dBAcoustics

Environmental Noise Impact Assessment Kimberley Rehabilitation and Development Project, Kimberley

Environmental Impact Report
Noise Impact Assessment

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Date: 13 August 2020

Member: BJB van der Merwe CK 1996/060044/23

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 **NDI Geological Consulting Services (Pty) Ltd** was appointed as environmental assessment practitioner in terms of the National Environmental Management Act (NEMA), 1998 as amended (Act No. 107 of 1998), other than fair remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, No 43110 of 20 March 2020 for the **compilation of an EIA and EMPr for the Changing the Face of the City Project, Kimberley – Noise Impact Assessment**. I further declare that I am confident in the results of the studies undertaken and conclusions drawn because 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, 2020. I have further provided the environmental assessment practitioner with written access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not. I am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2020 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: 26 August 2020

Title / Position: Environmental noise specialist

Qualification(s): MSc Environmental Management

Experience (years): 18 years

Registration(s): SAAI, NACA, SAAG and IAIAsa

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 18 years. I have been instrumental in the pre-feasibility studies of proposed projects which may have an impact on the environment and noise receptors. 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, construction of the N2 near Butterworth, 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: Chameleon Environmental, Gibb, Royal Haskoning DHV, Coffey Environmental, Golder Associates Africa (Pty) Ltd, GCS Environmental (Pty) Ltd, Hatch, Knight Piesold Environmental (Pty) Ltd and SRK Engineering (Pty) Ltd, WOOD Environmental.

Qualifications

1. MSc – Environmental Management – University of Johannesburg;
2. BSc Honors 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).

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, Wolseley, Swellendam;
- 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 NDI Geological Consulting Services (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 refer 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.

Copyright

Executive Summary

dBAcoustics was commissioned to determine what the noise impact will be of the proposed Kimberley Rehabilitation and Development (KRD) project on the living environment in the vicinity of the project. The KRD project is a project within Kimberley to provide Retail Banking, Hotel and Conference facilities, housing within the Kimberley urban development area. The noise impact assessment will be part of the Environmental Impact Assessment (EIA) process to determine the potential noise impacts during the construction and operational phases of the project.

The development areas are situated in the following areas:

- BMW site (North of Schmidtdrift Road and West of Waterloo Road, West End) – Retail Banking, Hotel & Conference and Offices;
- St Augustine site (North of St Augustine Road and South of Green Street, West End) – Housing;
- Colville Site (East of Barkly Road and South of St John Way, Colville) – Housing.

The following quarries will be used to transport raw material to and to manufacture building material for the construction phase of the project:

- Vooruitzigt Quarry – west of the R31 and Retswelele residential area;
- Roodepan Quarry – east of Midlands Road and Roodepan residential area.

Purpose of the study

The noise survey was carried out to:

- Determine the prevailing ambient noise levels at the three sites and the two quarries which are all situated in the vicinity of residential areas.
- Quantify the cumulative impact of the construction and/or operational phases on the prevailing ambient noise levels and the outdoor environment.
- To make recommendations on engineering control measures.
- Identify and evaluate noise related problems i.t.o. SANS 10103 of 2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication and the International IFC - International Finance Corporation, Environmental Health and Safety Guidelines.

The noise survey was carried out on 29 and 30 July 2020 during the day and night-time periods. The ambient noise level in the vicinity of the proposed alternatives alignments is predominantly made up out of:

- Domestic type noise;
- Distant traffic noise;
- Central business type noises;
- Traffic noise;
- Birds and insects.

The ambient noise level is proportional to the type of activity i.e. traffic and domestic type noise far and near field, wind direction, inversion conditions, additional sounds i.e. frogs, animals, insects etc. present at the time during the season in a specific area.

The levels of noise emissions from road traffic as given in SANS 10210 of 2004 for the prediction of road traffic noise are a function of:

- The number of vehicles passing in a time (determined for each hour);
- The mean speed of the vehicles;
- The percentage heavy-duty vehicles;
- The road surface texture;
- The road gradient;
- The road worthiness of the vehicles.
- Distance between road and receiver;
- Intervening topography and structures that may shield the noise from the receiver;
- Meteorological effects.

Two aspects are important when considering potential noise impacts of a project and it is:

- The increase in the noise level, and;
- The overall noise level produced.

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 to manage the mechanical activities at the different areas;

- The transmission path – To ensure that the natural topography can play a role in reducing the noise as it propagates from the activities;
- The receiver - Reduction of the noise at the receiver which is not always a solution due to the nature of this project. This is not an option and will have to be assessed once the construction and operational phases are in progress.

The following are recommendations for the proposed project:

- The natural topography and distance to be used to reduce the noise from the activities at the three sites;
- Construction machinery and equipment with low noise levels to be always used during the construction phase of the project;
- Measure the environmental noise levels during the construction phase of the project to ensure compliance to the recommended environmental noise levels;
- The crushers, brickmaking plant and the kiln to be maintained on a continuous basis so that a noise nuisance and/or noise disturbance is not created;
- The reverse signal at machinery and/or vehicles which will operate within the residential areas to be replaced with a vibration type monitor;
- Speed limit of the different roads to be always adhered to while transporting material to and from the three construction sites;
- The emergency generator to be placed in such a position that the prevailing ambient noise will not be exceeded;
- Noise monitoring to be done on a quarterly basis during the construction phase (three sites and two quarries) and operational phase (two quarries) to ensure compliance to the Noise Control Regulations;

Conclusion and summary

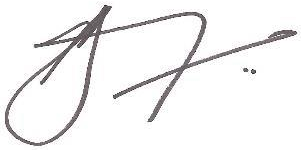
The proposed project, whereby aggregate will be removed from Colville, St Augustine and BMW sites and construction activities will take place at all five areas, will be below the threshold value of 7.0dBA before such activities can be classified as a noise disturbance. The recommended noise mitigatory measures must always be in place and quarterly noise assessments must be carried out to determine compliance to the Noise Control Regulation, 1992 on a pro-active basis.

The distance between the proposed activities and the noise receptors and the wind direction will play an important role in noise propagation and how the noise from the construction phase of the project will be perceived at the residential properties in the vicinity

of the project areas. The management of the activities during the construction phase and the operational phase of the project will ensure how successful the project will be in terms of the increase of the prevailing ambient noise levels and how the residents will perceive the increase in the noise level.

The potential noise intrusion from the Kimberly Rehabilitation Upgrade project can however be controlled by means of approved acoustic screening measures, state of the art equipment, proper noise management principles and compliance to the Noise Regulations, 1992 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 to identify any noise increase on a pro-active basis and to address the problem accordingly.

The proposed Kimberly Rehabilitation Upgrade project will be in line with the environmental noise standards and guidelines provided that all the noise mitigatory measures are in place and that the Noise Impact Management Programme (NIMPr) for the project is adhered to.



Barend van der Merwe – MSc UJ
Environmental Noise Specialist

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE EIA AND EMPr FOR THE PROPOSED KIMBERLEY REHABILITATION AND DEVELOPMENT PROJECT.

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ABBREVIATIONS

dBA – A-weighted sound pressure level;

dB – Decibel;

EIA – Environmental Impact Assessment;

IFC – International Finance Corporation;

m – Meters;

m/s – meters per second;

N, E, S, W – North, East, West, South;

NEMA – National Environmental Act;

NR – Noise receptor;

LBasic – Basic noise level in dBA;

MP – Measuring points;

PPV – Peak particle velocity

SANS – South African National Standards

Glossary of Acoustic Terminology

Ambient noise level	The totally encompassing sound in each time usually being composed of sound from many sources near and far.
A – Weighting	An electronic filter that simulates the human hearing characteristic which is less sensitive to sounds at low frequencies than at high frequencies.
Damping/Absorption	The process by which a fluid (such as air), material or structure absorbs sound by dissipating the impinging or transmitted sound energy. Also known as absorption.
Decibel (dB)	A descriptor that is used to indicate the level determined as 10 times the logarithmic ratio of two quantities with the same units.
dBA	A descriptor that is used to indicate that 10 times the logarithmic ratio of two quantities with the same units have been A-weighted.
Environmental zone	The physical component of an area where there are people living in proximity of proposed development.
Equivalent noise level	A single value noise level that has the same energy content as a time varying noise level measured over a given period. It is therefore a time averaged noise level.
Frequency	The characteristic of a time varying signal that describes the number of cycles per second, expressed in Hertz, Hz**.**
Integrated noise level	A time and energy averaged measure of a noise signal varying as a function of time.
Level	The property of any parameter that expresses its magnitude as 10 times the logarithm of the ratio of the value of parameter to a reference value with the same units. For a noise level the reference value is 20µPa for sound pressure and 1pW for sound power.
Noise	Sound is pressure fluctuations in the air, or other supporting medium, that can be detected by the ear or by a microphone. Noise is sound which is loud or perceived to be unpleasant in each situation and thus causes disturbance. Any unwanted sound.
Noise emission	The noise energy that is transmitted from a point, line, or surface source into the environment.

This report was prepared in terms of the Environmental Management Act, 1998 (Act No. 107 of 1998) as amended, the Environmental Impact Assessment Regulations, 2014 as amended – no. 43110 of 20 March 2020 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	P 3 to P 6
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	P 3 to P 6
b)	A declaration that the specialist is independent	P 2
c)	An indication of the scope of, and the purpose for which, the report was prepared	P 25
cA)	An indication of the quality and age of the base data used for the specialist report	P 26 to P 37
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	P 26 to P 37
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	P 26 to P 37
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process	P 26 to P 37
f)	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	P 37
g)	An identification of any areas to be avoided, including buffers	N/A
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	P 38
i)	A description of any assumption made and any uncertainties or gaps in knowledge	P 51
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	P 48, P 49 and P 50
k)	Any mitigation measures for inclusion in the EMPr	P 51
l)	Any conditions for inclusion in the environmental authorisation	P51 and
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	P 53
n)	A reasoned opinion -	
(i)	As to whether the proposed activity or portions thereof should be authorised	P 52
iA)	Regarding the acceptability of the proposed activity or activities: and	P 52
(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	P 52
o)	A description of any consultation process that was undertaken during preparing the specialist report	NDI Geological Consulting Services (Pty) Ltd was appointed as environmental assessment practitioner

1. Introduction

The Kimberley Rehabilitation and Development (KRD) project is a project within Kimberley to provide Retail Banking, Hotel and Conference facilities, housing within the Kimberley urban development area. The noise impact assessment will be part of the Environmental Impact Assessment (EIA) process to determine the potential noise impacts during the construction and operational phases of the project.

The development areas are situated in the following areas:

- BMW site (North of Schmidtdrift Road and West of Waterloo Road, West End) – Retail Banking, Hotel & Conference and Offices;
- St Augustine site (North of St Augustine Road and South of Green Street, West End) – Housing;
- Colville Site (East of Barkly Road and South of St John Way, Colville) – Housing.

The following quarries will be used to transport raw material to and to manufacture building material for the construction phase of the project:

- Vooruitzigt Quarry – west of the R31 and Retswelele residential area;
- Roodepan Quarry – east of Midlands Road and Roodepan residential area.

The location of the quarries and development sites are given in Figure 1.

Figure 1: Location of the development sites

The existing mining debris which was dumped in the past on these sites will be hauled to the Roodepan quarry. Construction material will be transported from the Vooruitzigt and Roodepan quarries to the different proposed developmental sites. An overview of the project is illustrated in Figure 2.

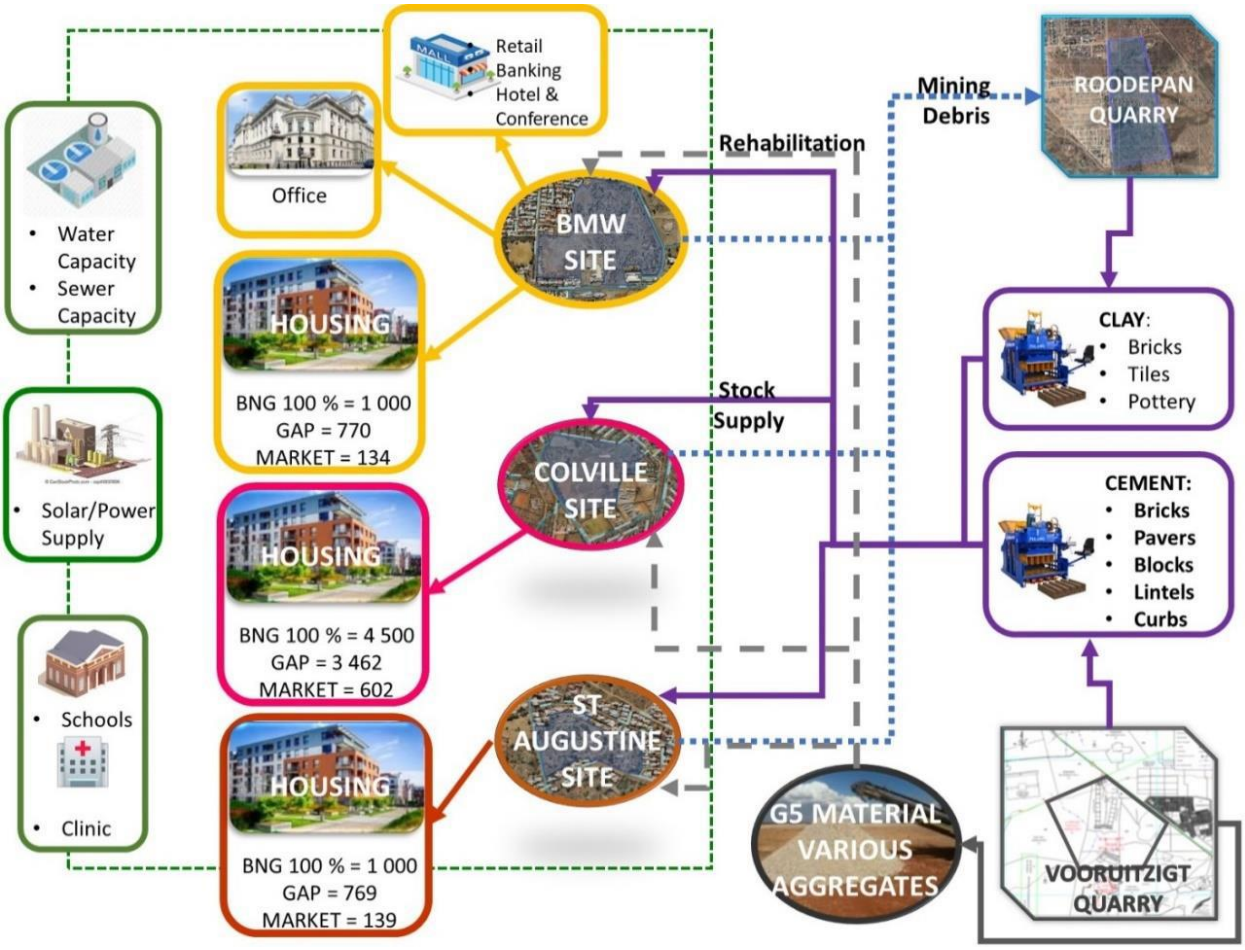

Figure 2: Overview of the proposed KRD project

The environmental noise survey was carried out 29 July 2020 and 30 July 2020 respectively and the noise survey was done to:

- Determine the prevailing ambient noise levels in the vicinity of the quarries and the three construction sites being BMW, St Augustine, and Colville sites;

- Quantify the alleged cumulative impact of traffic noise and construction activities on the prevailing ambient noise levels and the outdoor environment;

- Identify and evaluate noise related problems i.t.o. SANS 10103 of 2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication and the Kimberley noise by-laws;

- To recommend mitigation measures.

The proposed KRD project will be associated with an increase in the prevailing ambient noise levels in the vicinity of residential areas due to the nature of the project (construction activities) and such will be controlled by means of the noise by-laws and standards to manage the activities for it to be environmentally sustainable.

The prevailing ambient noise levels in the vicinity of the new route are predominantly made up of:

- Traffic noise;
- Intermittent traffic noise along the residential roads;
- Commercial/business type noises;
- Train noise; and
- Domestic type noises.

The ambient noise level is proportional to the type of activity i.e. traffic noise far and near field, wind direction, inversion conditions, additional sounds i.e. frogs, animals, insects etc. present at the time in a specific area.

The levels of noise emissions from road traffic as given in SANS 10210:2004 for the prediction of road traffic noise are a function of:

- The number of vehicles passing in a period (determined for each hour);
- The mean speed of the vehicles;
- The percentage heavy-duty vehicles;
- The road surface texture;
- The road gradient;
- The road worthiness of the vehicles.
- Distance between road and receiver;
- Intervening topography and structures that may shield the noise from the receiver;
- Meteorological effects.

Construction facilities such as access roads, stockpiles, workshops, batching plants, cement silos, crushers, brick manufacturing, hauling activities may create a noise increase along the construction site/s footprint on a temporary basis. Earthworks (excavations), concrete work, generators, dump sites, stockpile sites, mixing of concrete, and civil construction may create a noise increase in the vicinity of the noise receptors at the three sites.

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 together in the normal arithmetic way, for example, two sound sources of 50 dB each do not produce 100 dB but 53 dB, nor does 50 dB and 30 dB equal 80 dB, but remains 50 dB. Air absorption is important over large distances at high frequencies, depends on the humidity but is typically about 40 dB/km @ 4000 Hz. Road 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 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. Sound propagation upwind is refracted upwards creating a sound shadow and downwind refracted towards the ground producing a slight increase in sound level over calm isothermal conditions. The velocity of sound is inversely proportional to the temperature, so 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.

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 3-5 dBA.

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 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.

Several 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 on humans is limited to disturbance and/or annoyance and the accompanying emotional reaction. This reaction is 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, extractor fan and conveyor belt.

- 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.

Depending upon the intensity of the sound, the length of time of exposure and how often over time the ear is exposed to it, noise may affect our human condition in several ways. 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.

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

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

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

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

Traffic noise is generated from a combination of sources as a vehicle travel over the road surface such as engine noise, exhaust noise, wind turbulence, and the tire-pavement interface. Engine and exhaust type noise tend to be much more significant for medium and heavy-duty trucks compared to motor-vehicles.

The human perception of sound may be influenced by the acoustical characteristics of the noise (whether it has audible tones or other characteristics that may annoy the receptor) and how much louder the propagated sound is above the prevailing ambient noise level.

The perception of the noise is furthermore influenced by the attitude towards the noise source. One person may find the singing of birds in the morning delightful whereas another person may find the sound aggravating. If a person has a negative attitude towards a noise source is much more likely to view the new noise itself negatively however low it is (Rogers and Manwell, 2002).

In Table 1 are some of the noise levels that a person is exposed to daily in and around the house. These noise levels will mask most of the environmental noise levels from outside the house as and when it occurs.

Table 1: General noise levels a person is exposed to daily.

	Activity	**dBA**
Communication	Whisper	30.0
Communication	Normal Conversation	55.0-65.0
Communication	Shouted Conversation	90.0
Communication	Baby Crying	85.0
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	55.0-60.0
Home/Office	Clothes Dryer	56.0-60.0
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
Home/Office	Ringing Telephone	80.0
Home/Office	Hairdryer	80.0-95.0
Home/Office	Vacuum Cleaner	85.0-90.0
Home/Office	Maximum Output of Stereo	100.0-110.0

3. Legislative and Policy Contents

EIA Regulations 2014, as amended

Noise protocol (No 43110 of 20 March 2020) provides the criteria for the assessment report requirements which will be adhered to.

International Guidelines

- Environmental, Health and Safety (EHS) Guidelines, World Health Organisation (WHO, 2002).

National legislation

- National Environmental Management Act. 2006 Act 62 of 2008 (RSA, 2008).

Provincial legislation

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

National Standards

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

A noise disturbance is classified in terms of the Noise Control Regulations, 1992 as a noise that cause the ambient noise level to rise above the designated zone level by more than 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.

Legislative requirements

Constitution of South the Republic of South Africa (RSA, 1996)[i]

Article 24: Everyone has the right to an environment that is not harmful to their health and well-being; and

(b) to 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.

4. Scope of the noise study

The scope of the noise study was to determine the prevailing environmental ambient noise levels in the vicinity of the proposed activities. The results of the noise study and the prevailing baseline noise data and the acquired noise data will be used to evaluate the

recommended noise levels for the different districts according to Table 2 of SANS 10103 of 2008.

5. Methodology of the study

5.1 Method of evaluation
5.2 Site visit
5.3 Weather Data
5.4 Traffic Data
5.5 Ambient noise measurements
5.6 Noise impacts
5.7 Assessment of the noise impact

5.1 Method of evaluation

The noise survey was conducted in terms of the provisions of SANS 10103 of 2008 - The measurement and rating of environmental noise with respect to annoyance and to speech communication.

- 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;
- Certificate Number: 2019-AS-0892A;
- Date of Calibration: February 2020; and,
- Date of next calibration: February 2021.

The instrument was calibrated before and after the measurements was done and coincided within 1.0dBA. Batteries were fully charged, and the windshield was always in place .
The noise survey was carried out in terms of the Noise Control Regulations being:

"16 (1) Any person taking readings shall ensure that -

(a) sound measuring instruments comply with the requirements for type I instrument in accordance with SABS-IEC 60651, SABS-IEC 60804, and SABS-I EC 60942 as the case may be;
(b) the acoustic sensitivity of sound level meters is checked before and after every series of measurements by using a sound calibrator, and shall

reject the results if the before and after calibration values differ by more than 1 dBA;

(c) the microphones of sound measuring instruments are always provided with a windshield;

(d) the sound measuring instruments are operated strictly in accordance with the manufacturer's instructions; and,

(e) sound measuring instruments are verified annually by a calibration laboratory for compliance with the specifications for accuracy of national codes of practice for acoustics, to comply with the Measuring Units and National Measuring Standards Act 1973 (Act No. 76 of 1973).

(2) The measuring of dBA values in respect of controlled areas, ambient sound levels or noise levels in terms of these regulations shall be done as follows:

(a) outdoor measurements on a piece of land: By placing the microphone of an integrating impulse sound level meter at least 1,2 metres, but not more than 1,4 metres, above the ground and at least 3,5 metres away from walls, buildings or other sound reflecting surfaces".

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.

5.2 Site visit

A site visit was carried out on 29 July 2020 in and around the study area to:

- Identify the major contributors to the prevailing ambient noise level in the vicinity of the study area.
- Identify the nearest sensitive noise areas being residential areas and to identify major feeder roads.
- The site visit was furthermore done to identify potential measuring positions in and around the study area.

5.3 Weather Data

The following meteorological conditions were recorded:

<u>29 July 2020 – Site visit</u>

<u>Daytime</u>

- Wind speed – less than 1.1m/s;
- Temperature – 19.6^{o}C – No strong temperature gradient occurred near the ground;
- Cloud cover – High cloud cover;
- Wind direction – The wind was blowing from a north-westerly direction;
- Humidity – 10 % humidity.

30 July 2020 – Field survey

Daytime

- Wind speed – less than 0.3m/s;
- Temperature – 17.5^{o}C – No strong temperature gradient occurred near the ground;
- Cloud cover – High cloud cover;
- Wind direction – The wind was blowing from a north-westerly direction;
- Humidity – 10 % humidity.

Night-time

- Wind speed – No wind;
- Temperature – 9.3^{o}C – No strong temperature gradient occurred near the ground;
- Cloud cover – No clouds;
- Wind direction – No wind;
- Humidity – 10 % humidity

5.4 Traffic Data

There will be 30 trucks which will convey the material from the sites to the quarries during the day and the night-time periods. The routes which will be used is given in Figure 3.

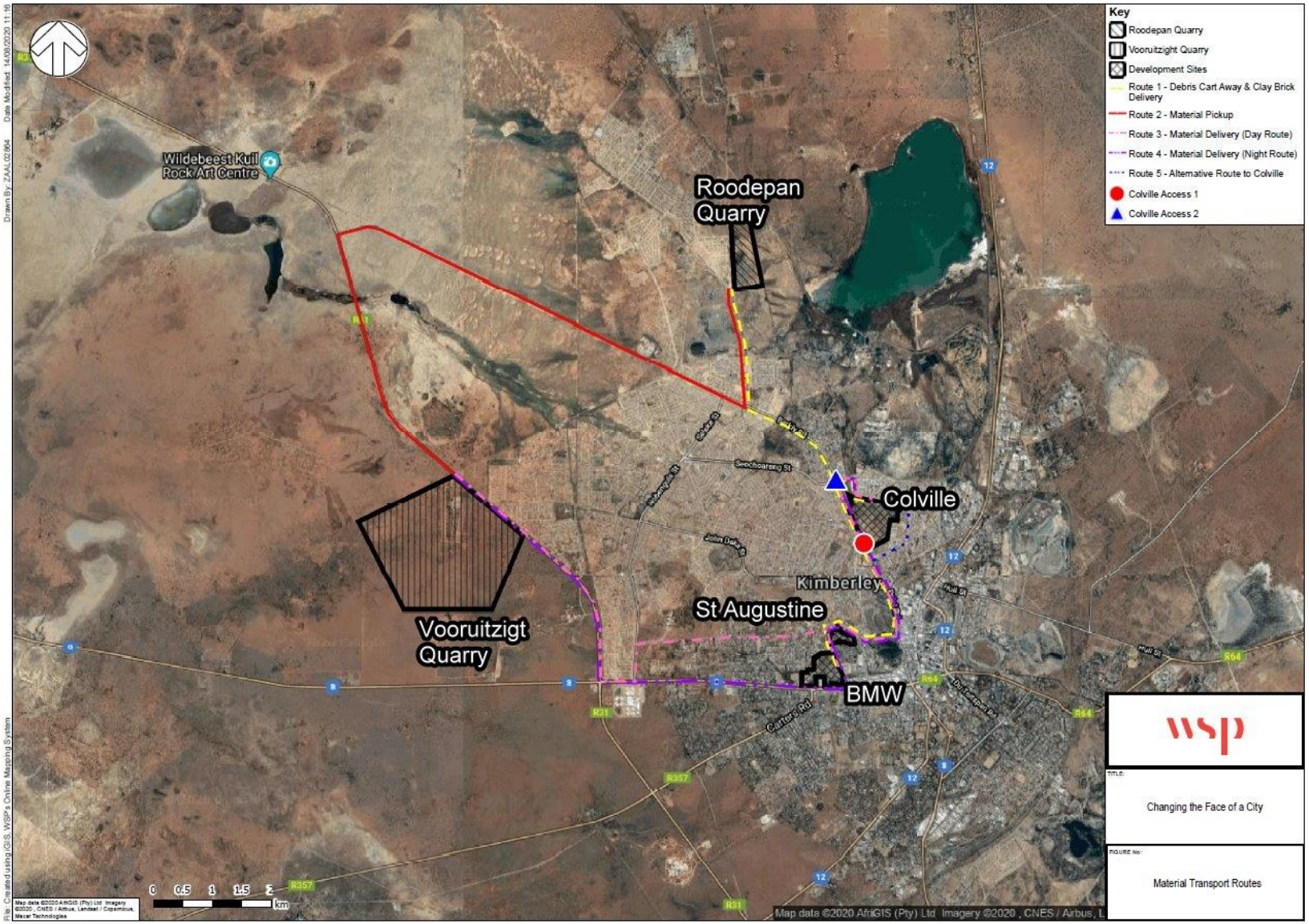

Figure 3: Hauling routes between the different sites

5.5 Ambient noise measurements

The measuring points were selected to be representative of the pre-vailing ambient noise levels of the study area and the geographical attributes such as the spatial and physical characteristics of the measuring points are illustrated in Table 2.

Table 2: Measuring points and co-ordinates for the study area

Position	Latitude	Longitude	Remarks
1	28^0 43.023'S	24^0 40.964'E	Centre of Vooruitzigt Quarry. Distant traffic noise.
2	28^0 42.876'S	24^0 41.239'E	80m from the R31. Traffic noise.
3	28^0 42.967'S	24^0 41.314'E	Along the R31. Traffic noise.
4	28^0 44.654'S	24^0 44.900'E	Along Schmidtsdrift Road (N8). Traffic noise.
5	28^0 44.380'S	24^0 44.950'E	Northern boundary of BMW site (along Waterloo Rd). Traffic noise.
6	28^0 44.420'S	24^0 44.733'E	Western boundary of BMW site along Floor Street. Domestic noise.
7	28^0 44.590'S	24^0 44.629'E	Western boundary of BMW site along Anderson Rd. Traffic noise.
8	28^0 44.611'S	24^0 45.022'E	Eastern boundary along Waterloo Road. Traffic and commercial type noise.
9	28^0 44.290'S	24^0 44.838'E	Southern boundary of St Augustine Site. Traffic and domestic noise.
10	28^0 44.253'S	24^0 44.902'E	Southern boundary of St Augustine Site. Traffic and domestic noise.
11	28^0 44.212'S	24^0 45.010'E	Southern boundary of St Augustine Site. Traffic and domestic noise.
12	28^0 44.238'S	24^0 45.100'E	Southern boundary of St Augustine Site. Traffic and domestic noise.
13	28^0 44.187'S	24^0 45.151'E	Eastern boundary of St Augustine Site. Distant traffic and domestic noise.
14	28^0 44.127'S	24^0 45.014'E	Northern boundary of St Augustine site. Distant traffic noise.
15	28^0 44.141'S	24^0 45.888'E	Northern boundary of St Augustine site along Waterloo Rd. Traffic noise.
16	28^0 44.096'S	24^0 44.821'E	Northern boundary of St Augustine site along Green Street. Traffic noise.
17	28^0 44.150'S	24^0 44.775'E	Western boundary of St Augustine site along Diebel Street
18	28^0 44.207'S	24^0 44.770'E	Western boundary of St Augustine site along Diebel Street
19	28^0 44.293'S	24^0 44.780'E	Southern boundary of St Augustine Site. Traffic and domestic noise.
20	28^0 43.388'S	24^0 45.335'E	Western side of Colville site along Pniel Rd. Traffic noise.
21	28^0 43.262'S	24^0 45.515'E	Eastern boundary of Colville site. Distant traffic noise.
22	28^0 43.109'S	24^0 45.607'E	Eastern boundary of Colville site. Domestic and traffic noise.
23	28^0 42.960'S	24^0 45.616'E	Northern boundary of Colville site. Domestic and traffic noise.
24	28^0 42.930'S	24^0 45.359'E	Northern boundary of Colville site. Domestic and traffic noise.
25	28^0 43.007'S	24^0 45.110'E	Western boundary of Colville site. Domestic noise.
26	28^0 43.125'S	24^0 45.106'E	Western boundary of Colville site. Domestic and traffic noise.
27	28^0 40.774'S	24^0 43.850'E	Along Midlands Road. Traffic noise
28	28^0 40.421'S	24^0 43.838'E	Eastern side of Roodepan. Traffic noise
29	28^0 40.320'S	24^0 44.065'E	Eastern boundary of Roodepan Quarry. Distant traffic noise.

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 daytime and 22h00 to 6h00 for the night-time period.

The location of the measuring points at the sites is illustrated in Figure 4 and at the quarries in Figure 5.

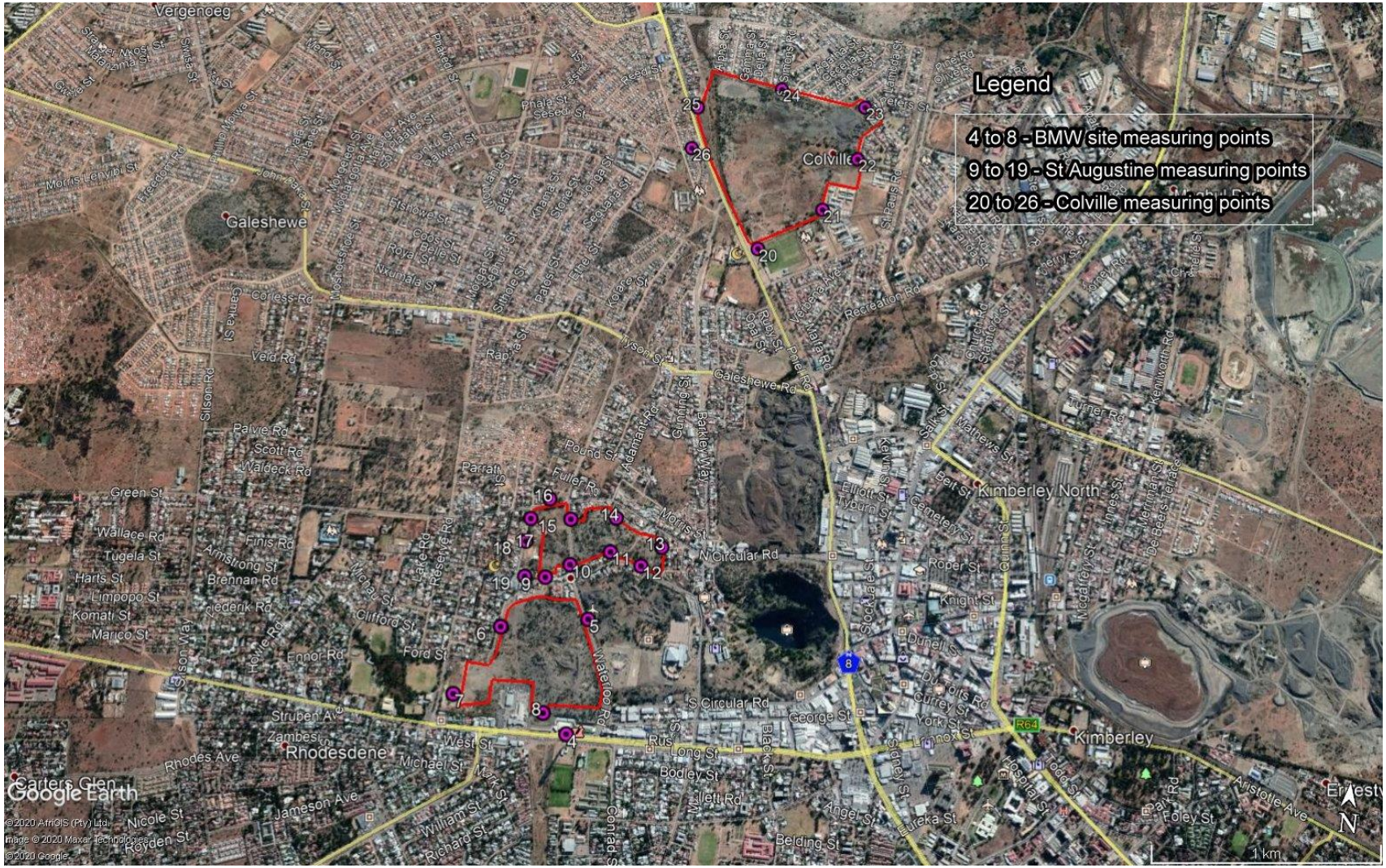

Figure 4: Location of BMW, St Augustine and Colville measuring points.

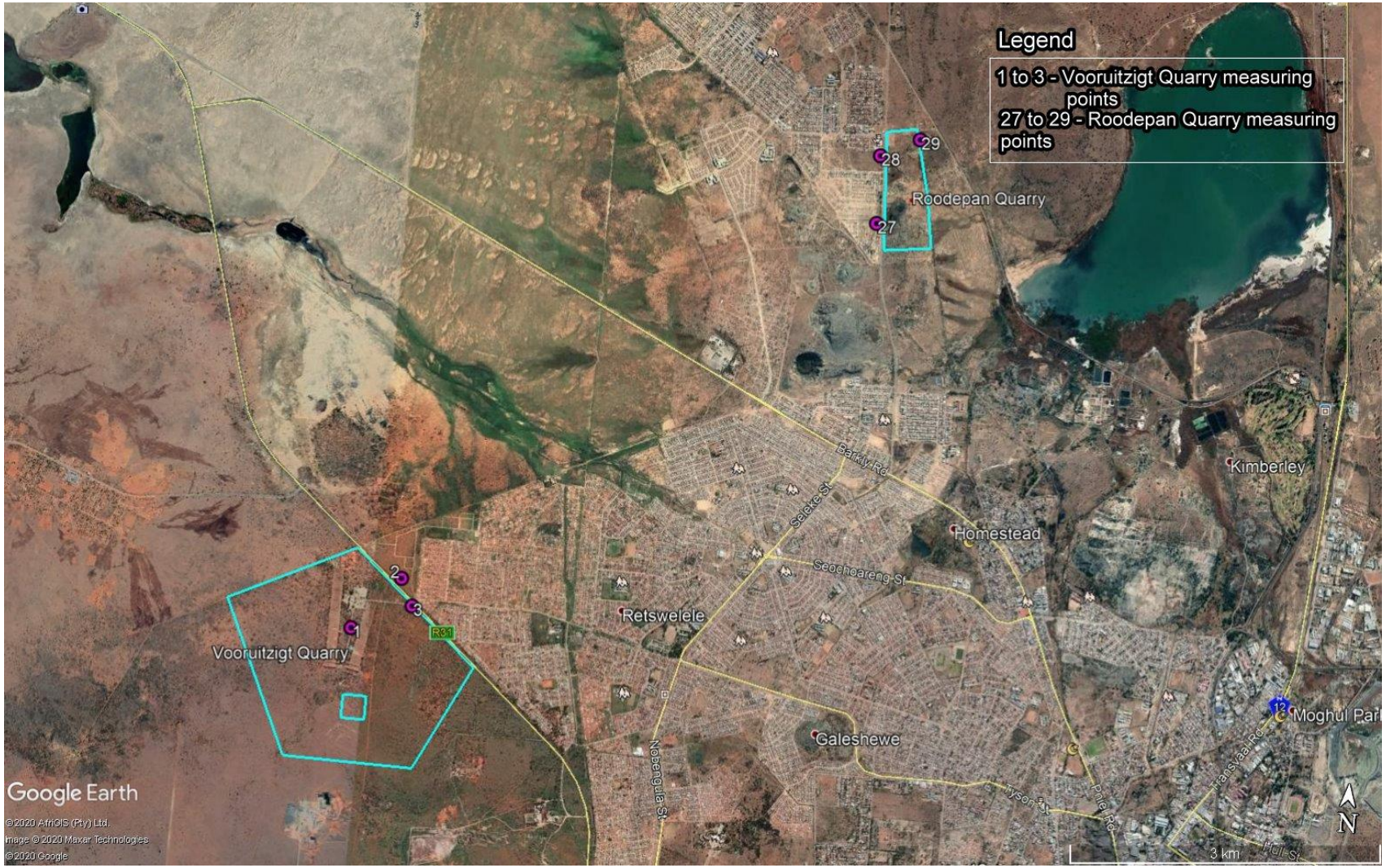

Figure 5: Location of Vooruitzigt and Roodepan quarries measuring points.

5.6 Noise emissions during the day and night within the study area:

- Traffic noise from traffic along feeder roads;
- Intermittent traffic noise from traffic along the internal roads;
- Domestic type noise;
- Commercial type noise; and
- Bird noise during the day and insect noise during the night**.**

5.7 Noise Impact

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. To evaluate such there must be uniform guidelines to evaluate each scenario. The World Health Organization has laid down sound pressure levels for specific districts and SANS 10103 of 2008 has provided the following continuous noise levels per district as indicated in Table 3.

Table 3: Typical rating levels for ambient noise in districts

Type of district	Equivalent continuous rating level $L_{Req.T}$ for ambient noise - dBA					
	Outdoors			Indoors, with open windows		
	Day-night L_{Rdn} [2)]	Daytime L_{Rd} [1)]	Night-time L_{Rn} [1)]	Day-night L_{Rdn} [2)]	Daytime L_{Rn} [1)]	Night-time L_{Rn} [1)]
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

The study area is situated in an area with a mixture between a type (c), (d) and (e) districts. The reference time intervals can be specified to cover typical human activities and variations in the operation of noise sources and are for daytime between 6h00 to 22h00 and for nighttime between 22h00 and 6h00.

5.8 Assessment methodology

The impact approach will be to determine what the impact during the construction and operational phases may have on the abutting noise receptors. The following methodology was followed:

- The site inspection was done prior to the start of the noise survey on 29 July 2020 – Winter period;
- Identify all the noise receptors within the vicinity of the study area and the routes and identify such by means of their spatial position on Google Imagery;
- Determine the prevailing ambient noise level at each of the measuring points by means of the recommended noise measuring procedure in SANS 10103 of 2008;
- Calculate or determine the acceptable rating level for each measuring point;
- Calculate, determine, and/or research the projected noise level of each noise source that is part of the construction and/or operational phase of the project;
- Calculate the noise impact at each of the noise receptors;
- Noise modeling during the construction and operational phases; and
- Assess the proposed project in terms of the SANS 10103 of 2008, SANS 10328 of 2008, Noise Control Regulations, Environmental Health and Safety Guidelines for Mining by the World Bank.

The control of noise is regulated by the Noise Control Regulations (NCR) GN154 as promulgated in Government Gazette No. 13717 dated 10 January 1992. The NCRs were revised in Government Notice R55 of 14 January 1994 to make it obligatory for all authorities to apply these regulations, which was promulgated under the Environment Conservation Act, 1989. Act No 73 of 1989. In terms of Schedule 5 of the Constitution of South Africa of 1996, the legislative responsibility for administering the NCRs is the responsibility of the Provincial and Local Authorities.

The Noise Control Regulations state that “No person shall make, produce or cause a disturbing noise, allow it to be made, produced or caused by any person, animal, device or apparatus or any combination thereof.” A disturbing noise means a noise level that exceeds the prevailing ambient noise level measured continuously at the same measuring point by 7.0dBA or more.

To determine the level of intrusion it will be required to determine the prevailing ambient noise levels at each measuring point and to calculate the increase in the

noise level during the operational phase of the project. The following formula (SANS 10328 of 2008) is used to determine the difference between the future expected rating level (calculated noise levels) and the typical rating level (prevailing ambient noise level):

$N_i = L_{Req.T\ (expected)} - L_{Req.\ T\ (typical)}$

where,

N_i is the noise impact, in decibels;

$L_{Req.T\ (expected)}$ is the calculated equivalent continuous A-weighted sound pressure level, in decibels;

$L_{Req.\ T(typical)}$ is the prevailing ambient equivalent continuous A-weighted sound pressure level, in decibels.

5.9 Study area sensitivity analysis

The construction and operational activities at BMW, St Augustine and Colville sites will take place in the vicinity of existing residential areas being West End, Diamant Park, and Colville, respectively. Building material such as gravel, clay, building sand etc. will take place at the two quarries of which Roodepan quarry is west of Roodepan residential area and Midlands Road which is a busy feeder road lies between the residential area and the quarry. R31 separate the Vooruitzigt Quarry and Retswelele residential area. This is a busy feeder road between Kimberley and Barkly west with a continuous flow of traffic such as mine hauling vehicles and motor vehicles. The sensitivity analysis of the study area is illustrated in Table 7.

The criteria for assessing the magnitude of a noise intrusion levels are illustrated in Table 4.

Table 4: 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	

6. Identification of the receiving environment

The sites are situated in the vicinity of residential areas with a mining area south of Vooruitzigt quarry, Commercial area south of BMW site, with factories some distance to the east of Colville and St Augustine/BMW sites respectively.

Busy feeder roads divide the different sites from the residential areas as follow:

- Midlands road runs between Roodepan quarry and Roodepan residential area;
- R31 runs between Vooruitzigt quarry and Retswelele;
- Barkly road runs between the residential area to the west and the Colville site;
- St Johns way/St Pauls Road and Stockroos Street runs between Square Hill Park and Colville site;
- Waterloo Road split St Augustine in two sections and residential areas abuts the St Augustine site;
- Waterloo Road/Change Road/Floor Street and Anderson Road abuts the BMW site.

The noise receptors are illustrated in Figure 3.

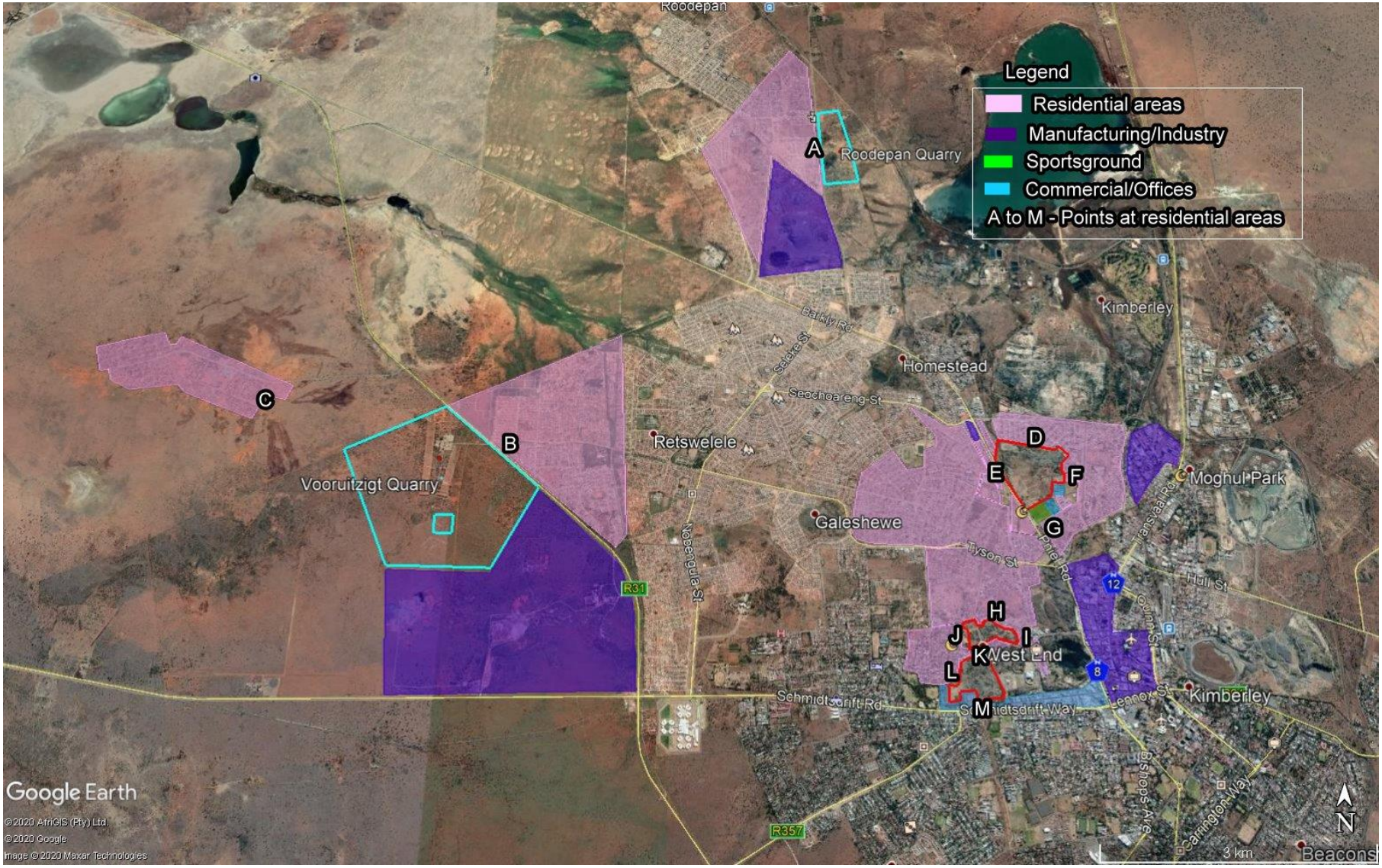

Figure 6: Location of the residential, manufacturing, and commercial areas in the vicinity of the sites.

The distances between the noise receptors and the proposed activities to remove the waste rock from the BMW/St Augustine/Colville sites are given in Table 5. The distance is the shortest direct line between the points and the construction site and may change once more information is available.

Table 5: Distances between the noise receptors and the activity per site.

Noise Receptors	Distance between the middle of the site and the noise receptors in meters	Distance between the point nearest to the residential area and the noise receptor in meters	Remarks
A	246	100	Residential area with main road.
B	876	100	Residential area with main road.
C	2 210	1 184	Residential area with vacant land.
D	378	100	Residential area with feeder road.
E	416	100	Residential area with main road.
F	469	100	Residential area with feeder road.
G	654	100	Sports grounds
H	173	100	Residential area with houses.
I	323	100	Residential area with houses.
J	262	100	Residential area with feeder road.
K	145	100	Residential area with feeder road.
L	241	100	Residential area with feeder road.
M	258	100	Commercial area.

7. Prevailing noise regime

7.1 Prevailing ambient noise levels at the study area

The noise survey was done at the different measuring points during the day and night-time. This will therefore be the prevailing ambient noise levels for that specific area. The prevailing ambient noise level in areas where there were no residential properties, roads and/or business properties will be much lower than build-up areas with roads. In some of the areas distant noise was audible but did not directly impacted the noise results. The distance between the source and the measuring point and the topography was an important aspect of the prevailing ambient noise level and how the sound was propagated.

The prevailing ambient noise levels at the different measuring points are given in Table 6.

Table 6: Noise results of the study area

Measuring point	Daytime - dBA				Night-time - dBA			
	Leq	Lmax	Lmin	Remarks	Leq	Lmax	Lmin	Remarks
1	43.6	54.6	33.0	Distant traffic, hauling vehicles to Kathu and Kimberly				
2	56.9	75.6	31.7	Traffic.	62.0	76.5	30.6	Distant traffic noise.
3	68.6	85.0	34.4	Traffic.				
4	65.7	81.8	53.9	Traffic along Schmidtsdrift Road.	52.7	66.6	39.1	Distant traffic noise.
5	57.7	73.7	27.5	Traffic along Waterloo Street.	36.7	49.4	27.3	Distant traffic noise.
6	43.4	62.3	35.9	Domestic noise.				
7	45.9	63.9	36.8	Distant traffic and domestic noise.				
8	55.2	65.2	47.7	Commercial and traffic noise.				
9	56.2	76.0	37.2	Distant traffic and domestic.				
10	62.6	80.2	33.8	Domestic noise.				
11	49.7	67.1	31.0	Traffic and domestic noise.	42.2	59.8	34.5	Distant domestic and barking noise.
12	49.7	67.1	31.0	Traffic and domestic noise.	42.2	59.8	34.5	Distant traffic noise.
13	47.2	63.4	36.0	Distant traffic noise.	44.9	62.9	34.0	Distant traffic noise.
14	42.8	58.8	34.9	Distant traffic noise.	41.6	58.8	32.2	Distant traffic noise.
15	62.6	80.2	33.8	Traffic noise and when no traffic 44.1dBA.				
16	61.8	82.1	37.8	Traffic noise.				
17	49.1	69.4	34.7	Domestic and workshop noise.				
18	44.3	65.8	35.9	Distant traffic noise.	44.7	63.7	38.9	Distant domestic noise.
19	47.1	66.5	33.9	Traffic noise.				
20	67.3	88.4	39.8	Traffic along Barkley Road noise.				
21	42.4	64.6	33.2	Distant traffic nose.	42.2	56.8	36.0	Distant traffic nose.
22	42.3	64.1	30.3	Domestic type noise.	44.3	63.5	36.2	Traffic noise.
23	42.4	62.3	33.2	Domestic and distant traffic noise.				
24	44.6	59.7	34.7	Domestic type noise.	45.3	62.4	37.1	Distant traffic nose.
25	48.5	68.5	39.2	Traffic along Barkley Road noise.	49.5	62.4	39.2	Distant traffic nose.
26	46.3	65.4	34.1	Traffic along Barkley Road noise.				
27	62.7	77.5	29.2	Traffic noise from Midlands Road.				
28	61.2	89.9	36.7	Traffic noise from Midlands Road.	48.4	61.6	33.3	Traffic noise.
29	39.0	56.6	30.2	Distant traffic noise.	41.8	70.1	31.7	Distant traffic and insect noise.

The prevailing ambient noise level along the feeder roads were as follow:

- Barkley Road – 62.7dBA during the day and 49.5dBA during the night;
- Midlands Road – 61.2dBA during the day and 48.4dBA during the night;
- R31 – 68.6dBA during the day and 62.0dBA during the night;
- Waterloo Road – 60.2dBA during the day and 36.7dBA during the night;
- Schmidtsdrift Road – 65.7dBA during the day and 52.7dBA during the night;
- North Circular Road – 61.8dBA during the day and 36.7dBA during the night;
- St Augustine Road – 49.7dBA during the day and 42.2dBA during the night; and
- Diebel Street – 44.3dBA during the day and 44.7dBA during the night.

The prevailing noise levels at the residential areas were as follow:

- Retswelele next to the R31 – 68.6dBA during the day and 60.0dBA during the night;
- Retswelele at 80m from the R31 - 65.7dBA during the day and 52.7dBA during the night;
- Roodepan at the nearest houses – 60.5dBA during the day and 48.4dBA during the night;
- Roodepan at 300m from the road – 39.0dBA during the day and 41.8dBA during the night;
- Residential areas at Colville site – 42.9dBA during the day and 43.9dBA during the night;
- Residential areas at St Augustine site – 46.6dBA during the day and 42.9dBA during the night; and
- Residential areas at BMW site – 44.7dBA during the day and 42.2dBA during the night.

The noise projections will be dealt with later on in the report and the construction noise at the different noise receptors will be dealt with when the construction activities during the removal of waste rock and when construction of the buildings at Colville, St Augustine and BMW sites take place. The activities at the Roodepan and Vooruitzigt quarries will be dealt with during the construction phase of the project.

8. Calculated noise levels during the Construction and Operational Phases

8.1 Construction Phase

The following noise levels as given in Table 9 are construction machinery and equipment that may be used during the construction phase of the project. The cumulative noise levels (when all the machinery is in use) were calculated for setback distances of 2m up to 1 920m. The calculations will be done with the distances as given in Table 7 with a source value of 85.0dBA to 95.0dBA at the point sources.

Table 7: 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 machinery and/or equipment**	**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
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
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
Arithmetic average of the noise levels from the construction activities when all such work within a radius of 30m	**85.0**	**59.5**	**53.5**	**47.4**	**41.4**	**37.5**	**29.4**	**23.4**	**17.3**

The following equation was used to calculate the noise level at the noise receptors during the construction phase:

$$Lp = Lw - 20\log R - 5dB$$

Where, Lp is the sound level at a distance from the source in dBA;

Lw is the sound level at the source in dBA;

R is the distance from the source.

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

- Sound level change of 1.0dB can barely be detected by humans;
- Change of 2.0dB to 3.0dBA, barely noticeable;
- Change of 5.0dB, readily noticeable;
- Change of 10.0dB perceived as a doubling in loudness;
- Change of 20.0dB represents a dramatic change.

The noise intrusion level criteria for the construction phase (removal of aggregate from the sites) at Colville St Augustine and BMW sites respectively and the construction of buildings are given in Tables 8 (removal of the aggregate at the sites with a distance of 100m from the activity), Table 9 (Removal of aggregate from the sites with distances as per Table 5) and Table 10 (during building activities and installation of the plant) respectively. The noise intrusion during the construction phase of the project will be below the threshold value of 7.0dBA. The magnitude of a noise intrusion levels is illustrated as follow.

Table 8: Calculated noise levels at the noise receptors during removal of the aggregate at the sites with 100m from the activity).

Residential areas	Front end loader activities - dBA	Loading of waste rock/material onto trucks - dBA	Earthworks dBA	A	B	C	D	E	D-B	E-C
				Cumulative noise level - dBA	Daytime prevailing ambient noise level - dBA	Night-time prevailing ambient noise level - dBA	Daytime cumulative noise level – dBA (A+B)	Night-time cumulative noise level – dBA (A+C)	Intrusion level during the daytime – dBA	ntrusion evel during the ight-time - dBA
D	43.5	40.5	35.5	45.7	46.6	42.9	49.2	47.5	2.6	4.6
E	43.5	40.5	35.5	45.7	46.6	42.9	49.2	47.5	2.6	4.6
F	43.5	40.5	35.5	45.7	46.6	42.9	49.2	47.5	2.6	4.6
G	37.5	34.5	29.5	39.7	46.6	42.9	47.4	44.6	0.8	1.7
H	43.5	40.5	35.5	45.7	46.6	42.9	49.2	47.5	2.6	4.6
I	43.5	40.5	35.5	45.7	42.9	37.8	47.5	46.4	4.6	8.6
J	43.5	40.5	35.5	45.7	42.9	37.8	47.5	46.4	4.6	8.6
K	43.5	40.5	35.5	45.7	46.6	42.9	49.2	47.5	2.6	4.6
L	43.5	40.5	35.5	45.7	44.7	42.2	48.2	47.3	3.5	5.1
M	43.5	40.5	35.5	45.7	65.7	52.7	65.7	53.5	0.0	0.8

Table 9: Calculated noise levels at the noise receptors during removal of aggregate from the sites with distances from the middle of the site.

Noise receptors	Front end loader activities - dBA	Loading of waste rock/material onto trucks - dBA	Earthworks dBA	A	B	C	D	E	D-B	E-C
				Cumulative noise level - dBA	Daytime prevailing ambient noise level - dBA	Night- time prevailing ambient noise level - dBA	Daytime cumulative noise level – dBA (A+B)	Night -time cumulative noise level – dBA (A+C)	Intrusion level during the daytime – dBA	Intrusion level during the night -time – dBA
D	32.0	29.0	24.0	34.2	46.6	42.9	46.8	43.4	0.2	0.5
E	31.1	28.1	23.1	33.3	46.6	42.9	46.8	43.4	0.2	0.5
F	30.1	27.1	22.1	32.3	46.6	42.9	46.8	43.3	0.2	0.4
G	27.2	24.2	19.2	29.4	46.6	42.9	46.7	43.1	0.1	0.2
H	38.7	35.7	30.7	40.9	46.6	42.9	47.6	45.0	1.0	2.1
I	33.3	30.3	25.3	35.5	42.9	37.8	43.6	39.8	0.7	2.0
J	35.1	32.1	27.1	37.3	42.9	37.8	44.0	40.6	1.1	2.8
K	40.3	37.3	32.3	42.5	46.6	42.9	48.0	45.7	1.4	2.8
L	35.9	32.9	27.9	38.1	44.7	42.2	45.6	43.6	0.9	1.4
M	35.3	32.3	27.3	37.5	65.7	52.7	65.7	52.8	0.0	0.1

Table 10: Calculated noise levels at the noise receptors during building activities at the sites and the installation of plant at the quarries

Residential area	Grubbing of footprint areas - dBA	Construction activities - dBA	Front end loader activities - dBA	Loading of waste rock/material onto trucks - dBA	Earthworks - dBA	A	B	C	D	E	D-B	E-C
						Cumulative noise level - dBA	Daytime prevailing ambient noise level - dBA	Night-time prevailing ambient noise level - dBA	Daytime cumulative noise level – dBA (A+B)	Night- time cumulative noise level – dBA (A+C)	Intrusion level during the daytime – dBA	Intrusion level during the night-time – dBA
A	37.2	34.7	35.7	32.7	33.7	42.1	43.6	41.7	45.9	44.9	2.3	3.2
B	26.1	23.6	24.6	21.6	22.6	31.0	60.5	48.4	60.5	48.5	0.0	0.1
C	18.1	15.6	16.6	13.6	14.6	23.0	41.8	42.7	41.9	42.7	0.1	0.0
D	33.5	31.0	32.0	29.0	30.0	38.3	46.6	42.9	47.2	44.2	0.6	1.3
E	32.6	30.1	31.1	28.1	29.1	37.5	46.6	42.9	47.1	44.0	0.5	1.1
F	31.6	29.1	30.1	27.1	28.1	36.5	46.6	42.9	47.0	43.8	0.4	0.9
G	28.7	26.2	27.2	24.2	25.2	33.6	46.6	42.9	46.8	43.4	0.2	0.5
H	40.2	37.7	38.7	35.7	36.7	45.1	46.6	42.9	48.9	47.2	2.3	4.3
I	34.8	32.3	33.3	30.3	31.3	39.7	42.9	37.8	44.6	41.9	1.7	4.1
J	36.6	34.1	35.1	32.1	33.1	41.5	42.9	37.8	45.3	43.0	2.4	5.2
K	41.8	39.3	40.3	37.3	38.3	46.6	46.6	42.9	49.6	48.2	3.0	5.3
L	37.4	34.9	35.9	32.9	33.9	42.2	44.7	42.2	46.6	45.2	1.9	3.0
M	36.8	34.3	35.3	32.3	33.3	41.6	65.7	52.7	65.7	53.0	0.0	0.3

8.2 Operational Phase

The potential impact from the activities at the two quarries were calculated at distances between the brick plants and the abutting residential were calculated at 100m, 300m, 500m, 600 and 1 000m (Roodepan quarry) and 1 221m (Vooruitzigt quarry) respectively. The magnitude of the noise intrusion levels is illustrated in Table 11.

Table 11: Calculated noise levels at the noise receptors during operational activities at Roodepan Quarry.

Residential areas	Removal of clay from the pit -dBA	Earthmoving activities - dBA	Clay to stockpile - dBA	Brick plant activities - dBA	Firing of bricks in the kiln - dBA	Emergency generators - dBA	A	B	C	D	E	D-B	E-C
							Cumulative noise level - dBA	Daytime prevailing ambient noise level - dBA	Night-time prevailing ambient noise level - dBA	Daytime cumulative noise level – dBA (A+B)	Night-time cumulative noise level – dBA (A+C)	Intrusion level during the daytime – dBA	Intrusion level during the night-time – dBA
100m from brick making footprint	45.0	48.5	43.5	40.5	45.5	45.5	53.2	60.5	48.4	61.2	54.4	0.7	6.0
300m from brick making footprint	35.5	39.0	34.0	31.0	36.0	36.0	43.6	43.6	41.7	46.6	45.8	3.0	4.1
500m from brick making footprint	31.0	34.5	29.5	26.5	31.5	31.5	39.2	43.6	41.7	44.9	43.6	1.3	1.9
600m from brick making footprint	29.4	32.9	27.9	24.9	29.9	29.9	37.6	43.6	41.7	44.6	43.1	1.0	1.4
1000m from brick making footprint	25.0	28.5	23.5	20.5	25.5	25.5	33.2	43.6	41.7	44.0	42.3	0.4	0.6

Table 12: Calculated noise levels at the noise receptors during operational activities at Vooruitzigt Quarry.

Residential areas	Aggregate removal - dBA	Earthmoving activities - dBA	Primary Crusher - dBA	Secondary Crusher - dBA	Tertiary crusher - dBA	Aggregate stockpile - dBA	Brickmaking process - dBA	Emergency generators - dBA	A Cumulative noise level	B Daytime prevailing ambient noise level - dBA	C Night-time prevailing ambient noise level - dBA	D Daytime cumulative noise level – dBA (A+B)	E Night-time cumulative noise level – dBA (A+C)	D-B Intrusion level during the daytime – dBA (D-E)	E-C Intrusion level during the night-time – dBA (E-C)
100m from brick making footprint	45.0	48.5	45.5	46.5	44.5	40.5	45.5	45.5	54.7	56.9	60.0	58.9	61.1	2.0	1.1
300m from brick making footprint	35.5	39.0	36.0	37.0	35.0	31.0	36.0	36.0	45.1	43.6	41.8	47.4	46.8	3.8	5.0
500m from brick making footprint	31.0	34.5	31.5	32.5	30.5	26.5	31.5	31.5	40.7	43.6	41.7	45.4	44.2	1.8	2.5
600m from brick making footprint	29.4	32.9	29.9	30.9	28.9	24.9	29.9	29.9	39.1	43.6	41.7	44.9	43.6	1.3	1.9
2 210m from the brickmaking footprint	18.1	21.6	18.6	19.6	17.6	13.6	18.6	18.6	27.8	43.6	41.7	43.7	41.9	0.1	0.2

8.3 Projected traffic noise levels

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 may create an increased noise level along Knights Road and Tide Street on an intermittent basis during peak periods. The calculation of the noise levels during the construction phase are based on 10 vehicles of which 5 vehicles will be motor vehicles and 5 vehicles will be heavy-duty vehicles per hour. There will be scattered traffic during the day and night during off-peak periods as can be expected at residential areas.

The calculations to determine the noise level from the additional traffic when delivering building material to the three sites are based on the following equation:

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 52.3dBA during the construction phase.

9 Environmental noise risk assessment

The ranking system that is used to assess the significance rating of the project is according to the EIA Regulations, 2014 (as amended).

The following activities will generate noise during the construction phase of the project:

- Removal of aggregate from the Colville, St Augustine, and BMW sites;
- Dumping of aggregate within the Vooruitzigt quarry boundaries;
- Ground works at the three sites;
- Foundations for the proposed buildings at the three sites;
- Building activities;
- Transportation of building material to and from the construction sites;
- Provision of infra-structure such as sewage systems, water reticulation systems, roads, stormwater systems at the three sites;
- Shop fitting of the residential buildings and offices;
- Grubbing and removal of vegetation at the different footprint zones at Roodepan and Vooruitzigt quarries;
- Construction of buildings/offices, kiln, and brickmaking plant;
- Use of emergency generators for lighting; and
- Use of earthmoving machinery.

The impact assessment for the construction phase is given in Table 13.

Table 13: Impact rating during the construction phase.

Aspect	Impact (Extent + Duration + Intensity + Probability)	Significance Rating	Mitigation	Impact after mitigation measures	Significance rating after mitigatory measures
Removal of aggregate from the Colville, St Augustine, and BMW sites	8	Negative moderate	Vehicles with low noise levels to be used and the reverse signal to be replaced with a vibration type monitor. The calculated noise level at 25m from the road will be 52.3dBA which will be lower than the prevailing traffic noise levels along the identified hauling routes.	6	Negative low
Dumping of aggregate within the Vooruitzigt quarry boundaries	8	Negative moderate	Vehicles with low noise levels to be used and the reverse signal to be replaced with a vibration type monitor.	6	Negative low
Ground works at the three sites	8	Negative moderate	Building activities to take place with outmost care	6	Negative low

			and all activities to be environmentally sustainable.		
Foundations for the proposed buildings at the three sites	8	Negative moderate	Machinery with low noise levels and maintained in a good order to be used and to comply with the IFC's Health and Safety Regulations.	6	Negative low
Building activities	8	Negative moderate	Machinery with low noise levels to be used.	6	Negative low
Transportation of building material to and from the construction sites	8	Negative moderate	Speed limit of the different roads to be always adhered to.	6	Negative low
Provision of infra-structure such as sewage systems, water reticulation systems, roads, stormwater systems at the three sites	8	Negative moderate	Building activities to take place with outmost care and all activities to be environmentally sustainable.	6	Negative low
Shop fitting of the residential buildings and offices	8	Negative moderate	Building activities to take place with outmost care and all activities to be environmentally sustainable.	6	Negative low
Grubbing and removal of vegetation at the different footprint zones at Roodepan and Vooruitzigt quarries	8	Negative moderate	Machinery with low noise levels to be used and reverse siren to be replaced with a vibration type monitor.	6	Negative low
Construction of buildings/offices, kiln, and brickmaking plant	8	Negative moderate	Machinery with low noise levels to be used and reverse siren to be replaced with a vibration type monitor.	6	Negative low
Use of earthmoving machinery	8	Negative moderate	Machinery with low noise levels to be used and reverse siren to be replaced with a vibration type monitor.	6	Negative low
Use of emergency generators for lighting	8	Negative moderate	The emergency generator to be placed in such a position that the prevailing ambient noise will not be exceeded.	6	Negative low

*Impact assessment methodology attached as Appendix B

The noise sources at the development/s which may create an increase in the noise levels in the near field on a temporary and/or permanent basis during the operational phase of the project:

- Primary, secondary, and tertiary crushers to be used at the Vooruitzigt quarry;
- Brickmaking plant at Vooruitzigt quarry;
- Brickmaking kilns at Roodepan quarry;
- Hauling vehicles within the boundaries of the quarries;

- Use of earthmoving vehicles; and
- Delivery trucks which will deliver bricks at the three sites.

The risk assessment for the operational phase of the project is given in Table 14.

Table 14: Impact rating during the operational phase

Aspect	Impact (Extent + Duration + Intensity + Probability)	Significance Rating	Mitigation	Impact after mitigation measures	Significance rating after mitigatory measures
Primary, secondary, and tertiary crushers to be used at the Vooruitzigt quarry	8	Negative moderate	The crushers must be maintained on a continuous basis and waste dumps must be used as noise barriers	6	Negative low
Brickmaking plant at Vooruitzigt quarry	8	Negative moderate	The brickmaking plant must be maintained on a continuous basis and waste dumps must be used as noise barriers	6	Negative low
Brickmaking kilns at Roodepan quarry	8	Negative moderate	The brickmaking kilns must be maintained on a continuous basis and waste dumps must be used as noise barriers	6	Negative low
Hauling vehicles within the boundaries of the quarries	8	Negative moderate	Vehicles with low noise levels to be used and the reverse signal to be replaced with a vibration type monitor.	6	Negative low
Use of earthmoving vehicles	8	Negative moderate	Vehicles with low noise levels to be used and the reverse signal to be replaced with a vibration type monitor.	6	Negative low
Delivery trucks which will deliver bricks at the three sites	8	Negative moderate	Vehicles with low noise levels to be used and the reverse signal to be replaced with a vibration type monitor.	6	Negative low

*Impact assessment methodology attached as Appendix B

10. Discussion

Two aspects are important when considering potential noise impacts of a project and it is:

- The increase in the noise level, and;
- The overall noise level produced.

The threshold value of 7.0dBA above the prevailing ambient noise level will not be exceeded during the construction and/or operational phases of the project. The only time the noise intrusion will be above 5.2dBA (which is medium according to the impact magnitude) will be during night-time at NR I and NR J when aggregate will be removed at 100m from the

residential areas. The impact magnitude during the construction phase will be low to medium at the three sites and at Roodepan and Vooruitzigt quarries.

The impact magnitude will be below 5.2dBA above the prevailing ambient noise level (medium according the impact magnitude) when activities will take place 300m from the footprint areas at Roodepan quarry and Vooruitzigt quarry respectively.

11. Assumptions/Limitations

There was no environmental noise data available of the prevailing ambient levels along the proposed route and the residential areas in the vicinity of the routes and the current noise data will be used to establish the noise zones for the study area.

The Kimberley noise by-laws is not conclusive in assessing a project of this nature and it was decided to make use of the Noise Control Regulations, 1992 and SANS 10103 of 2008.

12. 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 to manage the mechanical activities at the different areas;
- The transmission path – To ensure that the natural topography can play a role in reducing the noise as it propagates from the activities;
- The receiver - Reduction of the noise at the receiver which is not always a solution due to the nature of this project. This is not an option and will have to be assessed once the construction and operational phases are in progress.

The following are recommendations for the proposed project:

- The natural topography and distance to be used to reduce the noise from the activities at the three sites;
- Construction machinery and equipment with low noise levels to be always used during the construction phase of the project;
- Measure the environmental noise levels during the construction phase of the project to ensure compliance to the recommended environmental noise levels;

- The crushers, brickmaking plant and the kiln to be maintained on a continuous basis so that a noise nuisance and/or noise disturbance is not created;
- The reverse signal at machinery and/or vehicles which will operate within the residential areas to be replaced with a vibration type monitor;
- Speed limit of the different roads to be always adhered to while transporting material to and from the three construction sites;
- The emergency generator to be placed in such a position that the prevailing ambient noise will not be exceeded;
- Noise monitoring to be done on a quarterly basis during the construction phase (three sites and two quarries) and operational phase (two quarries) to ensure compliance to the Noise Control Regulations;
- The recommended ambient noise levels for the residential component of the project to comply with the following noise levels:

Type of occupancy	Design Equivalent Continuous rating level ($L_{Req.T}$) for ambient noise - dBA	Maximum Equivalent Continuous rating level ($L_{Req.T}$) for ambient noise - dBA
Living rooms	35.0	45.0
Kitchens	45.0	55.0
Bathroom & toilets	40.0	55.0
Bedroom	30.0	50.0

The recommended noise level for a residential area is 55.0dBA during the day and 45.0dBA during the night and in areas where there are busy feeder roads it is 60.0dBA during the day and 50.0dBA during the night.

13. Conclusion and summary

The proposed project, whereby aggregate will be removed from Colville, St Augustine and BMW sites and construction activities will take place at all five areas, will be below the threshold value of 7.0dBA before such activities can be classified as a noise disturbance. The recommended noise mitigatory measures must always be in place and quarterly noise assessments must be carried out to determine compliance to the Noise Control Regulation, 1992 on a pro-active basis.

The distance between the proposed activities and the noise receptors and the wind direction will play an important role in noise propagation and how the noise from the construction phase of the project will be perceived at the residential properties in the vicinity of the project areas. The management of the activities during the construction phase and the operational phase of the project will ensure how successful the project will be in terms

of the increase of the prevailing ambient noise levels and how the residents will perceive the increase in the noise level.

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

The Environmental management Programme (EMPr) for the Kimberly Rehabilitation and Upgrade project will have to consist out of the following as illustrated in Table 15. Quarterly environmental noise monitoring will provide the data for reviewing, assessing, and revising the EMP.

Table 15: Noise management plan

Action	Description	Frequency	Responsible person
Management objective	To ensure that the legislated environmental noise levels will always be adhered to .	Quarterly noise surveys during the construction and operational phases of the project.	The contractor during the construction phase and the site engineer during the operational phase of the project
Monitoring objective	Measure the environmental noise levels during the construction phase of the project to ensure compliance to the recommended noise levels.	Quarterly basis	The site engineer.
Monitoring technology	The environmental noise monitoring must take place with a calibrated Class 1 noise monitoring equipment. At the noise receptors as identified in Figure 4 (P32) and Figure 5 (P33).	Quarterly basis	The site engineer and independent qualified environmental noise specialist.
Specify how the collected information will be used	The data must be discussed on a quarterly basis by means of a noise report and during a site meeting.	Quarterly basis	Site engineer
Spatial boundaries	At the boundaries of the identified residential areas according to the identified measuring points.	Quarterly basis	Site engineer
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 environmental ambient noise levels.	Quarterly basis	Site engineer

Accuracy and precision of the data	The environmental noise survey will have to be carried out in terms of the recommendations of SANS 10103 of 2008.	Calibrated equipment which complies with the recommendations of SANS 10103 of 2008 must always be used .	Responsible environmental noise specialist

The following noise management plan must be in place to monitor the noise levels during the construction and operational phases at the noise receptors in the vicinity of the sites:

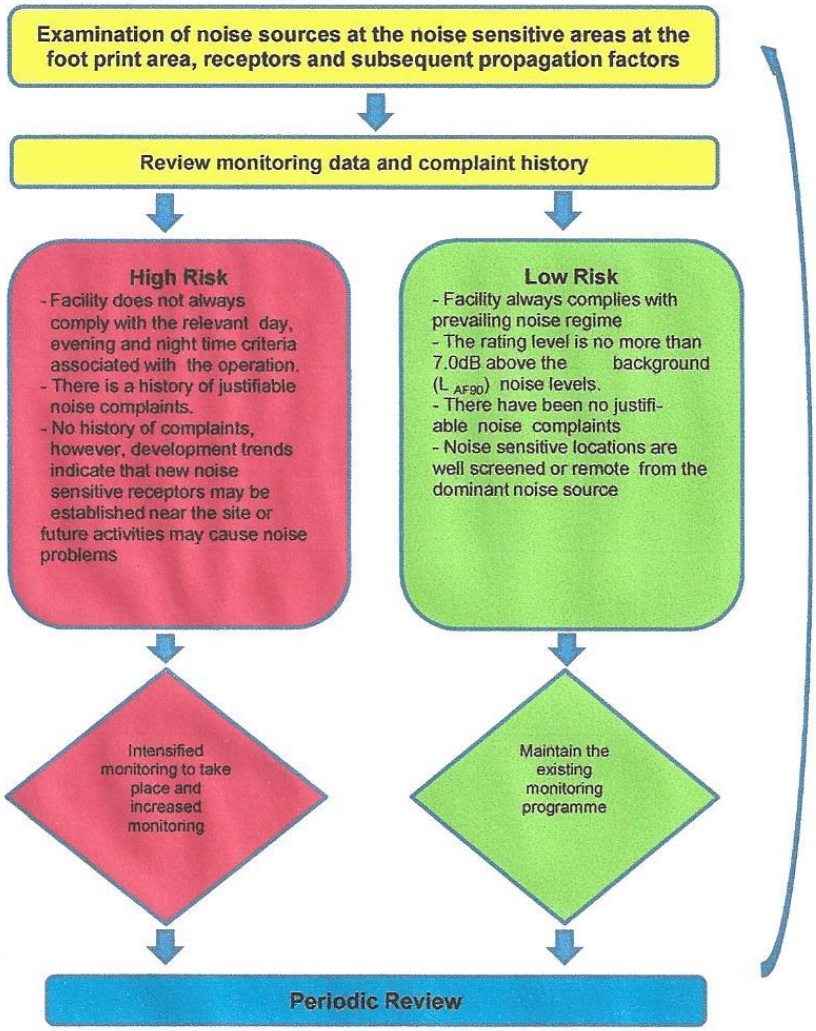

Figure 7: Noise management plan

The potential noise intrusion from the Kimberly Rehabilitation Upgrade project can however be controlled by means of approved acoustic screening measures, state of the art equipment, proper noise management principles and compliance to the Noise Regulations, 1992 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 to identify any noise increase on a pro-active basis and to address the problem accordingly.

The proposed Kimberly Rehabilitation Upgrade project will be in line with the environmental noise standards and guidelines provided that all the noise mitigatory measures are in place and that the Noise Impact Management Programme (NIMPr) for the project is adhered to.

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Environmental Noise Specialist

References:

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

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

Google Earth – Aerial photos;

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

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);

Definitions/Noise:

Ambient noise
The totally encompassing sound in each 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 500 m or less from the point of observation.

Residual noise
The ambient noise that remains at a given position in each 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.

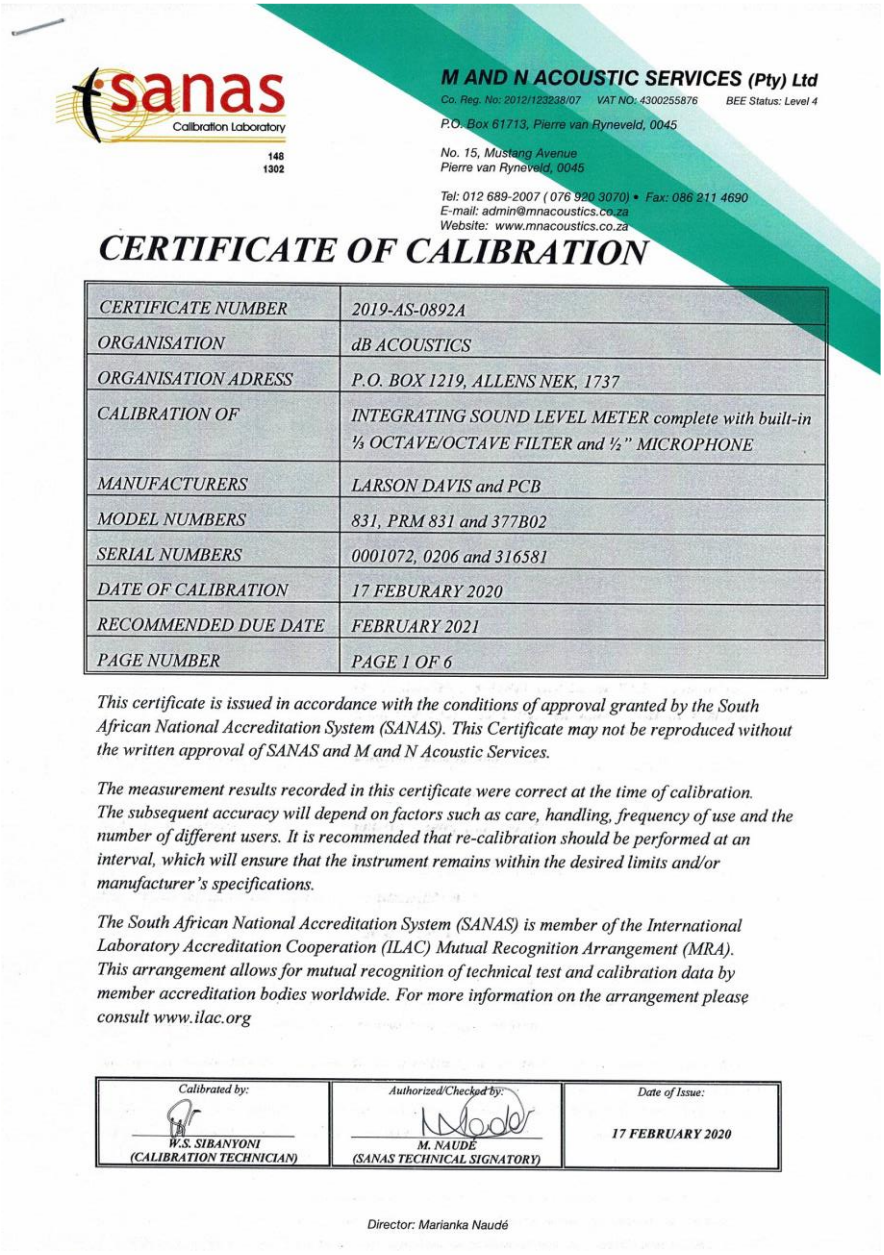
NOTE Complaints about noise usually arise because of one or more specific noises.

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

Appendix A
Appendix A – Calibration Certificate



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CERTIFICATE OF CALIBRATION

CERTIFICATE NUMBER	2019-AS-0892A
ORGANISATION	dB ACOUSTICS
ORGANISATION ADRESS	P.O. BOX 1219, ALLENS NEK, 1737
CALIBRATION OF	INTEGRATING SOUND LEVEL METER complete with built-in ⅓ OCTAVE/OCTAVE FILTER and ½" MICROPHONE
MANUFACTURERS	LARSON DAVIS and PCB
MODEL NUMBERS	831, PRM 831 and 377B02
SERIAL NUMBERS	0001072, 0206 and 316581
DATE OF CALIBRATION	17 FEBURARY 2020
RECOMMENDED DUE DATE	FEBRUARY 2021
PAGE NUMBER	PAGE 1 OF 6

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Calibrated by:	Authorized/Checked by:	Date of Issue:
W.S. SIBANYONI (CALIBRATION TECHNICIAN)	M. NAUDÉ (SANAS TECHNICAL SIGNATORY)	17 FEBRUARY 2020

Director: Marianka Naudé

Appendix B – Impact Assessment Criteria and Summary Impact Table

The impact assessment methodology requires that each potential impact identified is clearly described including the following:

- Extent (spatial scale) - will the impact affect the national, regional, or local environment or only that of the site?
- Duration (temporal scale) - how long will the impact last?
- Intensity - will the impact be of high, moderate, or low severity?
- Probability (likelihood of occurrence) - how likely is it that the impact may occur?

To determine the environmental significance (importance) of each identified potential impact, a numerical value has been assigned to each of the above criteria (Table 1). The following formula is used to calculate the environmental consequence of each impact:

Significance = Extent + Duration + Intensity + Probability

Nature	**Category**	
Extent (E)	Categories 1 – 4	
	1	Footprint / site
	2	Local (within a radius of 2 kms of site)
	3	Regional
	4	National
Duration (D)	Categories 1 – 4	
	1	Short (less than five years)
	2	Medium term (5-15 years)
	3	Long term (15-30 years)
	4	Permanent
Intensity (I)	Categories 1 – 4	
	1	Low
	2	Moderate
	3	High
	4	Very High
Probability (P)	Categories 1 – 4	
	1	Improbable
	2	Probable
	3	Highly Probable
	4	Definite
IMPACT : Cumulative		
Extent (E)		
Duration (D)		
Intensity (I)		
Probability (P)		
Significance	**Significance = E + D + I + P**	
	Minimum value of 4, maximum of 16	
	Status determines if positive / negative	

	Neg (13 - 16 points) **NEGATIVE VERY HIGH**	Permanent and important impacts. The design of the site may be affected. Intensive remediation is needed during construction and/or operational phases. Any activity which results in a "very high impact" is likely to be a fatal flaw.
	Neg (10 - 12 points) **NEGATIVE HIGH**	These are impacts which individually or combined pose a significantly high negative risk to the environment. These impacts pose a high risk to the quality of the receiving environment. The design of the site may be affected. Mitigation and possible remediation are needed during the construction and/or operational phases. The effects of the impact may affect the broader environment.
	Neg (7 - 9 points) **NEGATIVE MODERATE**	These are impacts which individually or combined pose a moderate negative risk to the quality of health of the receiving environment. These systems would not generally require immediate action, but the deficiencies should be rectified to avoid future problems and associated cost to rectify once in HIGH risk. Aesthetically and/or physically non-compliance can be expected over a medium term. In this case the impact is medium term, moderate in extent, mildly intense in its effect and probable. Mitigation is possible with additional design and construction inputs.
	Neg (4 - 6 points) **NEGATIVE LOW**	These are impacts which individually or combined pose a deleterious or adverse impact and low negative risk to the quality of the receiving environment, and may lead to potential health, safety, and environmental concerns. Aesthetically and/or physical non-compliance can be expected for short periods. In this case the impact is short term, local in extent, not intense in its effect and may not be likely to occur. A low impact has no permanent impact of significance. Mitigation measures are feasible and are readily instituted as part of a standing design, construction, or operating procedure.
	0 **Neutral**	Impact is neither beneficial nor adverse. These are impacts which cannot be classified as either positive, negative, or classified as null and void in the case of a negative impact being adequately mitigated to a state where it no longer renders a risk.
	Pos (4 - 6 points) **POSITIVE LOW**	These are impacts which individually or combined pose a low positive impact to the quality of the receiving environment and health, and may lead to potential health, safety, and environmental benefits. In this case the impact is short term, local in extent, not intense in its effect and may not be likely to occur. A low impact has no permanent impact of significance.
	Pos (7 - 9 points) **POSITIVE MODERATE**	These are impacts which individually or combined pose a moderate positive effect to the quality of health of the receiving environment. In this case the impact is medium term, moderate in extent, mildly intense in its effect and probable.
	Pos (10 - 12 points) **POSITIVE HIGH**	These are impacts which individually or combined pose a significantly high positive impact on the environment. These impacts pose a high benefit to the quality of the receiving environment and health, and may lead to potential health, safety, and environmental benefits. In this case the impact is longer term, greater in extent, intense in its effect and highly likely to occur. The effects of the impact may affect the broader environment.

	Pos (13 - 16 points) **POSITIVE VERY HIGH**	These are permanent and important beneficial impacts which may arise. Individually or combined, these pose a significantly high positive impact on the environment. These impacts pose a very high benefit to the quality of the receiving environment and health, and may lead to potential health, safety, and environmental benefits. In this case the impact is long term, greater in extent, intense in its effect and highly likely or definite to occur. The effects of the impact may affect the broader environment.