dBAcoustics

Rehabilitation and Upgrade of the N11 Section 13 Mokopane (km1.310 and Groot Sandsloot River (km 24.0) Mokopane
Noise Impact Assessment.

Environmental Impact Report
Noise Impact Assessment

Barend van der Merwe
PO Box 1219,
Allensnek, 1737
Tel no. 011 782 7193
Date: 3 February 2023

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 **Chameleon Environmental** 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 EMP for the upgrade of the N11 Section 13, Mokopane – 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: 3 February 2023

Title / Position: Environmental noise specialist

Qualification(s): MSc Environmental Management

Experience (years): 22 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 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 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 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 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 mining 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 Chameleon Environmental. 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 by Chameleon Environmental as part of the Environmental Impact Assessment process to conduct a noise impact assessment to determine the prevailing ambient noise levels in the vicinity of the N11 Upgrade - Section 13, from Mokopane (km 1.310 to Grootsandsloot River (km 24.0). The widening and upgrade of the N11 Section 13 is required due to the large volume of traffic along this route.

The noise impact assessment is furthermore required as part of Sections 2 and 23 of the National Environmental Management Act, 2014 (Act 25 of 2014) to determine the impact such a road may have on the environment especially the residential areas along this route.. Traffic noise is audible at the residential areas and the occupants are therefore exposed to traffic noise during the day and the night.

Purpose of the study

The noise survey was carried out to:

- Determine the prevailing ambient noise levels in the vicinity of the proposed Section 13 of the existing N11.
- Quantify the alleged cumulative impact of traffic noise 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 conducted on 18 and 19 January 2023 during the day and night-time periods. The ambient noise level in the vicinity of the proposed upgrade project is predominantly made up out of:

- Domestic type noise;
- Traffic noise;
- Central business type noises;
- Agricultural type noise;
- Distant 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. 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.

The proposed upgrade of Section 13 of the N11 will be in an area where there are residential properties, commercial properties, schools, and open land. People in the study area is exposed to traffic noise during the day and the night.

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 – Type of road surface to be used;
- The transmission path - Reduction of noise between the source and the receiver – Smoother roads;
- The receiver – type of road construction and surface.

The following are recommendations for the proposed road:

- UTFC Asphalt surface to be used along the entire road from km22.0 to km39.0;
- The natural topography to be used where the road will be in cut to reduce the noise from the road traffic;
- Road construction machinery and equipment with low noise levels to be always used during the construction phase of the project;

- There must be a smooth gradient and sudden sharp gradients to be avoided;
- Construction activities to take place during the daytime periods only (06h00 to 22h00), not later than midday on Saturdays and not at all on Sundays and Public Holidays;

Conclusion and summary

The proposed upgrade of Section 13 of the N11 (km1 310 to km24.0) road will have an impact on the residential areas E, G and H during the construction phase of the project. The noise increase at the remainder of the noise receptors during the construction phase will be below 7.6dBA and the activities at the construction camp will be insignificant.

The impact on the environment and the noise receptors can however be controlled or minimized by means of the type of road surface to be used. The distance between the proposed road and the noise receptors and the wind direction will play an important role in noise propagation and how the continuous noise from the traffic will be perceived at the farmhouses and communities along the new corridor. 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.

There will be a noise increase in the vicinity of any road as it is a linear noise source depending on the distances the noise receptors are situated from the road. The receptors close to the road (< 100m) will experience a noise intrusion whereas the noise receptors (≥ 100m) will show an increase but not exceeding the threshold value of 7.0dBA.The potential noise intrusion from the road 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, 1994 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 N11-Section 13 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 Plan (NIMP) for the project is adhered to.

Barend van der Merwe – MSc UJ
Environmental Noise Specialist

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE EIA AND EMP FOR THE REHABILITATION AND UPGRADE OF NATIONAL ROUTE 11, SECTION 13 (KM 1.310 TO KM 24,0).

CONTENTS

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

Figures:

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 such as ground, rock, and sand, which transmits vibration from the source to the person.
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	P3 to P6
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	P3 to P6
b)	A declaration that the specialist is independent	P2
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section 4
cA)	An indication of the quality and age of the base data used for the specialist report	Section 5
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 6 and 7
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 5
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 5
f)	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 6
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	Section 1
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Section 4
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	Section 8
k)	Any mitigation measures for inclusion in the EMPr	Section 10
l)	Any conditions for inclusion in the environmental authorisation	Section 11
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 11
n)	A reasoned opinion -	Section 12
(i)	As to whether the proposed activity or portions thereof should be authorised	Section 12
iA)	Regarding the acceptability of the proposed activity or activities: and	Section 12
(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	Section 12
o)	A description of any consultation process that was undertaken during preparing the specialist report	N/A

1. Introduction

The South African National Roads Agency (SOC) Limited (SANRAL) have identified a need for the rehabilitation and upgrade of National Route N11 Section 13 from Mokopane (km 1.130 to Grootsandsloot River (km 24.0). The existing road is a single carriageway surfaces road with varying width stretching through areas that can be classified as urban, semi-urban and rural.

The core strategies of the project area the following:

- Implementing measures to improve the safety of pedestrians and general public;
- Improve the general geometry of the road to increase capacity and safety;
- Access to adjacent properties by means of local access roads replacing direct access to the N11.

The proposed rehabilitation and upgrade project of the N11 Section 13 will consist out of:

- Clearing and grubbing of the site;
- Groundworks;
- Compaction of road surfaces;
- Accommodation of traffic;
- Construction of temporary deviations;
- Installation of drainage culverts;
- Installation of subsoil surface drains;
- Construction of new pavement layers;
- Landscaping and grassing;
- Installation of street lighting in built-up areas

Traffic noise from the existing N11- Section 13 was audible in the vicinity of the residential areas on both sides of the road on a continuous basis during the day and intermittent during the night. . The residents living or working in the vicinity of the existing road are already exposed to traffic noise levels from traffic along the N11 - Section 13. The environmental noise survey was carried out 18 and 19 January 2023 and the noise survey was done to:

- Determine the prevailing ambient noise levels in the vicinity of the existing N11 – Section 13 at;

- Quantify the alleged cumulative impact of traffic noise 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 International IFC - International Finance Corporation, Environmental, Health and Safety Guidelines;

- To make recommendations on acoustic control measures.

The project and study area are illustrated in Figure 1.

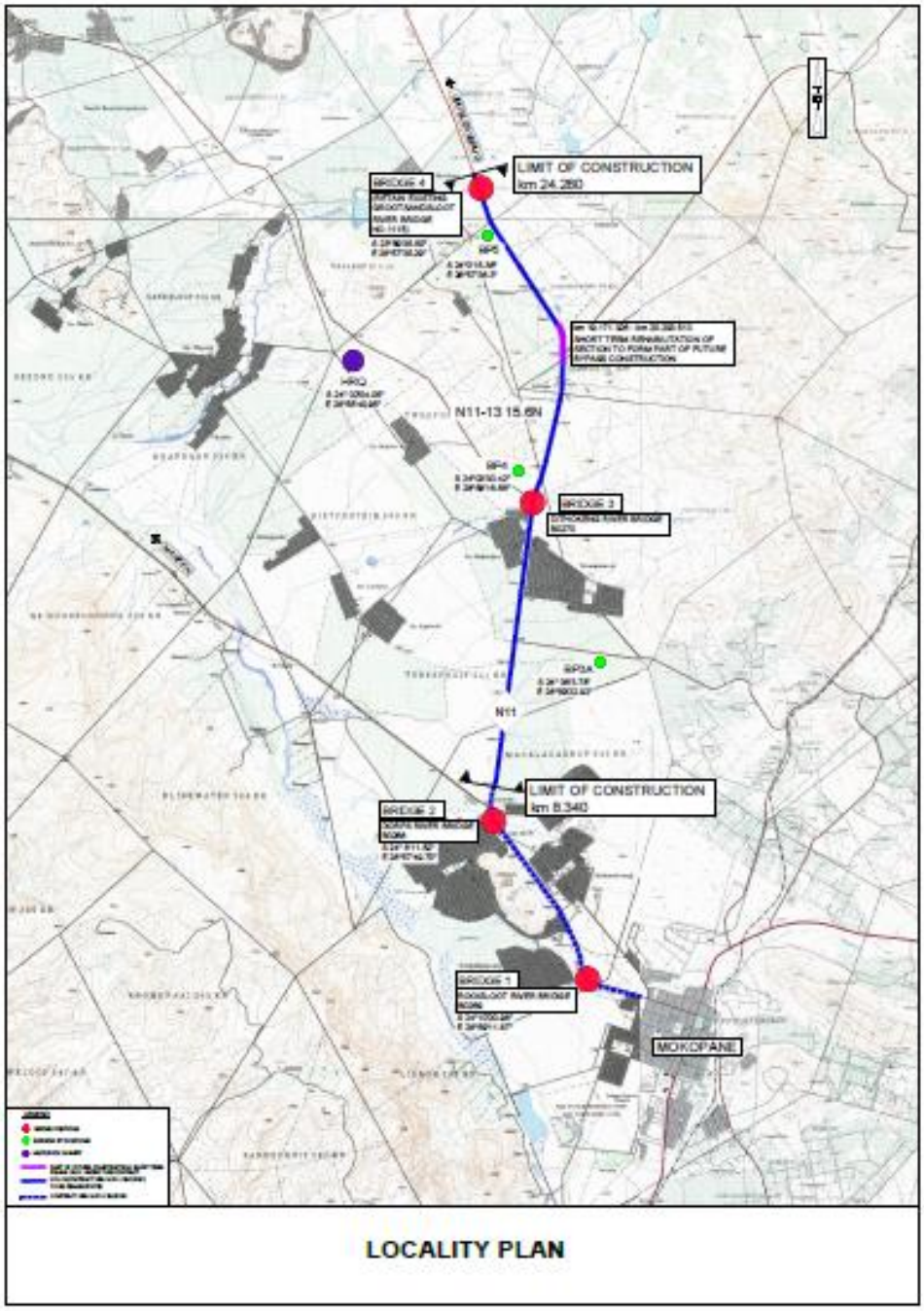


Figure 1: Location of the project area

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

- Distant traffic noise;
- Intermittent traffic noise along the gravel and/or surfaced access roads;
- Agricultural type noises;
- Domestic type noises;
- Animals;
- Insects during the day and the night.

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.

The aspects such as road surface texture and the gradient of the road can be dealt with during the design stage of the road. The other aspects such as number of vehicles, speed of the vehicles and meteorological effects are all variables that may change on a daily basis, which may have an influence on the noise levels and how the resultant noise is perceived.

The predicted impact from the traffic noise into the environment will be assessed in accordance with SANS 10103 of 2008, the measurement and rating of environmental noise with annoyance and to speech communication.

Construction facilities such as access roads, topsoil stockpiles workshops, batching plants, cement silos, concrete washing facilities and workshops may create a noise increase at the construction site camp footprint on a temporary basis. Earthworks (excavations), Concrete work, Generators, Dump sites, Stockpile sites, mixing of concrete, and Stripping of topsoil may create a noise increase in the vicinity of the activities during road construction.

2. Background to environmental noise

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. At speeds exceeding 70km/h the tire-pavement noise tends to dominate.

Slap-down effect, tire vibration, trailing edge, and stick and slip are some of the mechanisms that create the noise.

- The slap-down effect is also called air-pumping and it occurs at the leading edge of the tire as the tread meets the roadway.

- Tire vibration is when vibrations are caused by irregularities in the road surface and the kinetic energy is converted to acoustic energy.

- Noise is generated at the trailing edge of the tire as the tread is released from the road surface.

- A stick-and-slip phenomenon produces a high frequency noise at the interface.

An important factor of the whole noise scenario associated with the forward moving vehicle is the type of road surface in use and the amount of air voids in the surface that can absorb sound energy as it propagates to the receivers.

There is a combination of sources that create the higher noise level in the vicinity of a freeway such as mechanical noise and tire/road surface noise. Other aspects that must be taken into consideration in effective noise mitigation along roads are noise barriers, road surfaces, traffic management, land use control, and vegetation. These aspects will all be taken into consideration in reducing the noise level to an acceptable environmental noise level in and around the residential areas in proximity of the newly constructed N11 Section 13.

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
Communication	Normal Conversation	55-65
Communication	Shouted Conversation	90
Communication	Baby Crying	85
Communication	Computer	37-45
Home/Office	Refrigerator	40-43
Home/Office	Radio Playing in Background	45-50
Home/Office	Background Music	50
Home/Office	Washing Machine	50-75
Home/Office	Microwave	55-59
Home/Office	Clothes Dryer	56-58
Home/Office	Alarm Clock	60-80
Home/Office	Vacuum Cleaner	70
Home/Office	TV Audio	70
Home/Office	Flush Toilet	75-85
Home/Office	Ringing Telephone	80
Home/Office	Hairdryer	80-95
Home/Office	Vacuum Cleaner	84-89
Home/Office	Maximum Output of Stereo	100-110

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 2014 (RSA, 2014).

Provincial legislation

- Noise Regulations of 1994. Government Notice No. 55 of 14 January 1994.

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 and Assumptions/limitations

The scope of the noise study was to determine the prevailing environmental ambient noise levels in the vicinity of the proposed project area. 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.

Assumptions/Limitations:

- The noise data of the previous study was outdated, and it was required to conduct a new noise study.

- The motor-vehicles travel during night-time at higher speeds as the 60km/h speed limit for this road.
- The 2020 traffic data along the N11 – Section 13 was used to compile the noise zones for the study area.
- The first section of the N11- Section13 up to km 8,0 (Marken turn-off), carries about 9000 vehicle/day, where after traffic reduces to about 5000 vehicle/day. Beyond the Mokopane Platinum Mine turn-off (km 23,35) the traffic volume drops to about 2600 vehicle/day.
- Pedestrian movements parallel to the N11- Section 13 are considerable, especially through the built-up areas.

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. A 24-hour noise survey was conducted at the Mokopane Comprehensive School with a road speed limit of 60km/h and at the Witvinger nature reserve with a road speed limit of 120km/h respectively with the following noise equipment:.

1. Larson Davis Sound Expert LXT

   - Larson Davis Integrated Sound Level meter Type 1 – Serial no. S/N 0006037;
   - Larson Davis Pre-amplifier – Serial no. PRM LXT1 069946;
   - Larson Davis ½" free field microphone – Serial no. 316345;
   - Certificate Number: 2022-AS-0035;
   - Date of Calibration: 17 January 2022.

2. Larson Davis 831

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

- Larson Davis Pre-amplifier – Serial no. PRM831 377B02;
- Larson Davis ½" free field microphone – Serial no. 0206 and 316581;
- Certificate Number: 2022-AS-1688;
- Date of Calibration: 22 November 2022.

3. Larson Davis Handheld Calibrator 200

- Serial no.9855;
- Certificate number: 2022-AS-1679;
- Date of Calibration: 21 November 2022.

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 18 January 2023 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 to the N11 road-Section 13.
- 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:

18 January 2023

Daytime

- Wind speed – less than 2.5m/s;
- Temperature – 31.5^{o}C – No strong temperature gradient occurred near the ground;
- Cloud cover – High cloud cover;
- Wind direction – North-westerly;
- Humidity – 10 % humidity.

Night-time

- Wind speed – less than 2.0m/s;
- Temperature – 18.5^{o}C ;
- Cloud cover – No cloud cover;
- Wind direction – North-westerly;
- Humidity – 20 % humidity.

19 January 2023

Daytime

- Wind speed – less than 1.1m/s;
- Temperature – 31.7^{o}C – No strong temperature gradient occurred near the ground;
- Cloud cover – High cloud cover;

- Wind direction – North-westerly;
- Humidity – 10 % humidity.

Night-time

- Wind speed – less than 1.5m/s;
- Temperature – 19.0^{o}C ;
- Cloud cover – No cloud cover;
- Wind direction – North-westerly;
- Humidity – 10 % humidity.

5.4 Traffic Data

The dynamics of the future traffic will be the same as the existing traffic characteristics and it is anticipated that there will be a growth of 1.8% per annum in the traffic volume. The noise contours were based on the average traffic volume of 9 000 vehicles /day from Mokopane to the Marken turn-off and 5 000 vehicles per day to the Mogalakwena mine turnoff. Dynamics of the future traffic in and around the study area:

- There will be a constant flow of traffic along these roads during the day and intermittent flow during the night-time;
- There are no acoustic screening measures in place and the natural topography will be used as noise barriers noise receptors;
- The prevailing winds may give rise to higher ambient noise levels at the noise receptors;
- There will be an increase in the traffic volume during peak periods;
- Some of the residential areas are already exposed to distant and near traffic noise which is part of the prevailing ambient noise level for that specific area.

It is recommended that three pavement base/subbase layer material types be considered and developed in the preliminary design stage, namely:

- Asphalt Base on a Stabilised Sub-base (BTB or EME).
- Macadam Base on a Stabilised Sub-base (Water bound or dry).
- Bitumen Stabilised Material (BSM) based on a Stabilised Sub-base.

The projected ADT and ADDTT up to 2045 are illustrated in Table 3.

Table 3: Projected Average Daily Traffic volumes

Year	2020	2025	2030
ADT	3119	4498	6427
ADDTT	391	558	642

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 5.

Table 4: Measuring points and co-ordinates for the study area

Position	Latitude	Longitude	Remarks
1	24^0 10.524S	28^0 59.810E	Mokopane Comprehensive School – 24-hour noise survey
2	24^0 10.524S	28^0 59.810E	Witvinger Nature Reserve – 24-hour noise survey
3	24^0 01.850S	28^0 56.087E	Borrow pit
4	24^0 03.616S	28^0 59.198E	Borrow pit
5	24^0 05.998S	29^0 00.000E	Borrow pit

The following is of relevance to the ambient noise measurements:

- The 24-hour noise surveys were conducted at 30m from the N11 to the north where the speed limit was 120km/h and to the south where the speed limit was 60km/h;
- The L_{Aeq} was measured over a representative sampling period exceeding 10 minutes at each measuring point at the burrow pits;
- 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.

Figure 2: Measuring points throughout the study area

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

- Traffic noise;
- Intermittent traffic noise along the N11 and gravel access roads;
- Agricultural type noises;
- Insect noise;
- Train noise; and
- Domestic type noises**.**

There was a low frequency noise present at a distance from the existing N11 road throughout the study area which was caused by traffic noise. The above noise sources are in general, and the intensity of the noise may change proportionally, depending on the position of the receptor in terms of the noise source.

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 5.

Table 5: 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) and (d) 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 18 and 19 January – Summer 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 modelling 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, 1994. 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 proposed road alignment and the alternative roads will be situated in the vicinity of some of the noise receptors and along vacant land. The sensitivity analysis of the study area is illustrated in Table 7.

The criteria for assessing the magnitude of a noise impact are illustrated in Table 6.

Table 6: 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 residential houses and/or areas are situated throughout the study area of which some are single houses and others residential areas. The noise receptors are illustrated in Figure 3.

Figure 3: Noise receptors in the vicinity of the N11

The houses along the N11 are close to the N11 and the distances between the existing road and the noise receptors A to I is 30m to 50m.

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 in the vicinity of the N11 Section 13 and the borrow pits. This will therefore be the prevailing ambient noise levels for that specific area. In some of the areas distant noise was audible but did not directly impact 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. MP1 was in an area where the speed limit was 60km/h and MP2 the speed limit was 120km/h hence the differences in the measured noise levels. During the day the traffic was continuous and during the night intermittent, but insect noise increased the noise level accordingly which is normal for summer. The prevailing ambient noise levels for the 24-hour measuring periods are given in Table 7. The graphs for the 24-hour noise surveys are given in Figures 4 and 5.

Table 7: Noise results of the study area

Measuring point	Lden - dBA	Daytime – dBA 6h00 to 19h00	Evening – dBA 19h00 to 22h00	Night – dBA 22h00 to 6h00
1	**62.9**	**58.4**	**57.1**	**56.1**
2	**69.6**	**66.5**	**63.9**	**62.4**

The Leq, maximum values and minimum values for the 24-hour period at MP1 (Comprehensive School – 60km/h speed limit) was 57.5dBA , Lmax was 79.9dBA and the Lmin was 39.9dBA. The Leq for the 24-hour period at MP2 (Witvinger Nature Reserve – 120km/h speed limit) was 65.0dBA , Lmax was 89.7dBA and the Lmin was 26.0dBA. The noise levels at the borrow pits as measured at MP3, MP4 and MP5 during the day are presented in Table 8. The measured noise levels were some distance from the N11 which is the main source of the ambient noise levels. These levels can be the noise levels at the residential areas some distance from the road.

Table 8: Noise levels at MPs 3, 4 and 5

Measuring point	Location	Daytime - dBA			
		Leq	Lmax	Lmin	Remarks
3	**Borrow pit 1**	**37.9**	57.6	26.1	There will be no activities at night
4	**Borrow pit 2**	**36.7**	56.9	25.8	There will be no activities at night
5	**Borrow pit 3**	**36.6**	56.8	25.3	There will be no activities at night

The peak levels were from traffic when passing the measuring point. There is clearly a decrease in the noise level from 22h00 until 4h00 in the vicinity of MP1 and between 22h15 until 3h45 at MP2 although there were isolated traffic peaks.

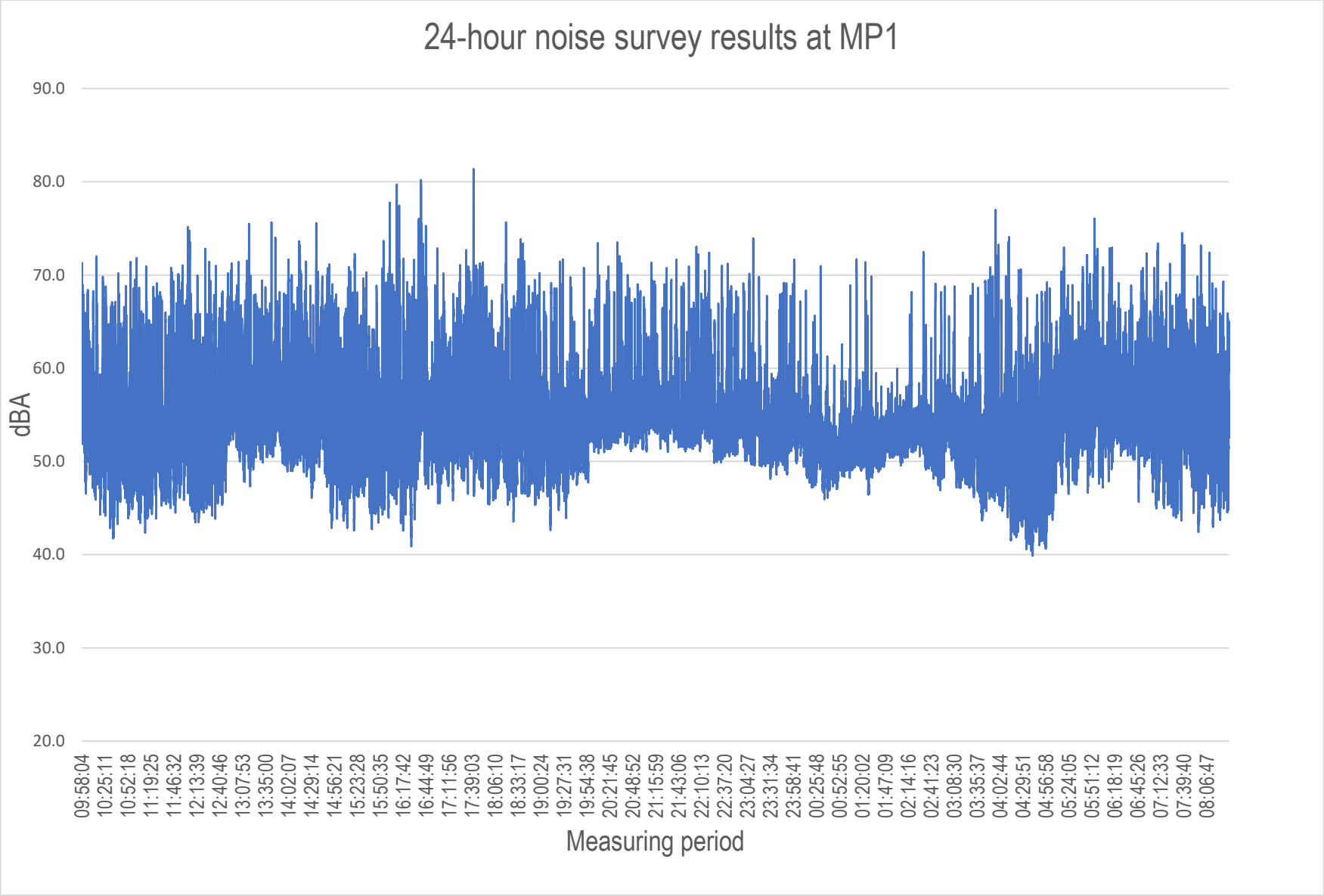
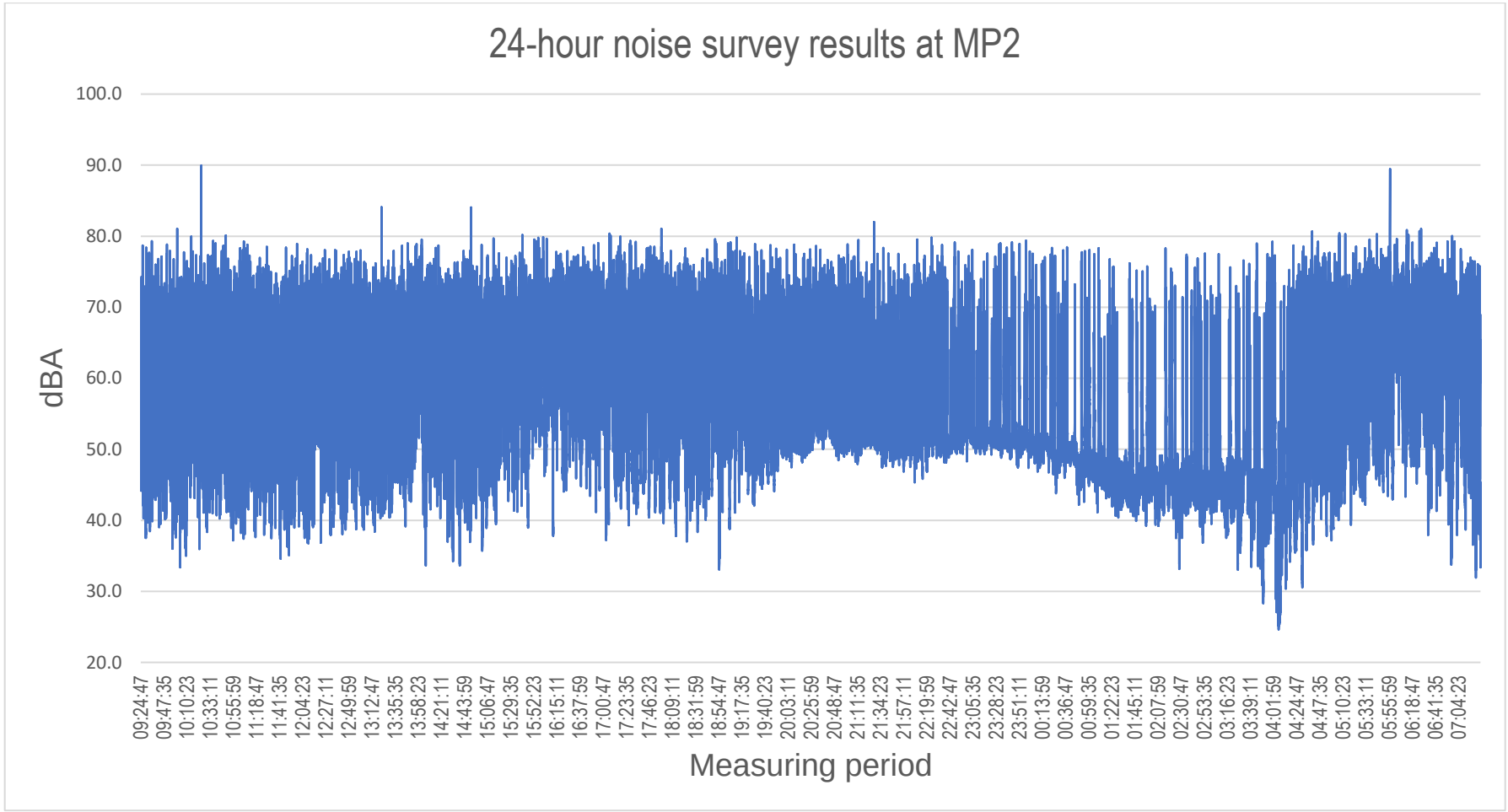


Figure 4: 24-hour noise survey results at MP1


24-hour noise survey results at MP2
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
dBA
09:24:47
09:47:35
10:10:23
10:33:11
10:55:59
11:18:47
11:41:35
12:04:23
12:27:11
12:49:59
13:12:47
13:35:35
13:58:23
14:21:11
14:43:59
15:06:47
15:29:35
15:52:23
16:15:11
16:37:59
17:00:47
17:23:35
17:46:23
18:09:11
18:31:59
18:54:47
19:17:35
19:40:23
20:03:11
20:25:59
20:48:47
21:11:35
21:34:23
21:57:11
22:19:59
22:42:47
23:05:35
23:28:23
23:51:11
00:13:59
00:36:47
00:59:35
01:22:23
01:45:11
02:07:59
02:30:47
02:53:35
03:16:23
03:39:11
04:01:59
04:24:47
04:47:35
05:10:23
05:33:11
05:55:59
06:18:47
06:41:35
07:04:23
Measuring period

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. The cumulative noise levels (when all the machinery is in use) were calculated for setback distances of 2m up to 1 920m.

Table 9: 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
Drilling Equipment	100.0	71.5	65.5	59.4	53.4	47.4	41.4	35.4	29.3
Flatbed truck	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Pickup truck	70.0	41.5	35.5	29.4	23.4	17.4	11.4	5.4	-0.7
Tractor trailer	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Crane	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Pumps	70.0	41.5	35.5	29.4	23.4	17.4	11.4	5.4	-0.7
Welding Machine	72.0	43.5	37.5	31.4	25.4	19.4	13.4	7.4	1.3
Generator	90.0	61.5	55.5	49.4	43.4	37.4	31.4	25.4	19.3
Compressor	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Jackhammer	90.0	61.5	55.5	49.4	43.4	37.4	31.4	25.4	19.3
Rock drills	100.0	71.5	65.5	59.4	53.4	47.4	41.4	35.4	29.3
Pneumatic tools	85.0	56.5	50.5	44.4	38.4	32.4	26.4	20.4	14.3
Cumulative noise levels from the construction activities when all such work within a radius of 30m	**103.9**	**75.4**	**69.3**	**63.3**	**57.3**	**51.3**	**45.3**	**39.2**	**33.2**

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 of the road (Table 10) and the activities at the construction camp (Table 11) will be done in terms of the noise level criteria in Table 6.

The noise intrusion during the construction phase of the road will be below the threshold value of 7.0dBA except at Residential areas E, G and H where the house were some 25m from the N11.

Table 10: Calculated noise levels at the noise receptors during the construction phase of the road.

Residential area	Grubbing of footprint areas	Construction activities	Front end loader activities	Loading of waste rock/material onto trucks	Earthworks	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)	Intrusion level during the daytime – dBA (D-E)	Intrusion level during the night-time – dBA (E-C)
A	48.6	46.1	47.1	44.1	45.1	53.5	59.4	58.1	60.4	59.4	2.3	3.2
B	51.0	48.5	49.5	46.5	47.5	55.9	60.1	59.1	61.5	60.8	3.4	4.6
C	49.9	47.4	48.4	45.4	46.4	54.8	59.8	58.5	60.9	60.1	2.8	3.9
D	41.5	39.0	40.0	37.0	38.0	46.4	58.4	56.6	58.7	57.0	0.6	0.8
E	57.0	54.5	55.5	52.5	53.5	61.9	63.4	62.9	65.7	65.5	7.6	9.3
F	44.0	41.5	42.5	39.5	40.5	48.9	58.6	56.9	59.0	57.6	0.9	1.4
G	57.0	54.5	55.5	52.5	53.5	61.9	63.4	62.9	65.7	65.5	7.6	9.3
H	57.0	54.5	55.5	52.5	53.5	61.9	63.4	62.9	65.7	65.5	7.6	9.3
I	51.9	49.4	50.4	47.4	48.4	56.8	60.5	59.5	62.1	61.4	4.0	5.2

Table 11: Calculated noise levels at the noise receptors during activities at the construction camp.

Residential area	Delivering of material to the construction yard	Batching plant	Front end loader activities	Emergency generator	Workshop Activities	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)	Intrusion level during the daytime – dBA (D-E)	Intrusion level during the night-time – dBA (E-C)
A	10.3	12.3	10.3	7.3	7.3	16.9	58.1	56.2	58.1	56.2	0.0	0.0
B	13.2	15.2	13.2	10.2	10.2	19.8	58.1	56.2	58.1	56.2	0.0	0.0
C	12.6	14.6	12.6	9.6	9.6	19.3	58.1	56.2	58.1	56.2	0.0	0.0
D	19.2	21.2	19.2	16.2	16.2	25.8	58.1	56.2	58.1	56.2	0.0	0.0
E	15.9	17.9	15.9	12.9	12.9	22.5	58.1	56.2	58.1	56.2	0.0	0.0
F	14.2	16.2	14.2	11.2	11.2	20.8	58.1	56.2	58.1	56.2	0.0	0.0
G	9.9	11.9	9.9	6.9	6.9	16.5	58.1	56.2	58.1	56.2	0.0	0.0
H	7.4	9.4	7.4	4.4	4.4	14.0	58.1	56.2	58.1	56.2	0.0	0.0
I	9.9	11.9	9.9	6.9	6.9	16.5	58.1	56.2	58.1	56.2	0.0	0.0

8.2 Operational Phase

The noise contours for during the operational phase are illustrated in Figures 6 and 7. Noise reduction will be in place where the road sections are a distance from the N11.

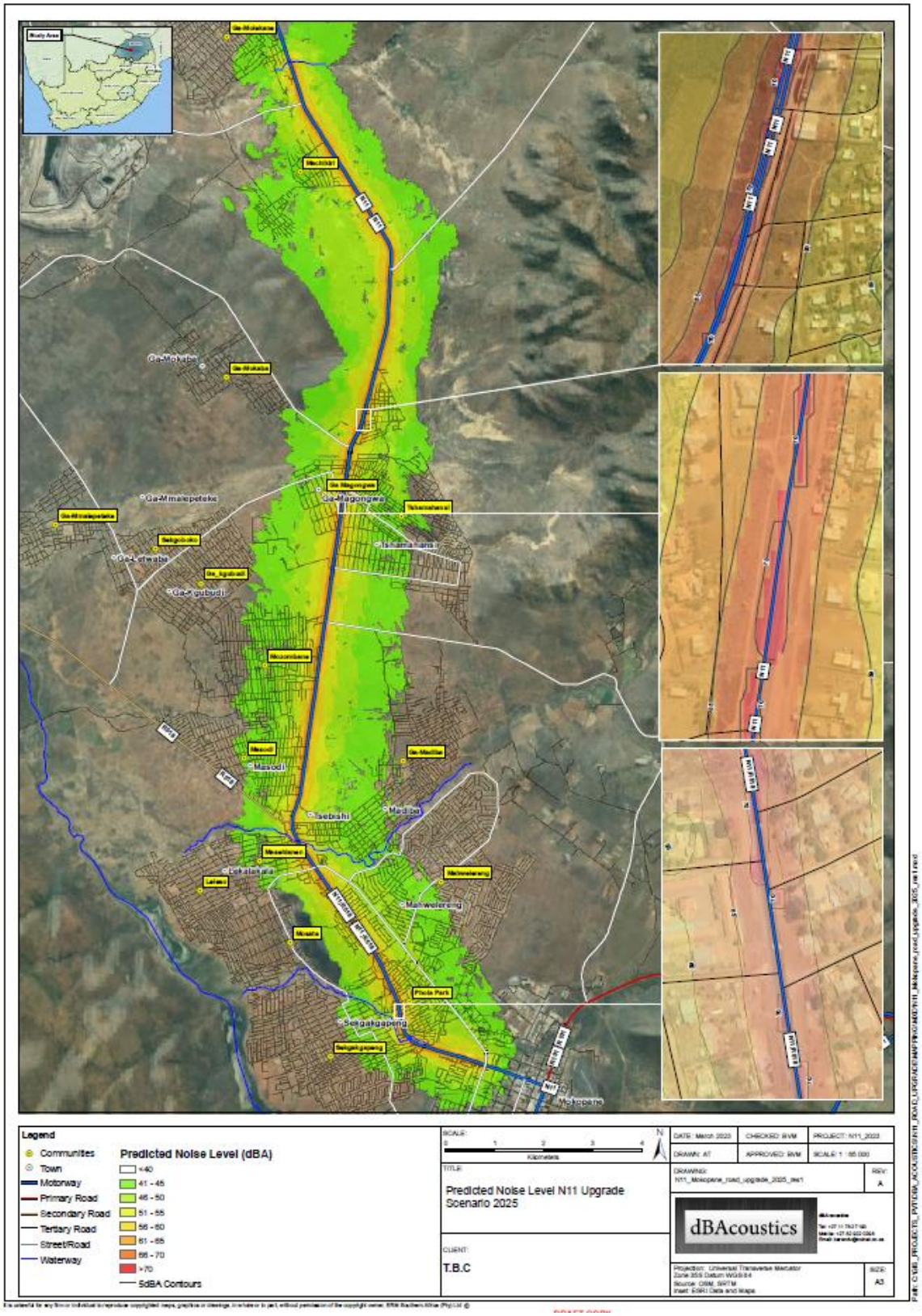


Figure 5: Noise contour for the operational phase 2025

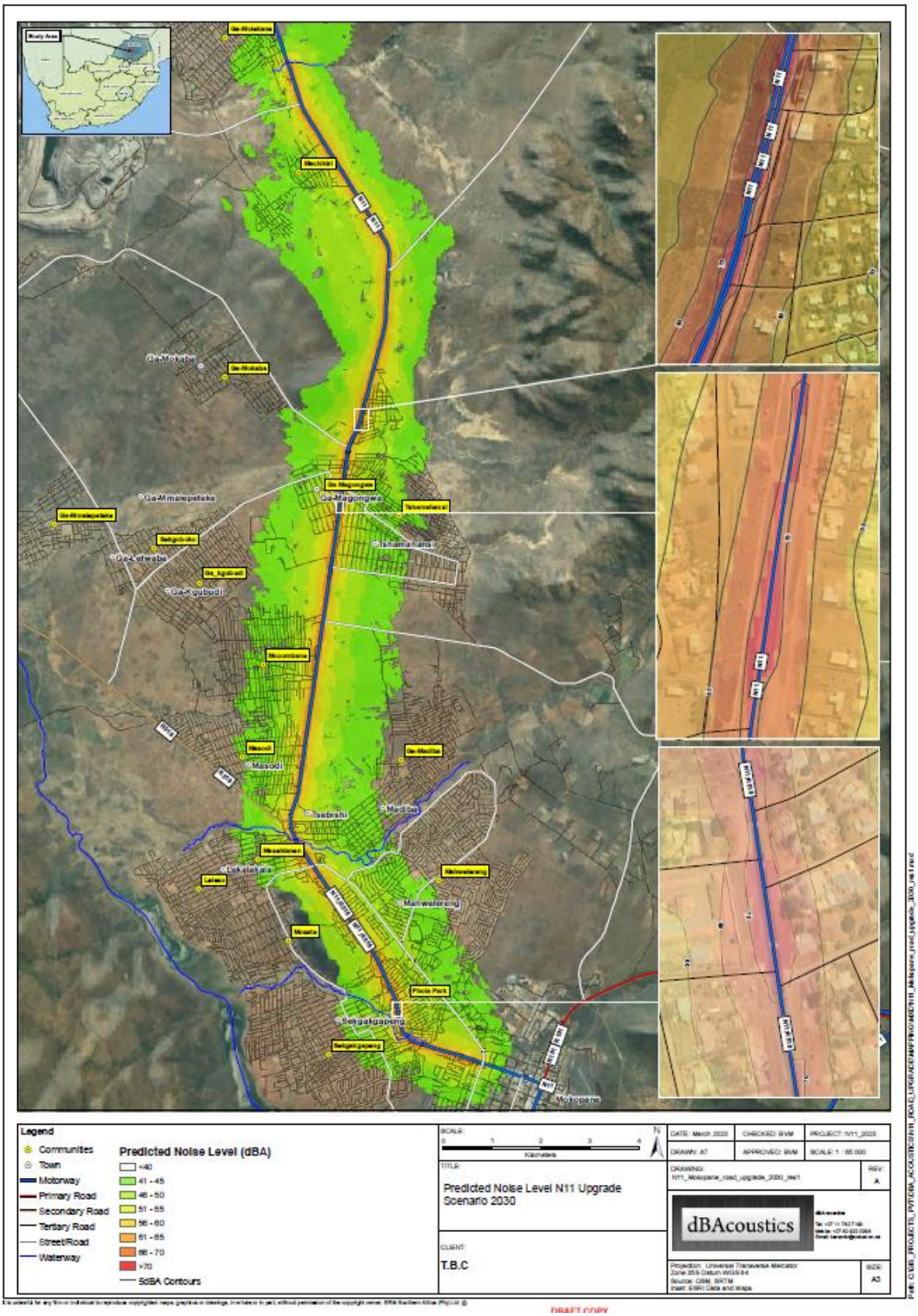


Figure 6: Noise contour for the operational phase 2030

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. The Impact Assessment Criteria and summary table is attached as Appendix C.

The activities during the different phases of the project will be:

Construction phase

- Site preparation – vegetation removal, grubbing and earthworks;
- Construction of camp and offices;
- Earthworks during preparation of road sections;
- Hauling of material and waste rock;
- Concrete batching and concrete works;
- Bridge and culvert construction;
- Bitumen mixing and surfacing;
- Emergency generator;
- Site rehabilitation of construction sites, camps.

Operational phase

- Use and maintenance of the N11 road;
- Maintenance work.

The noise risk assessment of the N11 during the construction phase will be dealt with in Table 13 and the operational phase in Table 12.

8.1 Construction phase

Table 12: Environmental noise impact assessment during the construction phase

POTENTIAL IMPACTS	ASPECT	Nature	Type	Extent	Duration	Severity	Reversibility	Irreplaceable Loss	Probability	MITIGATION POTENTIAL	SIGNIFICANCE		
											Without Mitigation	With Mitigation	MITIGATION MEASURES
Impacts on the prevailing ambient environmental noise levels and the creation of a noise disturbance and/or noise nuisance.	**Site preparation - vegetation removal, grabbing and earthworks**	Negative	Cumulative	Site	Short-term	Low medium High Positive	Partly reversible	Resource may be partially lost	Possible	Moderate or Partially Mitigatable	Moderate	Low	1. Road construction machinery and equipment or any other mahinary to compy with the manufacturer's specifications on recommended noise levels for specific applications. 2. Constructionactivities take place during day time only (06:00 - 22:00) not later than midday on a Saturday and not at all on a Sunday and/or Public holiday. 3. Environmental Noise Surveys to be carried out at the construction sites during the time of the activities. 4. The natural topography to be used where the road will be in cut to reduce the noise from the road traffic 5. The road surface to be used must be environmentally sustainable
	Construction of camp and offices	Negative	Cumulative	Site	Short-term	Low medium High Positive	Partly reversible	Resource may be partially lost	Probable	Moderate or Partially Mitigatable	Moderate	Low	
	Earthworks during preparation of road sections	Negative	Cumulative	Site	Short-term	Low medium High Positive	Partly reversible	Resource may be partially lost	Probable	Moderate or Partially Mitigatable	Moderate	Low	
	Hauling of construction material and waste rock	Negative	Cumulative	Site	Short-term	Low medium High Positive	Partly reversible	Resource may be partially lost	Possible	Moderate or Partially Mitigatable	Moderate	Low	
	Concrete batching and concrete works	Negative	Cumulative	Site	Short-term	Low medium High Positive	Partly reversible	Resource may be partially lost	Possible	Moderate or Partially Mitigatable	Moderate	Low	
	Bridge and culvert construction	Negative	Cumulative	Site	Short-term	Low medium High Positive	Partly reversible	Resource may be partially lost	Possible	Moderate or Partially Mitigatable	Moderate	Low	
	Bitumen mixing and surfacing	Negative	Cumulative	Site	Short-term	Low medium High Positive	Partly reversible	Resource may be partially lost	Possible	Moderate or Partially Mitigatable	Moderate	Low	
	Emergency generator	Negative	Cumulative	Site	Short-term	Low medium High Positive	Partly reversible	Resource may be partially lost	Possible	Moderate or Partially Mitigatable	Moderate	Low	
	Site rehabilitation of construction sites, camps	Negative	Cumulative	Site	Short-term	Low medium High Positive	Partly reversible	Resource may be partially lost	Possible	Moderate or Partially Mitigatable	Moderate	Low	

8.2 Operational phase

This assessment assumes that a **'**low-noise' road surface, e.g. UTFC asphalt surface will be used. Noise impact assessment to be done after completion of the construction phase and during the operational phase in the vicinity of noise receptors to determine where there are areas with high noise levels. The noise impact assessment for the operational phase is given in Table 13.

Table 13: Environmental noise impact assessment during the operational phase at noise receptors A to I

POTENTIAL IMPACTS	ASPECT	Nature	Type	Extent	Duration	Severity	Reversibility	Irreplaceable Loss	Probability	MITIGATION POTENTIAL	SIGNIFICANCE		MITIGATION MEASURES
											Without Mitigation	With Mitigation	
Impacts on the prevailing ambient environmental noise levels and the creation of a possible noise disturbance and/or noise nuisance at times at noise receptors A to I face the upgraded N11 Section 13 road .	**Use and maintenance of the new road between km1.310 and km24.0**	Negative	Cumulative	Local	Long term	Low medium High Negative	Irreversible	Resource may be partially lost	Possible	Moderate or Partially Mitigatable	Moderate	Low	1. UTC Asphalt surface to be used along the upgraded road - Section 13 (km1.310 to km24.0) 2. There must be a smooth gradient and sudden sharp gradients to be avoided. 3. Speed along the road to be 60km/h and 120km/h respectively.

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 will not be exceeded at noise receptors except at E, G and H where the distance between the houses and the N11 is 25m.

The proposed new upgraded road will be in an area where there are communities and the existing N11 – Section 13. People in the study area is already exposed to traffic noise during the day and the night. The location of the road was designed to have a smoother gradient with the result that vehicles will travel along the road without excessive noise generation which is currently experienced due to the poor condition of the road surface.

11. Recommendations

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

- The source - Reduction of noise at the source – Type of road surface to be used;
- The transmission path - Reduction of noise between the source and the receiver – Cutting and topography;
- The receiver - Reduction of the noise at the receiver by constructing a barrier along the boundary of the property – is not always an option and will have to be assessed once the road is operational.

The following are recommendations for the proposed road:

- UTFC Asphalt surface to be used along the entire road from km1.310 to km24;

- Road construction machinery and equipment with low noise levels to be always used during the construction phase of the project;

- There must be a smooth gradient and sudden sharp gradients to be avoided;

- Construction activities to take place during the daytime periods only (06h00 to 22h00), not later than midday on Saturdays and not at all on Sundays and Public Holidays;

- Measure the environmental noise levels levels during the construction phase of the project to ensure compliance to the recommended noise levels;

The above mitigatory measures will have to be in place to give effect to SANS 10103 of 2008 (Table 1 – Residential areas). A copy of these recommended noise levels is illustrated in Table 15.

Table 15: Recommended ambient noise levels for residential properties

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	40.0

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.

12. Conclusion and summary

The proposed upgrade of Section 13 of the N11 (km1 310 to km24.0) road will have an impact on the residential areas E, G and H during the construction phase of the project. The noise increase at the remainder of the noise receptors during the construction phase will be below 7.6dBA and the activities at the construction camp will be insignificant.

The impact on the environment and the noise receptors can however be controlled or minimized by means of the type of road surface to be used. The distance between the proposed road and the noise receptors and the wind direction will play an important role in noise propagation and how the continuous noise from the traffic will be perceived at the farmhouses and communities along the existing road. 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.
There will be a noise increase in the vicinity of any road as it is a linear noise source depending on the distances the noise receptors are situated from the road. The receptors close to the road (< 100m) will experience a noise intrusion whereas the noise receptors (≥ 100m) will show an increase but not exceeding the threshold value of 7.0dBA.

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 (such as noise) are avoided or mitigated throughout the project life cycle from design to the operational phase of the project (DEAT, 2004

The Environmental management Plan (EMP) for the upgraded road will consist of the following as illustrated in Table 15. Regular environmental monitoring will provide the data for reviewing, checking, and revising the EMP.

Table 15: Noise management plan

Action	Description	Frequency	Responsible person
Management objective	To ensure that the legislated noise levels will always be adhered to .	Quarterly for the first year after which the frequency can be annually for two years	The contractor during the construction phase and the responsible authority (SANRAL) during the operational phase of the project
Monitoring objective	Measure the environmental noise levels levels during the construction phase of the project to ensure compliance to the recommended noise levels.	Monthly to 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 3 on Page 38.	Quarterly for the first year after which the frequency can be annually for two years	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 during the construction phase and on an annual basis during the operational phase for the first two years.	Quarterly for the first year after which the frequency can be annually for two years	Site engineer and SANRAL
Spatial boundaries	At the boundaries of the identified residential areas A to N.	Quarterly for the first year after which the frequency can be annually for two years	Site engineer and SANRAL
Define how the data will be analysed and interpreted. and how it should be presented in monitoring reports	Reports must be compiled for each monitoring cycle and the results must be compared to the previous set of results to determine if there was a shift in the prevailing ambient noise levels.	Quarterly for the first year after which the frequency can be annually for two years	Site engineer and SANRAL
Accuracy and precision of the data	The noise survey will have to be conducted 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 potential noise intrusion from the road 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, 1994 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 N11-Section 13 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 Plan (NIMP) for the project is adhered to.

Barend van der Merwe (MSc UJ)
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;

Noise reducing thin layers for Highways, Internoise 2006, Honolulu - Final Report S12.405210 Tire Road noise Volume 2;

Noise Control Regulations - Noise Regulations of 1994. GN154 as promulgated in Government Gazette No. 13717 dated 10 January 1994;

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

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

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

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

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

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

Sandberg, U and Ejsmont A; Tire and road noise reference book, 2002;

Sandberg U and Descornet G, Road surface influence on tire/road noise Part 1, Inter-noise Miami, Florida, USA;

van Blokland, G; Understanding and handling road surface acoustics;

Van Blokland, G; Road noise reduction;

Van Blokland, G. and de Graaf, D. Effect of tire noise limits on traffic noise. M + P Report, June 1995;

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 Certificates

sanas Calibration Laboratory
148
1302

M AND N ACOUSTIC SERVICES (Pty) Ltd
Co. Reg. No: 2012/123238/07 VAT NO: 4300255876 BEE Status: Level 4
P.O. Box 61713, Pierre van Ryneveld, 0045
No. 15, Mustang Avenue
Pierre van Ryneveld, 0045
Tel: 012 689-2007 (076 920 3070) • Fax: 086 211 4690
E-mail: admin@mnacoustics.co.za
Website: www.mnacoustics.co.za

CERTIFICATE OF CALIBRATION

CERTIFICATE NUMBER	2022-AS-1688
ORGANISATION	DB ACOUSTIC CC
ORGANISATION ADRESS	P.O. BOX 1219, ALLENSNECK, 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 329290
DATE OF CALIBRATION	21 - 22 NOVEMBER 2022
RECOMMENDED DUE DATE	NOVEMBER 2023
PAGE NUMBER	PAGE 1 OF 6

This certificate is issued in accordance with the conditions of approval granted by the South African National Accreditation System (SANAS). This Certificate may not be reproduced without the written approval of SANAS and M and N Acoustic Services.

The measurement results recorded in this certificate were correct at the time of calibration. The subsequent accuracy will depend on factors such as care, handling, frequency of use and the number of different users. It is recommended that re-calibration should be performed at an interval, which will ensure that the instrument remains within the desired limits and/or manufacturer's specifications.

The South African National Accreditation System (SANAS) is member of the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA). This arrangement allows for mutual recognition of technical test and calibration data by member accreditation bodies worldwide. For more information on the arrangement please consult www.ilac.org

Calibrated by:	Authorized/Checked by:	Date of Issue:
W.S. SIBANYONI (CALIBRATION TECHNICIAN)	M. NAUDÉ (SANAS TECHNICAL SIGNATORY)	23 NOVEMBER 2022

Director: Marianka Naudé

Appendix B – Impact Assessment Criteria and Summary Impact Table

Refer to the EIA Regulations, 2014 for a list of the criteria.

CRITERIA	CATEGORIES	EXPLANATION
Overall nature	Negative	Negative impact on affected biophysical or human environment.
	Positive	Benefit to the affected biophysical or human environment.
Type	Direct	Are caused by the action and occur at the same time and place.
	Indirect or Secondary	Are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. May include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.
	Cumulative	Is the impact on the environment, which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.
Spatial Extent over which impact may be experienced	Site	Immediate area of activity incorporating a 50m zone which extends from the edge of the affected area.
	Local	Area up to and/or within 10km of the 'Site' as defined above.
	Regional	Entire community, drainage basin, landscape etc.
	National	South Africa.
Duration of impact	Short-term	Impact would last for the duration of activities such as land clearing, land preparation, fertilising, weeding, pruning and thinning. Quickly reversible.
	Medium-term	Impact would after the project activity such as harvesting. Reversible over time.
	Long-term	Impact would continue beyond harvesting/ extraction of the trees.
	Permanent	Impact would continue beyond decommissioning.
Severity	Low, Medium, High Negative	Based on separately described categories examining whether the impact is destructive or benign, whether it destroys the impacted

CRITERIA	CATEGORIES	EXPLANATION
	Low, Medium, High Positive	environment, alters its functioning or slightly alters the environment itself.
Reversibility	Completely Reversible	The impact can be completely reversed with the implementation of correct mitigation and rehabilitation measures.
	Partly Reversible	The impact can be partly reversed providing mitigation measures are implemented and rehabilitation measures are undertaken
	Irreversible	The impact cannot be reversed, regardless of the mitigation or rehabilitation measures.
Irreplaceable Loss	Resource will not be lost	The resource will not be lost or destroyed provided mitigation and rehabilitation measures are implemented.
	Resource may be partly destroyed	Partial loss or destruction of the resource will occur even though all management and mitigation measures are implemented.
	Resource cannot be replaced	The resource cannot be replaced no matter which management or mitigation measures are implemented.
Probability of occurrence	Unlikely	<40% probability.
	Possible	40% probability.
	Probable	>70% probability.
	Definite	>90% probability.
Mitigation Potential [i.e. the ability to manage or mitigate an impact given the necessary resources and feasibility of application.]	High or Completely Mitigatable	Relatively easy and cheap to manage. Specialist expertise or equipment is generally not required. The nature of the impact is understood and may be mitigated through the implementation of a management plan or through 'good housekeeping'. Regular monitoring needs to be undertaken to ensure that any negative consequences remain within acceptable limits. The significance of the impact after mitigation is likely to be low or negligible.
	Moderate or Partially Mitigatable	Management of this impact requires a higher level of expertise and resources to maintain impacts within acceptable levels. Such mitigation can be tied up in the design of the Project. The significance of the impacts after mitigation is likely to be low to moderate. May not be possible to mitigate the impact entirely, with a residual impact(s) resulting.
	Low or Un-mitigatable	Will not be possible to mitigate this impact entirely regardless of the expertise and resources applied.

C-56

CRITERIA	CATEGORIES	EXPLANATION
		The potential to manage the impact may be beyond the scope of the Project. Management of this impact is not likely to result in a measurable change in the level of significance.
Impact Significance	Negligible	-
	Low	Largely of HIGH mitigation potential, after considering the other criteria.
	Moderate	Largely of MODERATE or partial mitigation potential after considering the other criteria.
	Substantial	Largely of LOW mitigation potential after considering the other criteria.