the human ear. The device was held approximately 1.5 m above the surface and at least 3.0m away from hard reflecting surfaces. A suitable wind shield was used on the microphone for all measurements in order to minimise wind interference. The Instrument was checked and calibrated prior to use and maintained in accordance with equipment and coincided below 1.0dBA.The following instruments were used in the noise survey:

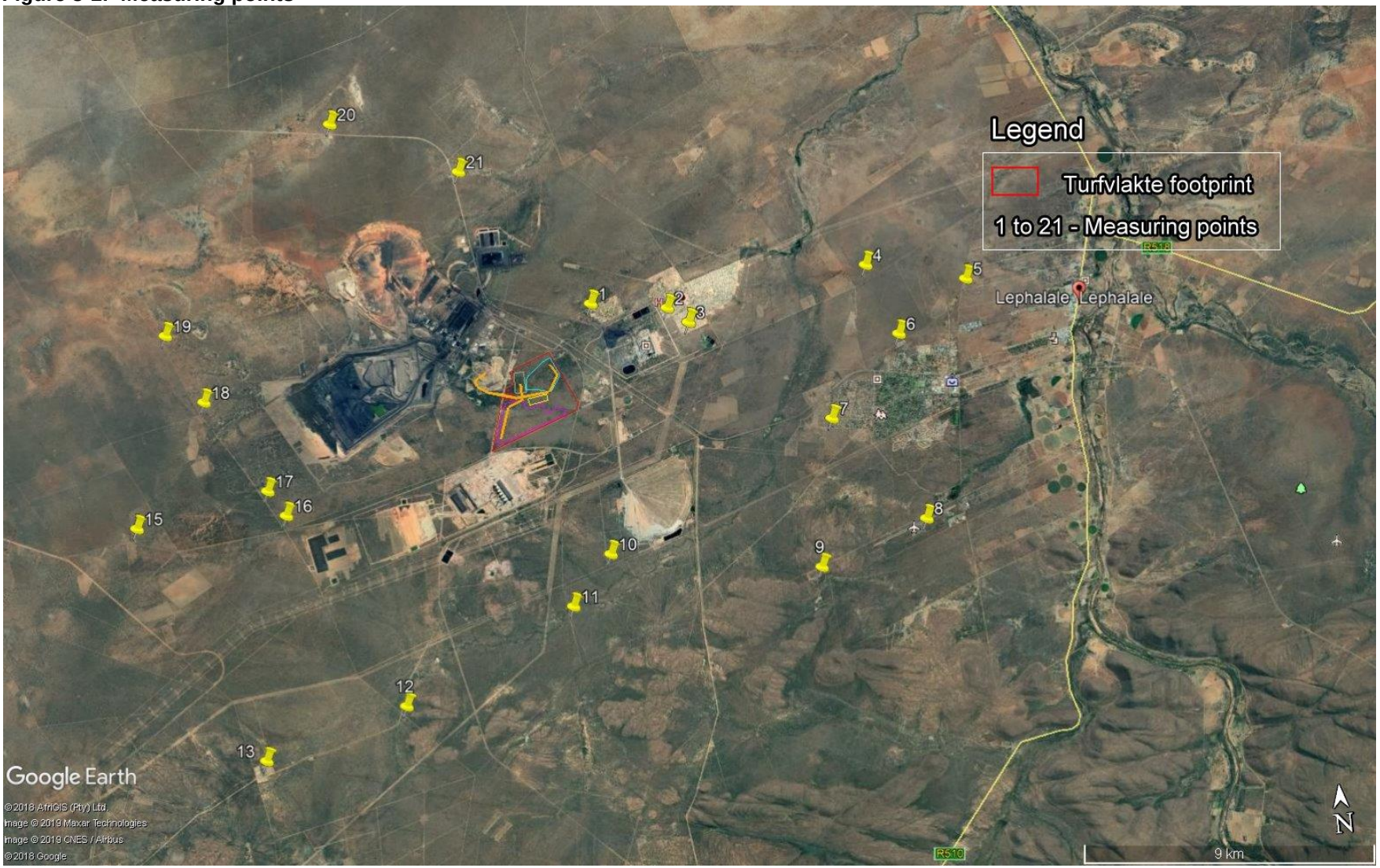
- Larsen Davis Integrated Sound Level meter Type 1 – Serial no. S/N 0001072;
- Larsen Davis Pre-amplifier – Serial no. PRM831 0206;
- Larsen Davis ½” free field microphone – Serial no. 377 B02 SN 102184;
- Larsen Davis Calibrator 200 – Serial no.9855.

The calibration certificates are attached as Appendix A. The measured ambient noise level during the daytime and night time periods will be the baseline ambient noise criteria for the study area and will be evaluated in terms of SANS 10103 of 2008.

3.2 Measuring points

The measuring points for the study area were selected to be representative of the prevailing ambient noise levels for the study area and include all the noise sources such as distant mining activities, power station noise, traffic and domestic noise. The measuring points are illustrated in Figure 3.1.

Figure 3-1: Measuring points



The location of the measuring points throughout the study area and the physical attributes of each measuring point are illustrated in Table 3.1.

Table 3-1: Measuring points and co-ordinates for the study area

Position	Latitude	Longitude	Remarks
1	23° 39.503'	27° 35.703'	Northern side of Maropong.Distant Matimba power station audible.
2	23° 39.706'	27° 37.086'	Marapong residential area. Distant Matimba power station audible.
3	23° 39.982'	27° 37.447'	Marapong boundary behind Matimba power station. Power station noise audible.
4	23° 39.336'	27° 40.775'	Lephalale Agricultural Holdings. Distant Matimba power station audible.
5	23° 39.739'	27° 42.571'	Lephalale Agricultural Holdings (Horse riding school). Distant Matimba power station audible.
6	23° 40.540'	27° 41.250'	Residential area at Lephalale. Domestic type noise.
7	23° 41.832'	27° 39.871'	Residential area. Distant traffic audible.
8	23° 43.663'	27° 41.403'	Mabula Lodge. Distant humming sound audible.
9	23° 44.285'	27° 39.402'	South east of the proposed Turfvlakte. Distant plant audible.
10	23° 43.703'	27° 35.591'	Eskom nature reserve. Far distant Medupi plant audible.
11	23° 44.508'	27° 34.812'	Eskom nature reserve. Far distant Medupi plant audible.
12	23° 45.872'	27° 31.589'	Kumanati Lodge. Distant Medupi plant audible.
13	23° 46.536'	27° 28.939'	Lephalale game traders. Agricultural activities audible.
14	23° 43.216'	27° 24.179'	Taaibosch. Insects and birds audible.
15	23° 42.446'	27° 27.036'	Along Steenbokpan Road. Traffic – 10 vehicles not included in results.
16	23° 42.493'	27° 29.772'	West of Grootegeluk mine. Distant Grootegeluk mine audible.
17	23° 42.052'	27° 29.481'	West of Grootegeluk mine. Distant Grootegeluk mine audible.
18	23° 40.462'	27° 28.492'	West of Grootegeluk mine. Distant Grootegeluk mine audible.
19	23° 39.289'	27° 27.915'	West of Grootegeluk mine. Distant Grootegeluk mine audible.
20	23° 36.065'	27° 31.313'	Along gravel road. Insects and birds.
21	23° 37.078'	27° 33.555'	Along gravel road. Insects and birds.

The following is of relevance to the ambient noise measurements:

- The L_{Aeq} was measured over a representative sampling period exceeding 10 minutes at each measuring point;
- The noise survey was carried out during the day and nighttime period being 6h00 to 22h00 for the day time and 22h00 to 6h00 for the night time period.

3.3 Site Characteristics

The following observations were made in and around the study area:

- There was a continuous to intermittent flow of traffic along the tarred feeder roads to the east and south of the proposed Turfvlakte mining area;
- The tarred feeder road immediately east of the proposed mining area was used by traffic and heavy-duty trucks;
- The gravel road leading to the south was used on an intermittent basis;
- Domestic type noise, traffic and Matimba power station noise contribute to the prevailing ambient noise level;

- Domestic type activities, traffic noise, birds and insects contribute to the prevailing ambient noise levels in the residential areas of Lephalale; and
- The wind and weather conditions play an important role in noise propagation.

3.4 Current noise sources

The following are noise sources in the vicinity of and the boundaries of the study area:

- Domestic noises;
- Intermittent traffic along the feeder roads and haul roads;
- Intermittent train and train hooting noise;
- Distant traffic noise from the abutting feeder roads;
- Noise from Matimba and Medupi power stations;
- Insects;
- Birds;
- Wind noise.

3.5 Atmospheric conditions during the noise survey

The noise readings were carried out at the different measuring points and the prevailing atmospheric conditions i.e. wind speed, wind direction and temperature were taken into consideration. The following meteorological conditions were recorded:

14 November 2017

Daytime

- Wind speed – less than 2.7m/s;
- Temperature – 28.5^{o}C – No strong temperature gradient occurred near the ground;
- Cloud cover – Clouds;
- Wind direction – The wind was blowing from a north-westerly direction;
- Humidity – 20% humidity.

Night time

- Wind speed – No wind to 2.9m/s;
- Temperature – 15.5^{o}C ;
- Cloud cover – Clouds;
- Wind direction – The wind was blowing from a north-easterly direction;
- Humidity – 70% humidity.

15 November 2017

Daytime

- Wind speed – less than 2.4m/s;
- Temperature – 28.7^{o}C – No strong temperature gradient occurred near the ground;
- Cloud cover – Clouds;
- Wind direction – The wind was blowing from a north-westerly direction;
- Humidity – 10% humidity.

Night time

- Wind speed – less than 2.7m/s;
- Temperature – 16.7^{o}C – No strong temperature gradient occurred near the ground;
- Cloud cover – Clouds;
- Wind direction – The wind was blowing from a north-easterly direction;
- Humidity – 10% humidity.

The wind speed and wind direction will determine the propagation of the mine and/or power station activity noises and how the residents will perceive noises.

4. Regulatory and Legislative Requirements

There are specific regulatory and legislative requirements which regulate the proposed development in terms of environmental noise. The legislative documents are as follows:

4.1 Department of Environment Affairs: Noise Control Regulations promulgated under the Environment Conservation Act**,** (Act No. 73 of 1989), Government Gazette No. 15423, 14 January 1994.

These noise control regulations are applicable in the study area and the main aspect of these noise control regulations is that you may exceed the prevailing ambient noise levels by 7.0dBA before a noise disturbance is created.

4.2 South African National Standards – SANS 10103 of 2008

The South African National Standards provide the guidelines for the different recommended prevailing ambient noise levels and how to evaluate when a specific operation or activity is creating a noise disturbance and what reaction can be expected if a noise disturbance is created.

4.3 South African National Standards – SANS 10210 of 2004

This national standard is used when calculating or predicting increased road traffic noise during new developments.

4.4 Environmental, Health and Safety Guidelines of the IFC of the World Bank

The recommended noise level for a noise sensitive area is 55.0dBA during the day and 45.0dBA during the night.

The Constitution of the Republic of South Africa Act, (Act No 108 of 1996) makes provision for the health and well-being of the citizens and to prevent pollution and to promote conservation.
According to Article 24 of the Act, everyone has the right to:

(a) an environment that is not harmful to their health and well-being; and
(b) have the environment protected for the present and future generations through reasonable legislative and other measures that-
    (i) prevent pollution and ecological degradation;
    (ii) promote conservation; and
    (iii) secure ecological sustainable development and use of natural resources, while promoting justifiable economic and social development.

It is widely recognized that many aspects of mining operations may lead to an increase in the environmental ambient noise levels. The impact of such an increase in the prevailing noise levels can be both physical and physiological. Many aspects of mining operations lead to an increase in noise levels over the prevailing ambient levels (Garvin *et al*., 2009).

5. Description of the receiving environment

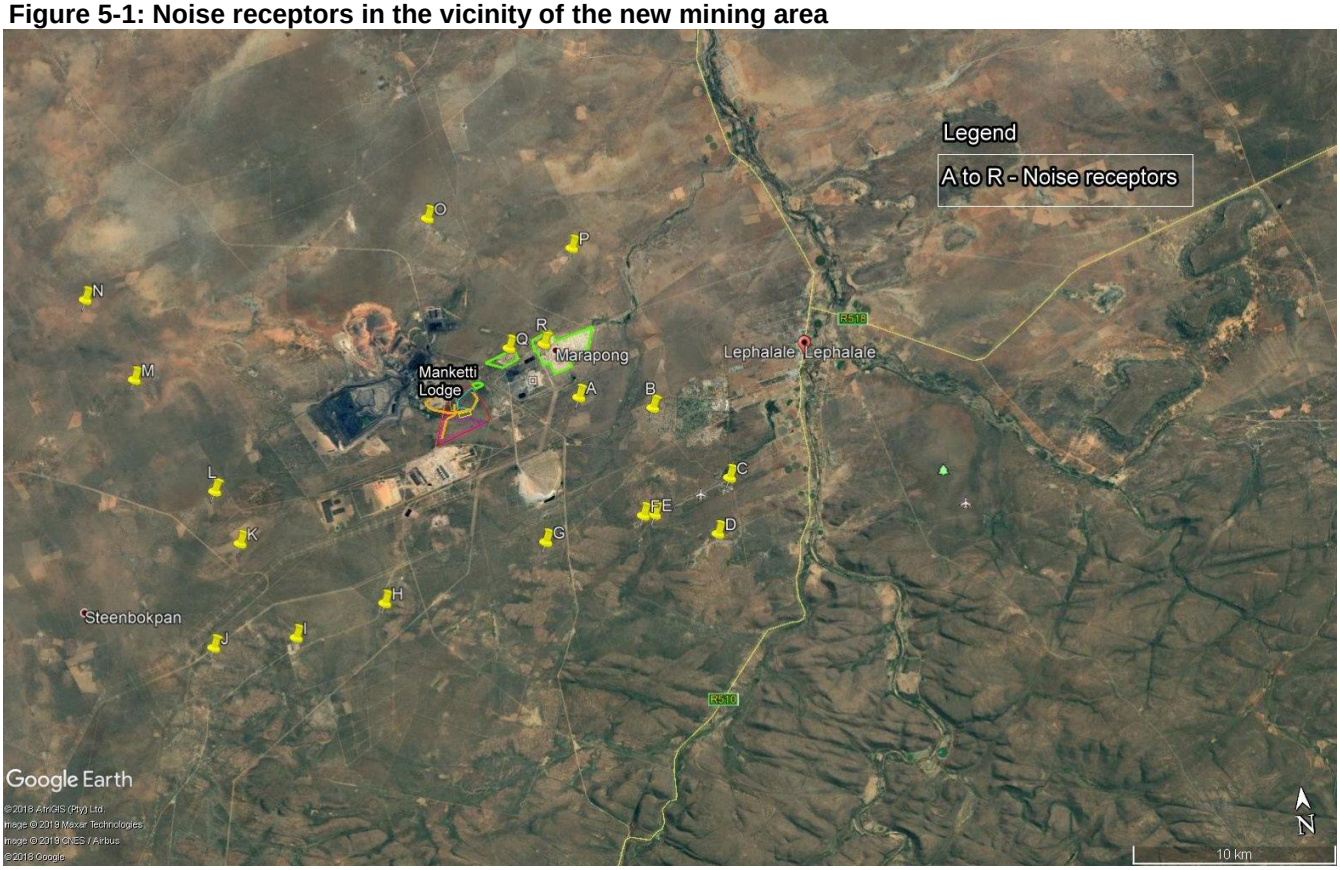
The prevailing ambient noise levels in build-up areas were created by domestic activities, distant traffic, barking dogs and wind in the trees. Some of the residential areas are located close to or in the vicinity of the feeder roads with the result that the prevailing ambient noise levels will be higher due to the traffic during the day and the night respectively. The distance between the nearest points of the residential areas to the proposed mining areas (Pit 1, Pit 2, Infra structure and Topsoil dump) will be determined and is illustrated in Table 5.1.

Table 5-1: Distance between the noise receptors and the different mine activities

Properties	Pit 1	Pit 2	Infra Structure	Haul Road	Topsoil dump
A	5490	5003	5538	5329	6004
B	9084	8375	9253	9048	9592
C	13662	13126	13442	13230	14049
D	14291	13912	13859	13652	14697
E	10212	10789	10755	10514	11427
F	10554	10329	10284	10081	10959
G	7420	8217	7812	7610	8562
H	10114	11454	10416	10213	10886
I	13637	15193	14267	14063	14394
J	16837	18189	17272	17071	12997
K	12697	13181	13167	12965	13085
L	12807	13327	13245	13040	12923
M	16310	16380	16520	16319	16091
N	19497	19526	19647	19243	18938
O	9902	8570	9500	9295	8944
P	9869	8734	9417	9215	9069
Q	2526	1976	3102	2901	2876
R	4286	3834	4686	4285	5106
Manketti lodge	1918	338	1456	1286	1432

The noise receptors in the vicinity of new Turfvlakte mine are illustrated in Figure 5.1.

Figure 5-1: Noise receptors in the vicinity of the new mining area



6 Results of the noise survey

The prevailing ambient noise levels at the different measuring points are given in Table 6.1. These noise levels include all the noise sources currently in the area such as domestic, traffic noise, distant mine noise and natural noise sources. The Leq is the average noise level for the specific measuring point over a period of time, the Lmax is the maximum noise level and the Lmin is the minimum noise level registered during the noise survey for the specific area in dBA.

Table 6-1: Noise levels for the day and night in the vicinity of the Turfvlakte study area.

Position	Day time				Night time			
	Leq - dBA	Lmax (Fast) - dBA	Lmin (Fast) - dBA	Remarks	Leq - dBA	Lmax (Fast) - dBA	Lmin (Fast) - dBA	Remarks
1	**43.2**	66.0	38.1	Distant Matimba Power station audible.	**48.1**	57.9	45.3	Distant Matimba power station audible
2	**50.3**	64.5	44.9	Distant Matimba Power station audible.	**51.2**	67.1	46.9	Distant Matimba Power station audible.
3	**49.3**	65.6	44.4	Distant Matimba Power station audible.	**49.8**	64.6	46.2	Distant Matimba Power station audible.
4	**40.4**	63.8	30.8	Distant Matimba power station noise and wind.	**43.9**	61.7	34.6	Distant Matimba power station noise and wind.
5	**40.2**	63.7	30.4	At the stables and no plant audible.	**43.2**	65.0	35.3	At the stables and no plant audible.
6	**43.6**	61.9	38.8	Cicadas, insects and domestic.	**47.9**	59.1	40.3	Insects and distant traffic.
7	**41.8**	50.5	36.5	Distant traffic and plant noise.	**43.6**	57.9	38.9	Distant traffic and insects.
8	**42.1**	69.8	39.4	Distant humming sound.	**38.4**	60.8	34.4	Distant insects and wind noise.

9	**36.7**	55.1	35.5	Distant power station noise.	**39.7**	62.0	38.8	Distant power station noise and insects.
10	**37.6**	75.8	33.5	Distant Medupi power station noise.	**39.7**	51.8	38.7	Insect noise.
11	**38.7**	71.6	35.4	Distant Medupi power station noise.	**39.5**	44.3	36.9	Insect noise.
12	**32.7**	56.6	23.6	Distant Medupi power station noise.	**39.4**	50.5	32.4	Insect noise.
13	**33.1**	51.0	24.3	Distant agricultural activity noise.	**37.4**	48.9	30.3	Distant Medupi power station noise.
14	**34.2**	55.4	19.6	Insects and bird noise.	**37.7**	56.2	33.3	Insects.
15	**34.9**	60.4	21.2	Distant Grootegeluk activity noise.	**34.6**	55.1	28.2	Distant Grootegeluk mining activity noise and insects.
16	**48.4**	68.4	38.3	Intermittent traffic noise.	**39.4**	53.9	35.4	Distant Grootegeluk mining activity noise and insects.
17	**35.8**	63.2	34.5	Distant Grootegeluk mine noise.	**32.5**	46.9	24.7	Distant Grootegeluk mine and insect noise.
18	**36.7**	65.1	31.9	Distant Grootegeluk mine noise.	**32.8**	47.7	25.4	Distant Grootegeluk mine and insect noise.
19	**36.2**	60.9	20.4	Distant Grootegeluk mine noise.	**35.0**	52.4	29.7	Distant Grootegeluk mine and insect noise.
20	**34.1**	61.3	23.4	Birds and insect noise.	**32.4**	55.7	20.6	Distant insect noise.
21	**35.5**	61.3	23.2	Birds and insect noise.	**34.9**	60.4	21.2	Distant insect noise.

The ambient noise level along Nelson Mandela Avenue which is the main access road to the Grootegeluk mine was 66.8dBA during the day and 62.2dBA during the night. The ambient noise level along the access road passed Manketti Lodge was 61.4dBA during the day and 46.1dBA during the night and at Manketti Lodge the ambient noise level was 53.1dBA during the day and 43.6dBA during the night. Traffic noise and distant plant noise contributed to the prevailing ambient noise level. The wind at MPs 4 to 9 was affected by wind and the prevailing ambient noise level during the day and night will be 36.7dBA without wind interference.

The following noise levels are from construction machinery which is used during the construction of mine establishment. The machinery will not work all at once and the rock drill operation will work individually when it will be required. This will be a point source like many of the machinery whereas dump trucks/hauling vehicles will create a linear noise source.

The noise reduction calculated in Table 6.2 is for direct line of sight and medium ground conditions. Engineering control measures and topography can have an influence on how the noise level is perceived by the occupants of nearby noise sensitive areas. The cumulative noise level of the machinery and equipment will be 64.9dBA at 60m and 40.8dBA at 960m from the construction area if all the machinery operates in a radius of 30m at one time. This will seldom happen and the cumulative noise level will therefore be lower.

Table 6-2: Sound pressure levels of construction machinery

Equipment	Reduction in the noise level some distance from the source - dBA								
Cumulative distance from source in meters	2m from the source	15m	30m	60m	120m	240m	480m	960m	1920m
Dump truck	91.0	62.5	56.5	50.4	44.4	38.4	32.4	26.4	20.3
Backhoe	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Drilling Equipment	100.0	71.5	65.5	59.4	53.4	47.4	41.4	35.4	29.3
Flatbed truck	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Pickup truck	70.0	41.5	35.5	29.4	23.4	17.4	11.4	5.4	-0.7
Tractor trailer	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Crane	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Pumps	70.0	41.5	35.5	29.4	23.4	17.4	11.4	5.4	-0.7
Welding Machine	72.0	43.5	37.5	31.4	25.4	19.4	13.4	7.4	1.3
Generator	90.0	61.5	55.5	49.4	43.4	37.4	31.4	25.4	19.3
Compressor	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Pile driver	100.0	71.5	65.5	59.4	53.4	47.4	41.4	35.4	29.3
Jackhammer	90.0	61.5	55.5	49.4	43.4	37.4	31.4	25.4	19.3
Rock drills	100.0	71.5	65.5	59.4	53.4	47.4	41.4	35.4	29.3
Pneumatic tools	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Cumulative noise levels from the construction activities when all of such work within a radius of 30m	**105.5**	**76.9**	**70.9**	**64.9**	**58.9**	**52.9**	**46.8**	**40.8**	**34.8**

7 Noise impact levels at the different residential areas

7.1 Environmental noise level calculations

The assessment of environmental noise impacts will vary because of the different prevailing ambient noise levels in different districts according to Table 2 of SANS 10103 of 2008. There is recommended noise levels for ambient noise levels in different districts. (See Table 2-1). The increase in the in the prevailing ambient noise level is quantified as follow:

The increase in the prevailing ambient noise level is calculated in the following manner:

$\Delta L\text{Req,T} = L\text{Req,T (post)} - L\text{Req,T (pre)}$

where,

LReq,T (post) – noise level after completion of the project – projected or calculated noise levels;

LReq,T (pre) – noise level before the proposed project – ambient noise level.

The criteria for assessing the magnitude of a noise impact are illustrated in Table 7.1.

Table 7-1: Noise intrusion level criteria

Increase Δ-dBA	**Assessment of impact magnitude**	**Color code**
0 <Δ≤ 1	Not audible	
1 <Δ≤ 3	Very Low	
3 <Δ≤ 5	Low	
5 <Δ≤ 10	Medium	
10 <Δ≤ 15	High	
15 <Δ	Very High	

The noise levels at the noise sensitive areas will be added in a logarithmic manner to determine the overall sound exposure at the receptor.

The following formula was used to calculate the noise level at the noise sensitive areas during the construction phase:

$$Lp = Lw - 20\log R - \alpha$$

Where, Lp is the sound level at a distance from the source in dBA;
Lw is the sound level at the source in dBA;
α is the noise reduction due to the distance from the source (5.0dBA);
R is the distance from the source.

The above equation and the Interactive noise calculator (ISO 9613) will be used to determine the noise levels during the construction phase and the operational phase of the project. The noise levels at the noise sensitive areas will be added in a logarithmic manner to determine the overall sound exposure at the receptor.

The following sound levels were used in determining the noise level at the residential areas during the construction phase:

- Site clearing and grubbing of footprint – 90.5dBA;
- Civil Construction and construction activities at the footprint - 85.5dBA;
- Construction of the haul roads – 87.5dBA; and

The noise intrusion level during the operational phase will be based on the following noise levels at the source:

- Open cast mining activities at the rim of the open cast pit – 80.0dBA;
- Hauling of coal – 87.5dBA;
- Maintenance activities – 80.0dBA;
- Emergency siren – 95.0dBA; and
- Emergency generator – 95.0dBA.

The noise intrusion level during the decommissioning phase will be based on the following noise levels at the source:

- Removal of infra-structure – 85.0dBA; and
- Rehabilitation of disturbed footprint – 85.0dBA.

8. Noise Impact Assessment Analysis

8.1 Construction phase of the pits

The noise intrusion levels at the residential areas A to R, (in dBA) will be insignificant, during the construction phase of the individual open cast pits (1 and 2) and is illustrated in the following tables.

Table 8-1: Noise intrusion levels in dBA during construction of Pit 1

Residential property	Site clearing and grubbing of footprint - dBA	Removal of topsoil	Construction of earthberm around the pit	Civil Construction (Service road)	Civil Construction	Building material and equipment deliveries	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level - Night time	Intrusion noise level - daytime	Intrusion noise level - night time
A	10.7	5.7	7.7	7.7	7.7	0.7	15.4	36.9	34.7	0.0	0.1
B	6.3	1.3	3.3	3.3	3.3	-3.7	11.0	36.9	34.6	0.0	0.0
C	2.8	-2.2	-0.2	-0.2	-0.2	-7.2	7.4	36.9	34.6	0.0	0.0
D	2.4	-2.6	-0.6	-0.6	-0.6	-7.6	7.1	36.9	34.6	0.0	0.0
E	5.3	0.3	2.3	2.3	2.3	-4.7	10.0	36.9	34.6	0.0	0.0
F	5.0	0.0	2.0	2.0	2.0	-5.0	9.7	36.9	34.6	0.0	0.0
G	8.1	3.1	5.1	5.1	5.1	-1.9	12.7	36.9	34.6	0.0	0.0
H	5.4	0.4	2.4	2.4	2.4	-4.6	10.1	36.9	34.6	0.0	0.0
I	2.8	-2.2	-0.2	-0.2	-0.2	-7.2	7.5	33.6	27.5	0.0	0.0
J	1.0	-4.0	-2.0	-2.0	-2.0	-9.0	5.6	33.6	27.5	0.0	0.0
K	3.4	-1.6	0.4	0.4	0.4	-6.6	8.1	33.6	27.5	0.0	0.0
L	3.4	-1.6	0.4	0.4	0.4	-6.6	8.0	48.6	34.6	0.0	0.0
M	1.3	-3.7	-1.7	-1.7	-1.7	-8.7	5.9	48.6	34.6	0.0	0.0
N	-0.3	-5.3	-3.3	-3.3	-3.3	-10.3	4.4	33.6	27.5	0.0	0.0
O	5.6	0.6	2.6	2.6	2.6	-4.4	10.2	36.9	34.6	0.0	0.0
P	5.6	0.6	2.6	2.6	2.6	-4.4	10.3	36.9	34.6	0.0	0.0
Q	17.5	12.5	14.5	14.5	14.5	7.5	22.1	43.2	48.1	0.0	0.0
R	12.9	7.9	9.9	9.9	9.9	2.9	17.5	50.2	51.2	0.0	0.0
Manketti lodge	19.8	14.8	16.8	16.8	16.8	9.8	24.5	43.3	43.3	0.1	0.1

Table 8-2: Noise intrusion levels in dBA during construction of Pit 2

Residential property	Site clearing and grubbing of footprint - dBA	Removal of topsoil	Construction of earthberm around the pit	Civil Construction (Service road)	Civil Construction	Building material and equipment deliveries at the site	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level - Night time	Intrusion noise level - daytime	Intrusion noise level - night time
A	11.5	6.5	8.5	8.5	8.5	1.5	16.2	36.9	34.7	0.0	0.1
B	7.0	2.0	4.0	4.0	4.0	-3.0	11.7	36.9	34.6	0.0	0.0
C	3.1	-1.9	0.1	0.1	0.1	-6.9	7.8	36.9	34.6	0.0	0.0
D	2.6	-2.4	-0.4	-0.4	-0.4	-7.4	7.3	36.9	34.6	0.0	0.0
E	4.8	-0.2	1.8	1.8	1.8	-5.2	9.5	36.9	34.6	0.0	0.0
F	5.2	0.2	2.2	2.2	2.2	-4.8	9.9	36.9	34.6	0.0	0.0
G	7.2	2.2	4.2	4.2	4.2	-2.8	11.9	36.9	34.6	0.0	0.0
H	4.3	-0.7	1.3	1.3	1.3	-5.7	9.0	36.9	34.6	0.0	0.0
I	1.9	-3.1	-1.1	-1.1	-1.1	-8.1	6.5	33.6	27.5	0.0	0.0
J	0.3	-4.7	-2.7	-2.7	-2.7	-9.7	5.0	33.6	27.5	0.0	0.0
K	3.1	-1.9	0.1	0.1	0.1	-6.9	7.8	33.6	27.5	0.0	0.0
L	3.0	-2.0	0.0	0.0	0.0	-7.0	7.7	48.6	34.6	0.0	0.0
M	1.2	-3.8	-1.8	-1.8	-1.8	-8.8	5.9	33.6	27.5	0.0	0.0
N	-0.3	-5.3	-3.3	-3.3	-3.3	-10.3	4.3	33.6	27.5	0.0	0.0
O	6.8	1.8	3.8	3.8	3.8	-3.2	11.5	36.9	34.6	0.0	0.0
P	6.7	1.7	3.7	3.7	3.7	-3.3	11.3	36.9	34.6	0.0	0.0
Q	19.6	14.6	16.6	16.6	16.6	9.6	24.2	43.3	48.1	0.1	0.0
R	13.8	8.8	10.8	10.8	10.8	3.8	18.5	50.2	51.2	0.0	0.0
Manketti lodge	34.9	29.9	31.9	31.9	31.9	24.9	39.6	44.8	44.8	1.6	1.6

The impact assessment for the construction phase is illustrated in Tables 8.3 to 8.7.

Table 8-3: Site clearing and grubbing of footprint

Areas	***Site clearing and grubbing of footprint***								
Impact Summary	*Noise increase at the boundary of the mine footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

Table 8-4: Civil construction and construction activities at the footprint

Areas	***Civil construction and construction activities at the footprint***								
Impact Summary	*Noise increase at the boundary of the mine footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

Table 8-5: Construction of earthberm around the pit

Areas	***Construction of earthberm around the pit***								
Impact Summary	*Noise increase at the boundary of the mine footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

Table 8-6: Constructions of the haul road

Areas	***Constructions of the haul road***								
Impact Summary	*Noise increase at the boundary of the mine footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

Table 8-7: Building material and equipment deliveries at the site

Areas	***Building material and equipment deliveries at the site***								
Impact Summary	*Noise increase at the boundary of the mine footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

8.2 Operational Phase

The environmental noise impact during the operational phase at the noise receptors is illustrated in Table 8.8. The noise impact will be insignificant at the different noise receptors A to R.

Table 8-8: Noise intrusion levels in dBA during the operational phase

Residential property	Open cast mining activities - Pit 1	Open cast mining activities - Pit 2	Topsoil Activities	Hauling of coal	Maintenance activities	Emergency siren	Emergency generator	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level - Night time	Intrusion noise level - daytime	Intrusion noise level - night time
A	7.7	8.5	6.9	8.0	10.6	17.8	15.1	21.1	37.0	34.8	0.1	0.2
B	3.3	4.0	2.9	3.4	6.2	12.6	11.2	16.5	36.9	34.7	0.0	0.1
C	-0.2	0.1	-0.5	0.1	2.9	8.8	7.8	13.1	36.9	34.6	0.0	0.0
D	-0.6	-0.4	-0.8	-0.2	2.7	8.2	7.3	12.6	36.9	34.6	0.0	0.0
E	2.3	1.8	1.3	2.1	4.9	10.5	9.6	14.8	36.9	34.6	0.0	0.0
F	2.0	2.2	1.7	2.4	5.3	10.8	10.0	15.2	36.9	34.6	0.0	0.0
G	5.1	4.2	3.8	4.9	7.6	12.8	12.3	17.3	36.9	34.7	0.0	0.1
H	2.4	1.3	1.8	2.3	5.1	9.2	9.9	14.6	36.9	34.6	0.0	0.0
I	-0.2	-1.1	-0.7	-0.5	2.4	6.7	7.5	12.2	33.6	27.6	0.0	0.1
J	-2.0	-2.7	0.2	-2.1	0.8	5.1	5.9	10.8	33.6	27.6	0.0	0.1
K	0.4	0.1	0.2	0.2	3.1	7.3	8.3	12.9	33.6	27.6	0.0	0.1
L	0.4	0.0	0.3	0.2	3.1	7.3	8.2	12.8	48.6	34.6	0.0	0.0
M	-1.7	-1.8	-1.6	-1.8	1.1	5.5	6.3	11.1	33.6	27.6	0.0	0.1
N	-3.3	-3.3	-3.0	-3.2	-0.4	4.2	4.8	9.8	33.6	27.6	0.0	0.1
O	2.6	3.8	3.5	3.1	5.9	11.6	11.3	16.2	36.9	34.7	0.0	0.1
P	2.6	3.7	3.3	3.2	6.0	12.4	11.0	16.4	36.9	34.7	0.0	0.1
Q	14.5	16.6	13.3	13.2	15.7	24.6	16.8	26.9	43.3	48.1	0.1	0.0
R	9.9	10.8	8.3	9.9	12.1	19.9	19.9	24.0	50.2	51.2	0.0	0.0
Manketti lodge	16.8	31.9	19.4	20.3	22.2	30.3	30.2	36.1	44.0	44.0	0.8	0.8

The impact assessment for the operational phase is illustrated in Tables 8.9 to 8.16.

The noise contours during the operational phase of the mine where Pit 1 will be operational is illustrated in Figure 8.1, when Pit 2 will be operational in Figure 8.2.

Figure 8-1: Noise contours during operations at Pit 1 and other infra-structure

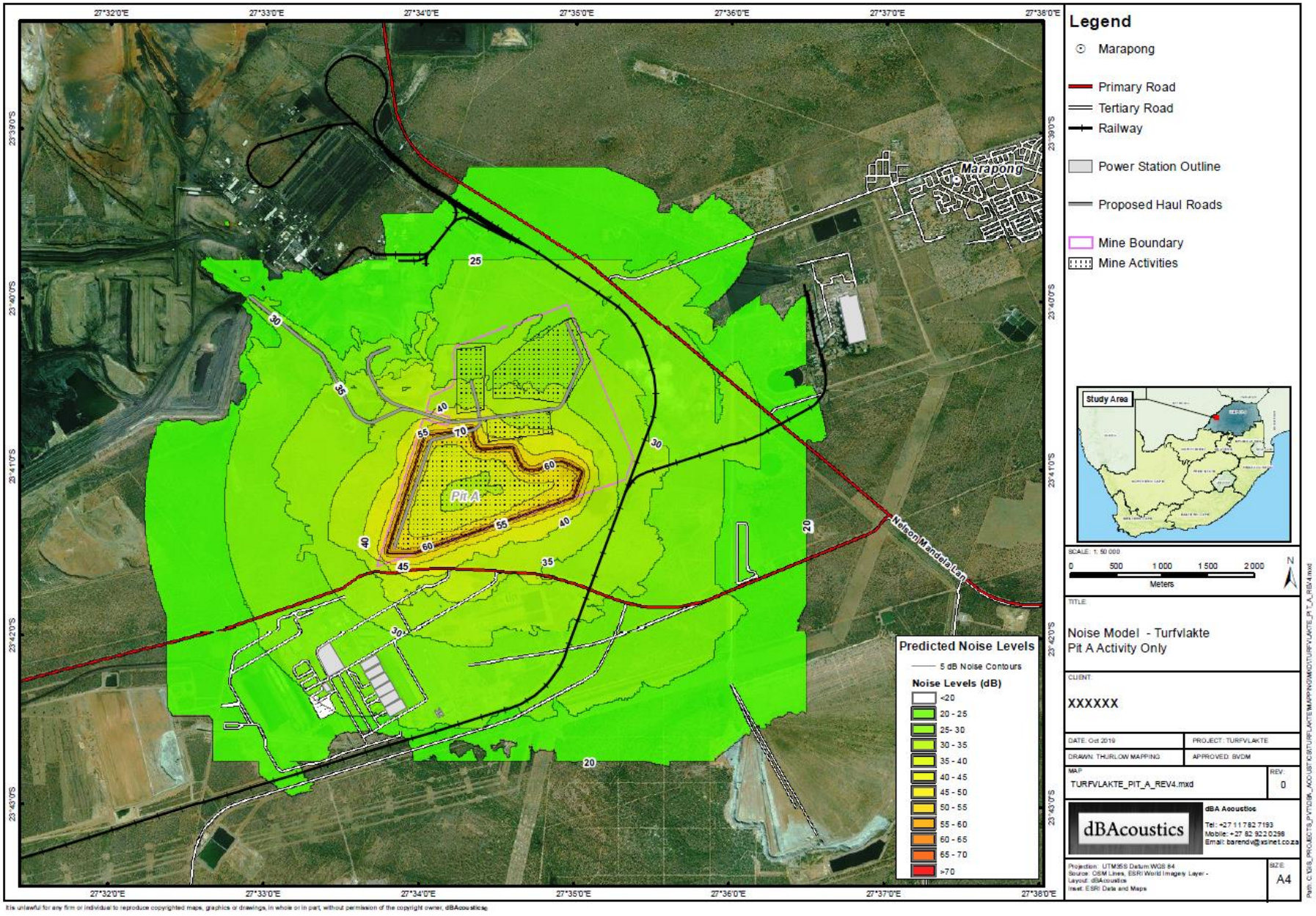


Figure 8-2: Noise contours during operations at Pit 2 and other infra-structure

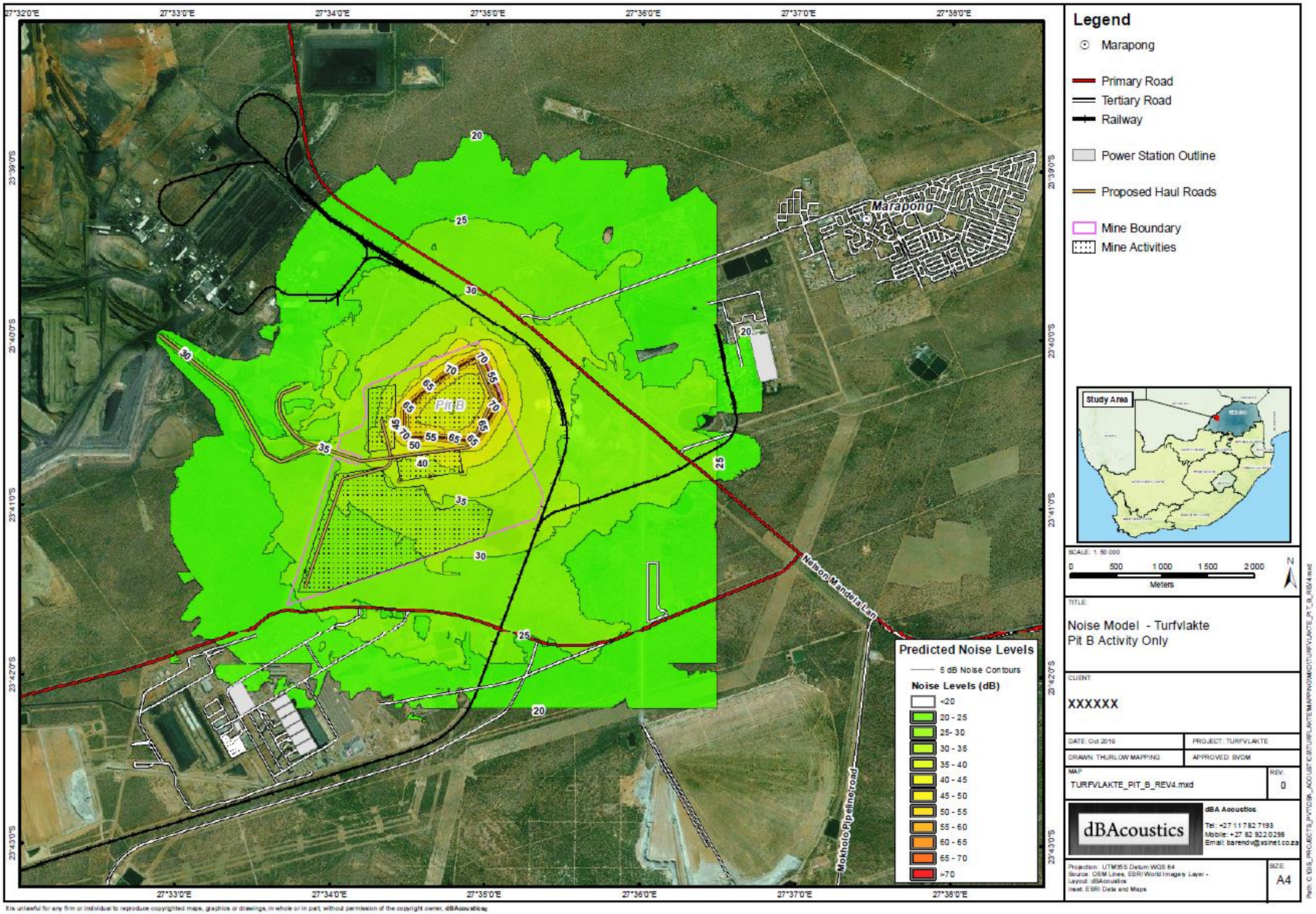


Table 8-9: Open cast mining activities at the rim of the open cast pit 1

Areas	***Open cast mining activities at the rim of the open cast pit 1***								
Impact Summary	*Noise increase at the boundary of the mine footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**4**	**3**	**3**	**3**	**1**	**12**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan. Environmental noise survey to be carried out on a quarterly basis.								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**2**	**3**	**1**	**10**	**-**	**M**

Table 8-10: Open cast mining activities at the rim of the open cast pit 2

Areas	***Open cast mining activities at the rim of the open cast pit 2***								
Impact Summary	*Noise increase at the boundary of the mine footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**4**	**3**	**3**	**3**	**1**	**12**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan. Environmental noise survey to be carried out on a quarterly basis.								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**2**	**3**	**1**	**10**	**-**	**M**

Table 8-11: Hauling of coal

Areas	***Hauling of coal***								
Impact Summary	*Noise increase at the boundary of the mine footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**4**	**3**	**3**	**3**	**1**	**12**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan. Environmental noise survey to be carried out on a quarterly basis.								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**2**	**3**	**1**	**10**	**-**	**M**

Table 8-12: Maintenance activities

Areas	***Maintenance activities***								
Impact Summary	*Noise increase at the boundary of the mine footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan. Environmental noise survey to be carried out on a quarterly basis.								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

Table 8-13: Emergency siren

Areas	***Emergency siren***								
Impact Summary	*Noise increase at the boundary of the mine footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**4**	**3**	**3**	**3**	**1**	**12**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan. Environmental noise survey to be carried out on a quarterly basis.								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**2**	**3**	**1**	**10**	**-**	**M**

Table 8-14: Emergency generator

Areas	***Emergency generator***								
Impact Summary	*Noise increase at the boundary of the mine footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**4**	**3**	**3**	**3**	**1**	**12**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan. Environmental noise survey to be carried out on a quarterly basis.								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**3**	**2**	**3**	**1**	**10**	**-**	**M**

8.3 Decommissioning phase

The noise intrusion levels during the decommissioning phase will be insignificant and is illustrated in Table 8.15.

Table 8-15: Noise intrusion levels in dBA during the decommissioning phase

Residential	Demolition of all surface infrastructure	Rehabilitation of all disturbed areas	Cumulative Levels	Cumulative noise level - Daytime	Cumulative noise level - Night time	Intrusion noise level - daytime	Intrusion noise level - night time
A	11.0	8.0	12.7	36.9	34.6	0.0	0.0
B	6.9	3.9	8.7	36.9	34.6	0.0	0.0
C	3.0	0.0	4.7	36.9	34.6	0.0	0.0
D	2.6	-0.4	4.4	36.9	34.6	0.0	0.0
E	4.8	1.8	6.6	36.9	34.6	0.0	0.0
F	5.2	2.2	7.0	36.9	34.6	0.0	0.0
G	7.5	4.5	9.3	36.9	34.6	0.0	0.0
H	5.0	2.0	6.7	36.9	34.6	0.0	0.0
I	2.3	-0.7	4.1	33.6	27.5	0.0	0.0
J	0.7	-2.3	2.4	33.6	27.5	0.0	0.0
K	3.0	0.0	4.7	33.6	27.5	0.0	0.0
L	3.0	0.0	4.8	48.6	34.6	0.0	0.0
M	1.1	-1.9	2.9	33.6	27.5	0.0	0.0
N	-0.5	-3.5	1.3	33.6	27.5	0.0	0.0
O	6.2	3.2	8.0	36.9	34.6	0.0	0.0
P	6.2	3.2	7.9	36.9	34.6	0.0	0.0
Q	16.1	13.1	17.8	43.2	48.1	0.0	0.0
R	12.4	9.4	14.1	50.2	51.2	0.0	0.0
Manketti lodge	22.6	19.6	24.3	43.3	43.3	0.1	0.1

The environmental noise impact of the decommissioning phase mining activities at the residential areas is illustrated in Table 8.16 & Table 8.17. The noise impact will be insignificant at the different noise receptors A to R during the decommissioning phase of the Turfvlakte mine establishment.

Table 8-16: Demolition of all infra-structure

Areas	***Demolition of all infra-structure***								
Impact Summary	*Noise increase at the boundary of the mine footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

Table 8-17: Planting of grass on rehabilitated areas

Areas	***Planting of grass on rehabilitated areas***								
Impact Summary	*Noise increase at the boundary of the mine footprint and at the abutting residential areas*								
Potential Impact rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**3**	**0.8**	**7.2**	**-**	**M**
Management Measures	Implementation of the noise mitigatory measures and the noise management plan								
After Management Impact Rating	**Status**	**Certainty/ Probability**	**Duration**	**Extent**	**Intensity**	**Frequency**	**Environmental significance points**	**+/-**	**Scoring**
	-1	**3**	**2**	**2**	**2**	**0.8**	**6.4**	**-**	**L**

9 Calculation of road traffic noise

The proposed routes will be within the boundaries of the Grootegeluk mining area and the only time when there will be outdoor traffic will be hauling of coal and/or deliveries of equipment and/or parts. The traffic along the feeder road (Nelson Mandela Avenue) will consist of heavy–duty trucks and motor-vehicles. The prevailing ambient noise level along the feeder road was as follows:

- 66.8dBA during the day and 62.2dBA during the night.

The calculations to determine the noise level from the additional traffic are based on the following equation:

SANS 10210 of 2004, the national standard for the calculating and predicting of road traffic noise was used to calculate the noise level to be generated by the traffic along the proposed road. The traffic will create a finite type noise as this road is already used by other vehicles on an ad hoc basis.

The calculation of the noise levels during the construction phase are based on a total of 8 vehicles per hour of which 6 will be heavy-duty vehicles and 2 will be motor-vehicles. The traffic volume per hour during the operational phase will be 10 vehicles of which 8 will be heavy-duty and 2 motor-vehicle per hour.

Basic Model

$L_{Basic} = 38.3 + 10 \text{ Log } (Q_r)$ dBA,

where; L_{Basic} = basic noise level in dBA and Q_r is the mean traffic flow per hour.

Primary corrections to the basic model:

- Traffic flow Q – vehicles/hour;
- Corrections for speed of traffic and percentage of heavy vehicles, $L_{P,v}$;
- Correction for gradient, L_{gr};
- Correction for road surface texture, L_{t}.

Propagation:

- Correction for ground conditions and distance of the receiver, $L_{d,hr}$;
- Height relative to source *h*,m;
- Average height of propagation h_{av}, m.

The calculated traffic noise level at 25m from the road will be along the feeder roads during the *construction phase* will be 47.5dBA and during the *operational phase* 50.7dBA. There will therefore be no noise impact from traffic activities (during the construction and/or operational phases) onto the residential properties.

10 Assumptions and Limitations

The following limitations forms part of the environmental noise impact assessment:

- The prevailing ambient noise levels for the study area was created by far and near noise sources associated with traffic and distant mining activities with the result that the prevailing ambient noise level may change at times;
- Noise measurements in the presence of winds in excess of 3.0m/s may impact the outcome of the environmental noise results;

- The identification of noise measuring points may create a problem in terms of the prevailing noise levels should it not be done with outmost care and in a scientific manner;
- The influx of traffic into an area will have an influence on the prevailing ambient noise levels and should be considered during the noise impact assessment process.

There will be a difference between the summer and winter periods as the insect activities such as crickets raise the prevailing ambient noise levels dramatically during the summer period whereas the prevailing ambient noise levels will not be influenced by insects during the winter period. The distances and topography between the proposed landfill site activities and the residential areas will play a role in the noise propagation and how the sound from the proposed landfill site activities will be perceived.

Noise or sound is part of our daily exposure to different sources which is part of daily living and some of the sounds which are intrusive such as traffic noise forms part of the ambient noise that people get accustomed to without noticing the higher sound levels. Any person in the workplace and at home is exposed to the following noise levels as given in Table 10-1. These are the average noise levels in the workplace and at home that will mask noise from a source introduced into an area:

Table 10-1 Different noise levels in and around the house and workplace

	Activity	**dBA**
Communication	Whisper	30.0
Communication	Normal Conversation	55.0-65.0
Communication	Shouted Conversation	90.0
Communication	Baby Crying	80.0
Communication	Computer	37.0-45.0
Home/Office	Refrigerator	40.0-43.0
Home/Office	Radio Playing in Background	45.0-50.0
Home/Office	Background Music	50.0
Home/Office	Washing Machine	50.0-75.0
Home/Office	Microwave	55.0-59.0
Home/Office	Clothes Dryer	56.0-58.0
Home/Office	Alarm Clock	60.0-80.0
Home/Office	Vacuum Cleaner	70.0
Home/Office	TV Audio	70.0
Home/Office	Flush Toilet	75.0-85.0
Industry	Industrial activities	85.0-95.0
Home/Office	Ringing Telephone	80.0
Home/Office	Hairdryer	80.0-95.0
Home/Office	Maximum Output of Stereo	100.0-110.0

11 Recommendations

The following three primary variables should be considered when designing acoustic screening measures for the control of sound and/or noise:

- The source – Reduction of noise at the source;
- The transmission path – Reduction of noise between the source and the receiver;
- The receiver – Reduction of the noise at the receiver.

The last option is not applicable as it was decided to control the noise levels at the source.

11.1 Acoustic screening recommendations

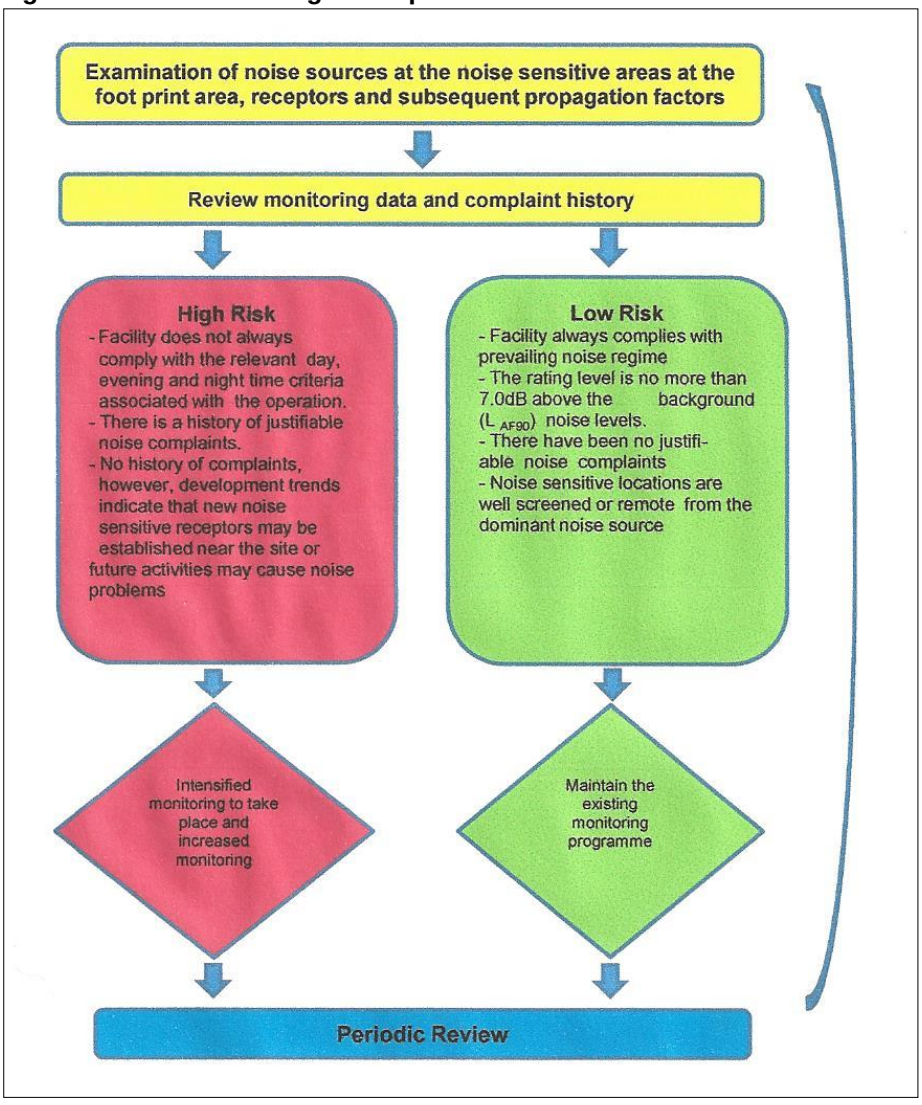
The acoustic screening measures for the project are given in Table 11.1. These are based on the best practicable methods, acoustic screening techniques and the IFC's Health and Safety Regulations.

Table 11-1: Recommended acoustic screening measures

Activity	Recommendations
Construction phase	• Machinery with low noise levels which complies with the manufacturer's specifications to be used. • Construction activities to take place during daytime period only. • Noise monitoring on a quarterly basis.
Operational phase	• Noise monitoring to be done at the open cast mining footprint, noise sources within mining footprint and at the abutting residential areas on a quarterly basis. • Actively manage the proposed Turfvlakte mining process and the noise management plan must be used to ensure compliance to the noise regulations and/or standards. • The noise levels to be evaluated in terms of the baseline noise levels.
Decommissioning phase	• Machinery with low noise levels which complies with the manufacturer's specifications to be used. • Activities to take place during daytime period only. • Vehicles to comply with manufacturers' specifications and any activity which will exceed 90.0dBA to be done during daytime only.
Cumulative impact of the entire process	• Actively manage the process and noise impact assessment to determine compliance to the noise regulations. The levels to be evaluated in terms of the baseline noise levels.

The following are the Environmental, Health and Safety Guidelines of the IFC of the World Bank, which should be taken into consideration during the construction, operational and decommissioning phases of the project. The following noise management plan as illustrated in Figure 11.1 must be used to identify any new noise sources which may have an impact on the abutting noise sensitive areas.

Figure 11-1: Noise management plan

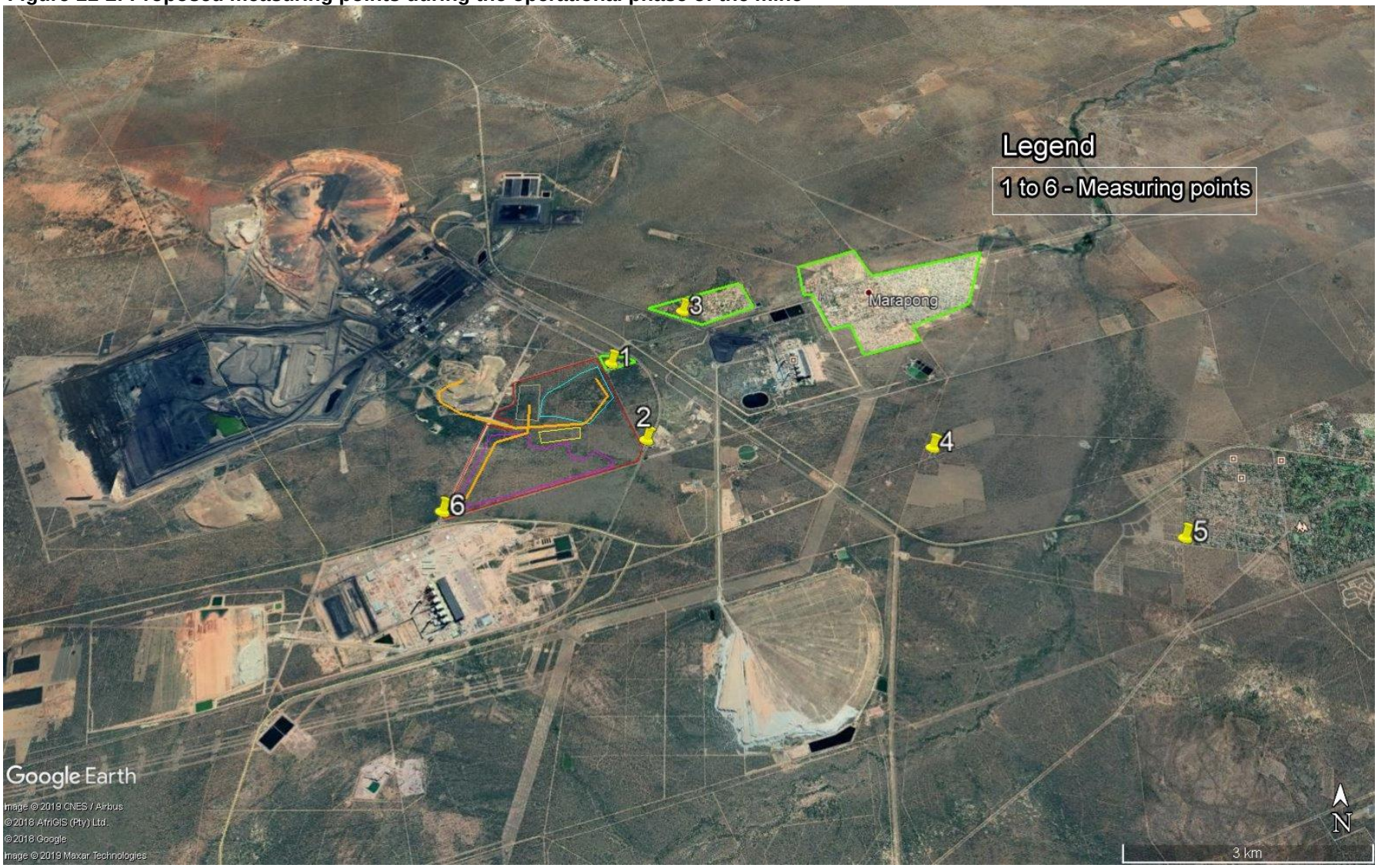


Noise monitoring will have to be carried out to determine the potential shift in the prevailing ambient noise levels on a monthly basis after which the frequency of monitoring may change to a quarterly basis. Noise readings to be carried out at the following measuring points as illustrated in Figure 11.2.

Table 11.2: Geographical information of the measuring points

Measuring point	Latitude	Longitude
1	23° 40.222'	27° 35.037'
2	23° 39.977'	27° 35.370'
3	23° 39.667'	27° 35.676'
4	23° 41.041'	27° 37.832'
5	23° 41.845'	27° 39.802'
6	23° 41.636'	27° 33.695'

Figure 11-2: Proposed measuring points during the operational phase of the mine



12 Conclusion

The proposed Turfvlakte mining project will be situated in an area where there are existing mining activities, feeder roads and residential areas. The noise impact assessment revealed that the noise increase will be insignificant and that the noise increase will not exceed the threshold value of 7.0dBA granted by the Noise Control Regulations, 1994. The recommended noise mitigatory measures will ensure that the proposed Turfvlakte mining project will be environmentally sustainable.

Animals depend on acoustic signals for essential functions. Some species have become threatened or endangered because of loss of habitat and further relocation as a result of noise disturbance is not possible. There is still an absence of understanding how observed behavioral and physiological effects translate into ecological consequences for wildlife. There are examples where mining activities did not impact on the breeding and well-fare of wild life inside mining areas and this was successfully introduced in mines in the Limpopo (IEMR, 2000).

Integrated Environmental Management (IEM) is a continuous process that ensures that the environmental impacts which can be introduced by mechanised activities during the construction, operational and decommissioning phases are avoided or mitigated throughout the project life cycle from design to the operational phase of the project (DEAT, 2004).

The Environmental management Plan (EMP) for the proposed mine establishment will consist of the following as illustrated in Table 12.1. Regular environmental monitoring will provide the data for reviewing, checking and revising the EMP.

Table 12-1: Environmental noise management plan

Action	Description	Frequency	Responsible person
Management objective	To ensure that the legislated noise levels will be adhered to at all times.	Annual	The engineer during the construction phase and the responsible person (Grootegeluk Environmental Department) during the construction phase of the project
Monitoring objective	Measure the environmental noise levels during the construction, operational and decommissioning phases of the project to ensure compliance to the recommended and threshold noise levels.	Quarterly basis	The Grootegeluk Environmental Department.
Monitoring technology	The environmental noise monitoring must be done with a calibrated Class 1 noise monitoring equipment.	Quarterly basis	The Grootegeluk Environmental Department .
Specify how the collected information will be used	The data must be collated and discussed on a quarterly basis during the operational phase with the responsible department (Grootegeluk Environmental department).	Quarterly basis.	The Grootegeluk Environmental Department.
Spatial boundaries	At the boundaries of the identified residential areas as well as at the mine footprint boundaries of the different mining areas (Figure 11-2.).	Quarterly basis.	The Grootegeluk Environmental Department.
Define how the data will be analysed and interpreted and how it should be presented in monitoring reports	Reports must be compiled for each monitoring cycle and the results must be compared to the previous set of results to determine if there was a shift in the prevailing ambient noise levels.	Quarterly basis.	The Grootegeluk Environmental Department.
Accuracy and precision of the data	The noise survey will have to be conducted in terms of the recommendations of SANS 10103 of 2008 and the applicable noise regulations.	Calibrated equipment which complies with the recommendations of SANS 10103 of 2008 must be used at all times.	Environmental noise specialist

The proposed Turfvlakte mining project will comply with the relevant Noise Control Regulations, 1994 and SANS 10103 of 2008 provided that the noise mitigatory measures are in place and that the noise management plan be adhered to at all times.

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Environmental noise and vibration specialist

13. List of Definitions and Abbreviations

13.1 Definitions

Ambient noise
The totally encompassing sound in a given situation at a given time and usually composed of sound from many sources, both near and far

A-weighted sound pressure level (sound level) (L_{pA}), in decibels
The A-weighted sound pressure level is given by the equation:

$L_{pA} = 10 \log (p_A/p_o)^2$

Where

p_A is the root-mean-square sound pressure, using the frequency weighting network A in pascals; and

p_o is the reference sound pressure (p_o = 20 μPa).

NOTE The internationally accepted symbol for sound level is dBA.

Distant source
A sound source that is situated more than 500 m from the point of observation

Equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$), in decibels
The value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval T, has the same mean-square sound pressure as a sound under consideration whose level varies with time. It is given by the equation

$$L_{Aeq,T} = 10 \log \left[\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \frac{p_A^2(t)}{p_o^2} dt \right]$$

Where
$L_{Aeq,T}$ is the equivalent continuous A-weighted sound pressure level, in decibels, determined over a time interval T that starts at t_1 and ends at t_2;

p_o is the reference sound pressure (p_o = 20 μPa); and

$p_A(t)$ is the instantaneous A-weighted sound pressure of the sound signal, in pascals.

Impulsive sound
Sound characterised by brief excursions of sound pressure (acoustic impulses) that significantly exceed the residual noise

Initial noise
The component of the ambient noise present in an initial situation before any change to the existing situation occurs

Intelligible speech
Speech that can be understood without undue effort

Low frequency noise
Sound, which predominantly contains frequencies below 100 Hz

Nearby source
A sound source that is situated at a distance of 500 m or less from the point of observation

Residual noise
The ambient noise that remains at a given position in a given situation when one or more specific noises are suppressed

Specific noise
A component of the ambient noise which can be specifically identified by acoustical means and which may be associated with a specific source
NOTE Complaints about noise usually arise as a result of one or more specific noises.

Ambient sound level
Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation.

Disturbing noise
Means a noise that causes the ambient noise level to rise above the designated zone level by 7.0dBA or if no zone level has been designated, the typical rating levels for ambient noise in districts, indicated in table 2 of SANS 10103.

Noise nuisance
Means any sound which disturbs or impairs the convenience or peace of any person

13.2 Abbreviations

dBA – A-weighted sound pressure level;

EMP – Environmental Management Plan;

IBR – Angular trapezoidal fluted profile sheet;

IFC – International Finance Corporation;

Km/h - Kilometers per hour;

Kg/m^3 – Kilogram per cubic meter;

m/s – meters per second;

NSA – Noise sensitive areas;

L_{Basic} – Basic noise level in dBA;

SANS – South African National Standards;

TLB – Tractor-loader-backhoe

14. References:

Constitution of the Republic of South Africa, 1996: (Act 108 of 1996). http://www.environment.co.za/environmental-laws-and-legislation-in-South-Africa. Accessed 12 March 2010.

DEAT (2004a) - Overview of Integrated Environmental Management Information Series. Department of Environment Affairs and Tourism (DEAT), Pretoria;

Constitution of the Republic of South Africa, 1996: (Act 108 of 1996). **http://www.environment.co.za/environmental-laws-and-legislation-in-South-Africa. Accessed 12 March 2010.**

Environmental, Health and Safety Guidelines for Community Noise, World Health Organisation, Geneva, 1999;

Environmental Protection Agency (EPA). Office of Environmental Enforcement (OEE) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4). April, 2012. http://*www.epa.ie* › About Us › Organisational Structure. *Accessed 12 July 2012.*

Google Earth, 2010, http//www.google.com/earth/download-earth.html. Accessed 12 May 2016**;**

IEMR, 2000 – Effects of noise on Wildlife. Institute for Environmental Monitoring and Research. ISSN: 1481-0336;

International Organization for Standardization – ISO (1993). ISO 9613-1:1993. Attenuation of sound during propagation outdoors – Part 1. Calculation of the absorption of sound by the atmosphere;

International Organization for Standardization – ISO (1993). ISO 9613-1:1993. Attenuation of sound during propagation outdoors – Part 2. General method of calculation;

Noise Control Regulations - Noise Regulations of 1992. GN154 as promulgated in Government Gazette No. 13717 dated 10 January 1992;

RSA, 1996. Statute of the Republic of South Africa – Constitutional Law, No 108 of 1996;

Rogers & Maxwell. Wind Energy Explained, Theory, Design and Application. DOI: 10 1002/04 70846127. Copyright © 2002. John Wiley & Sons Ltd;

SANS 10357 of 2004 – The calculation of sound propagation by the concave method (SANS, 2004);

SANS 10210 of 2004 – Calculating and predicting road traffic noise (SANS, 2004);

SANS 10328 of 2008 – Methods for environmental noise impact assessments (SANS, 2008);

SANS 10103 of 2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication (SANS, 2008);

World Bank, 1995, Guidelines for community noise. *International Finance Corporation General Concerns*. http://www.who.euromat.org. Accessed 20 July 2012.

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MANUFACTURERS	LARSON.DAVIS and PCB
MODEL NUMBERS	831, PRM 831 and 377 B02
SERIAL NUMBERS	0001072, 0206 and 102184
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Appendix B
Nature or Status of the Impact

The nature or status of the impact is determined by the conditions of the environment prior to construction and operation. A discussion on the nature of the impact will include a description of what causes the effect, what will be affected and how will it be affected. The nature of the impact can be described as negative or positive and can be derived from the significance ratings of the impacts.

RATING	DESCRIPTION	QUANTITATIVE RATING
Positive	A benefit to the holistic environment	1
Negative	A detriment to the holistic environment	-1

Probability of the Impact

The certainty or probability of the impact describes the likelihood of the impact actually occurring.

RATING	DESCRIPTION	QUANTITATIVE RATING
Improbable	In all likelihood the impact will not occur	1
Low Probability	Possibility of the impacts to materialise is very low	2
Probable	A distinct possibility that the impact will occur	3
Highly Probable	Most likely that the impact will occur	4
Definite	The impact will occur regardless of any prevention measures	5

Duration of the Impact

The duration of the impact refers to the temporal scale of the impact or benefit, in terms of the period of time that the surrounding environment will be affected or altered by the proposed project. This is determined by the following scale:

RATING	DESCRIPTION	QUANTITATIVE RATING
Short term	0-5 years Less than the project lifespan	1
Medium term	5 – 10 years	2
Long term	Life of project 15 - 40 years	3
Permanent	Where the impact will be irreversible and will remain	4

Spatial Extent of the Impact

The extent of the impact refers to the spatial scale of the impact or benefit of the proposed project and the area over which it extends. A description is provided of whether effects are limited in extent or affects a wide area or group of people. The extent is rated according to the following scale:

RATING	DESCRIPTION	QUANTITATIVE RATING
Site Specific	Effects occur within the site / servitude boundary	1
Local	Effects extend beyond the site boundary Affects immediate surrounding areas	2
Regional	Widespread effect Extends far beyond the site boundary Effects felt within a 50 km radius of the surface lease area	3
National	Effects felt beyond the 50km radius	4

Intensity of the Impact

The severity or intensity of an impact is an attempt to quantify the magnitude of the impacts and benefits associated with the proposed project. The severity scale accounts for extent and magnitude, but is subject to the value judgement of the report writer. The following scale is useful in measuring severity and benefit.

RATING	DESCRIPTION	QUANTITATIVE RATING
Very severe	Substantial deterioration / improvement Irreversible or permanent Cannot be mitigated	4
Very Beneficial	Permanent improvement and benefit	4
Severe	Marked deterioration Long term duration Serious and severe impacts Mitigation is very expensive, difficult or time consuming	3
Beneficial	Large improvement Long term duration	3
Moderately Severe	Moderate deterioration Medium term to long term duration Fairly easily mitigated	2
Moderately Beneficial	Moderate improvement Medium to long term duration	2
Slight	Minor deterioration Short to medium term duration	1

RATING	DESCRIPTION	QUANTITATIVE RATING
	Mitigation is easy, cheap or quick	
Beneficial	Minor improvement Short to medium term duration	1

Frequency of the Impact

The frequency of the impact refers to the temporal scale of the impact or benefit, in terms of the period of time that the surrounding environment will be affected or altered by the proposed project. This is determined by the following scale:

RATING	DESCRIPTION	QUANTITATIVE RATING
Continuous	Daily	1
Frequent	Less than daily (hours)	0.8
Infrequent	Moderate frequency (weekly)	0.5
Occasional	Less than weekly (Once or twice per month)	0.2

Significance of the impact

After assessment of an impact in accordance to the preceding six criteria, the significance of an impact can be determined through a synthesis of the aspects produced in terms of their status, probability, duration, frequency, extent and severity. The significance of an impact is an expression of the cost or value of an impact to society. The focus of EIAs must be a judgement as to whether or not impacts are significant, based upon the value system of society, or groups of people (Thompson, 1988, 1990).
The significance of the impact is determined by the following formula:

(Status * Certainty/Probability + Duration + Extent + Intensity)* Frequency = Significance

The following totals were used to calculate the threshold "classes" to determine the significance of the impact.

RATING	DESCRIPTION	THRESHOLD OF SIGNIFICANCE (Negative)
High	Negative long term / permanent change to the social environment	13 – 18
Medium	Medium or long term effects to the social environment These effects are real and mitigation is possible, difficult and often costly	7 – 12.9
Low	Short term effects on the social environment Effects are not substantial and are often viewed as unimportant Mitigation is cheap, easy, quick or seldom required	0 – 6.9

Some of the impacts will prove to be positive and a benefit to the social environment. Should the nature of the activity, as assessed, be positive the significance threshold will be reversed and the impact will be a benefit to the holistic environment.

RATING	DESCRIPTION	THRESHOLD OF SIGNIFICANCE (Positive)
High	To the greater benefit of the social environment No mitigation or monitoring needed	13 – 18
Medium	A benefit to the holistic environment Monitoring is needed Some mitigation is needed	7 – 12.9
Low	No real benefits to the holistic environment Mitigation and monitoring is needed	0 – 6.9