Environmental Noise Impact Assessment for the ML133 Exploration Project in Namibia

Project done for **Environmental Compliance Consultancy**

Report Compiled By:
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Report Details

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Revision Record

Version	Date	Comments
Rev 0	March 2026	For internal review
Rev 1	March 2026	For client review

Glossary and Abbreviations

dB	Descriptor that is used to indicate 10 times a logarithmic ratio of quantities that have the same units, in this case sound pressure.
dBA	Descriptor that is used to indicate 10 times a logarithmic ratio of quantities that have the same units, in this case sound pressure that has been A-weighted to simulate human hearing.
ECC	Environmental Compliance Consultancy
EHS	Environmental, Health, and Safety (IFC)
Hz	Frequency in Hertz
IEC	International Electro Technical Commission
IFC	International Finance Corporation
ISO	International Standards Organisation
km	Kilometre
L_{Aeq} (T)	The A-weighted equivalent sound pressure level, where T indicates the time over which the noise is averaged (calculated or measured) (in dBA)
L_{A90}	The A-weighted 90% statistical noise level, i.e. the noise level that is exceeded during 90% of the measurement period. It is a very useful descriptor which provides an indication of what the L_{Aeq} could have been in the absence of noisy single events and is considered representative of background noise levels (L_{A90}) (in dBA)
L_{AFmax}	The A-weighted maximum sound pressure level recorded during the measurement period
L_{AFmin}	The A-weighted minimum sound pressure level recorded during the measurement period
L_P	Sound pressure level (in dB)
L_W	Sound Power Level (in dB)
m	Metres
m/s	Speed in metres per second
ML133	Mining Licence 133
NACA	National Association for Clean Air
NSR	Noise sensitive receptor
p	Pressure in Pa
Pa	Pressure in Pascal
µPa	Pressure in micro-pascal
p_{ref}	Reference pressure, 20 µPa
SACNASP	South African Council for Natural Scientific Professions
SANS	South African National Standards
SLM	Sound Level Meter

Executive Summary

Airshed Planning Professionals (Pty) Ltd was commissioned by Environmental Compliance Consultancy (Pty) Ltd (ECC) to undertake an Environmental Noise Impact Assessment for the proposed exploration activities for the Mining Licence 133 (ML133) (hereafter referred to as the project).

The main objective of the noise specialist study was to determine the significance of impacts on the acoustic environment and noise receptors (NSRs) given noise generated by project exploration activities.

To meet the above objective, the following tasks were included in the Scope of Work:

1. A review of technical information for the operation of the project.
2. A review of the legal requirements and applicable environmental noise guidelines.
3. A study of the receiving (baseline) acoustic environment, including:
    a. The identification of NSRs from available maps;
    b. Analysis of sampled baseline noise levels.
4. An impact assessment, including:
    a. A source inventory for the project.
    b. Noise propagation simulations to determine environmental noise levels over the selected study area and at NSRs as a result of project activities.
    c. The screening of simulated noise levels against environmental noise criteria.
5. The identification and recommendation of suitable noise management measures and monitoring requirements.
6. The preparation of a comprehensive specialist environmental noise impact assessment report.

In the assessment of simulated noise levels, reference was made to the International Finance Corporation (IFC) noise level guidelines for residential receptors (55 dBA for day-time conditions).

The baseline acoustic environment was described in terms of the location of NSRs, the ability of the environment to attenuate noise over long distances, as well as measured baseline noise levels. The following was found:

- The closest potential sensitive receptors to the proposed project include individual dwellings.
- The baseline noise levels for the study area were between 29.4 dBA and 42.9 dBA for day-time and between 27.5 dBA and 36.8 dBA for night-time.

A source inventory was developed for the project activities. A list of equipment for exploration activities was provided. Noise levels for the equipment were calculated using predictive equations for industrial machinery as per the Handbook of Acoustics, Chapter 69, by Bruce and Moritz (1998).

The source inventory and information on local land use were used to populate the noise attenuation model (CadnaA, ISO 9613). The propagation of noise was calculated over an area of 13 km east-west by 9.6 km north-south. The area was divided into a grid matrix with a 20 m resolution.

The main findings of the impact assessment were as follows:

- Noise levels due to project activities were below the IFC Noise Guideline for residential areas at all identified NSRs within the study area.
- A ‘medium’ community reaction is expected at NSR R6 due to its close proximity to project activities.

General good practice noise mitigation measures are recommended for the project and ad-hoc noise surveys should be conducted should any noise related complaints be received.

It is further recommended that when exploration activities are close to receptors, activities should be clearly communicated, coordinated and scheduled with the residents of this homestead.

Given that the noise levels due to project exploration activities are below IFC noise guidelines, it is the specialist opinion that, from an environmental noise perspective, the project may be authorised.

Table of Contents

List of Tables

List of Figures

1 Introduction

Environmental Compliance Consultancy (Pty) Ltd (ECC) has been retained by Andrada Mining (Pty) Ltd to update the environmental and social impact assessment for mining licence (ML) 133 to bring the impact assessment to improved standards and ensure best international practises are met. The proponent holds an environmental clearance certificate to mine pegmatite-hosted deposits on ML 133. The mining method includes open pit mining, blasting, loading and hauling of ore to ML 134 and waste rock, with waste rock to be stockpiled at a waste rock dumpsite that is still to be determined.

Andrada plan to increase production and propose to commence mining operations on the ML 133. ML 133 is located ~45 km south of Uis, in the Erongo Region, Namibia. ML 133 is bordering the Omaruru River to the southeast, within the Nai Nais community in the Dâures Constituency. The Uis town can be accessed via the C36 road from Omaruru or the C35 from Henties Bay and Khorixas. The locality for ML 133 is shown in Figure 1.

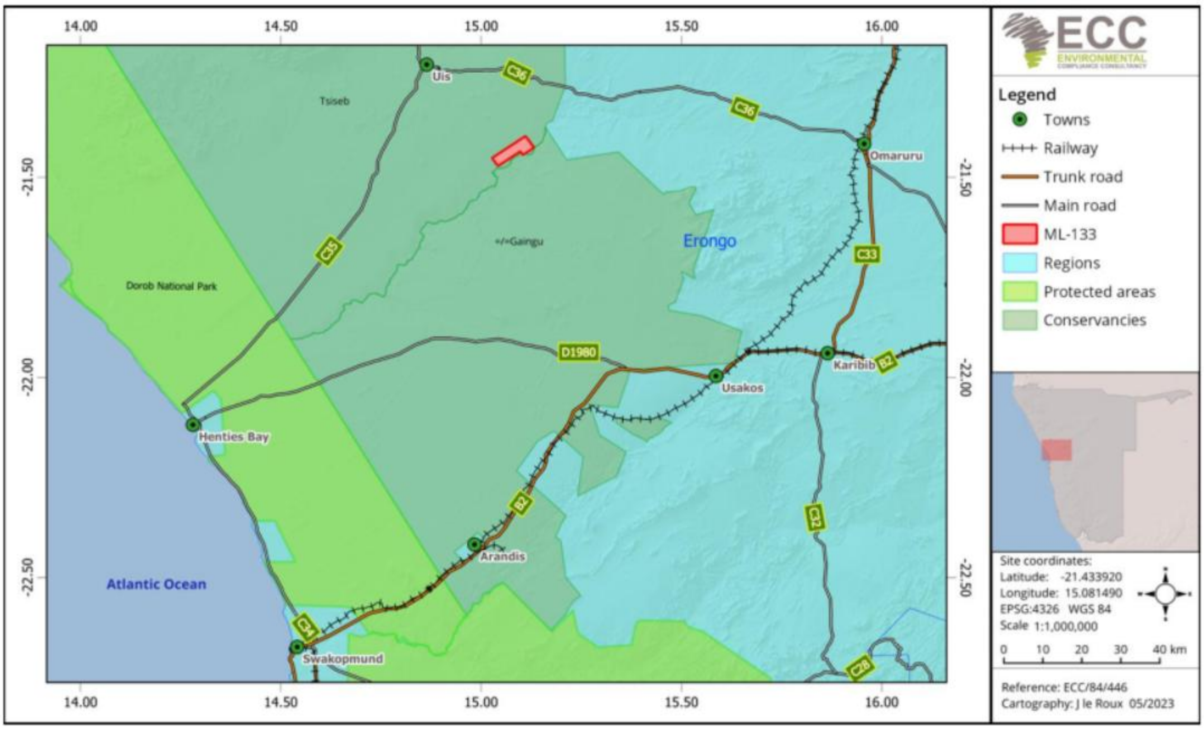


Figure 1-1: Location of ML133

Airshed Planning Professionals (Pty) Ltd was commissioned by Environmental Compliance Consultancy (Pty) Ltd (ECC) to undertake an Environmental Noise Impact Assessment for the proposed exploration activities for ML133 (hereafter referred to as the project).

1.1 Study Objective

The main objective of the noise specialist study was to determine the significance of impacts on the acoustic environment and potential noise sensitive receptors (NSRs) given noise generated by activities proposed as part of the project.

1.2 Scope of Work

To meet the above objective, the following tasks were included in the Scope of Work:

1. A review of technical information for the project.
2. A review of the legal requirements and applicable environmental noise guidelines.
3. A study of the receiving (baseline) acoustic environment, including:
    a. The identification of NSRs from available maps;
    b. Analysis of sampled baseline noise levels.
4. An impact assessment, including:
    a. A source inventory for project activities.
    b. Noise propagation simulations to determine environmental noise levels over the selected study area and at NSRs as a result of the project activities.
    c. The screening of simulated noise levels against environmental noise criteria.
5. The identification and recommendation of suitable noise management measures and monitoring requirements.
6. The preparation of a comprehensive specialist environmental noise impact assessment report.

1.3 Description of Activities from a Noise Perspective

The exploration equipment will include drill rigs, watercarts and light duty vehicles. For a given machine, the sound pressure levels depend on the part of the total mechanical or electrical energy that is transformed into acoustical energy. Mobile equipment generally produce noise in the lower end of the frequency spectrum. Noise generated during exploration is highly variably since it is characterised by variations in the power expended by equipment.

It was provided that the exploration activities would be during day-time hours only.

1.4 Specialist Details

1.4.1 Specialist Details

Airshed is an independent consulting firm with no interest in the project other than to fulfil the contract between the client and the consultant for delivery of specialised services as stipulated in the terms of reference.

1.4.2 Competency Profile of Specialist

Reneé von Gruenewaldt is a Registered Professional Natural Scientist (Registration Number 400304/07) with the South African Council for Natural Scientific Professions (SACNASP) and a member of the National Association for Clean Air (NACA).

Following the completion of her bachelor's degree in atmospheric sciences in 2000 and honours degree (with distinction) with specialisation in Environmental Analysis and Management in 2001 at the University of Pretoria, her experience in air pollution started when she joined Environmental Management Services (now Airshed Planning Professionals) in 2002. Reneé von Gruenewaldt later completed her master's degree (with distinction) in Meteorology at the University of Pretoria in 2009.

Reneé von Gruenewaldt became a partner of Airshed Planning Professionals in September 2006. Airshed Planning Professionals is a technical and scientific consultancy providing scientific, engineering, strategic impact assessments, management services and policy support to assist clients in addressing a wide variety of air pollution and environmental noise related projects. Her project experience range over various countries in Africa, providing her with an inclusive knowledge base of international legislation and requirements pertaining to air quality and environmental noise impacts.

A comprehensive curriculum vitae of Reneé von Gruenewaldt is provided in Appendix A. Declaration of independence is provided in Appendix B.

1.5 Background to Environmental Noise and the Assessment Thereof

Before more details regarding the approach and methodology adopted in the assessment is given, the reader is provided with some background, definitions and conventions used in the measurement, calculation and assessment of environmental noise.

Noise is generally defined as unwanted sound transmitted through a compressible medium such as air. Sound in turn, is defined as any pressure variation that the ear can detect. Human response to noise is complex and highly variable as it is subjective rather than objective.

A direct application of linear scales (in pascal (Pa)) to the measurement and calculation of sound pressure leads to large and unwieldy numbers. And, as the ear responds logarithmically rather than linearly to stimuli, it is more practical to express acoustic parameters as a logarithmic ratio of the measured value to a reference value. This logarithmic ratio is called a decibel or dB. The advantage of using dB can be clearly seen in Figure 1-2. Here, the linear scale with its large numbers is converted into a manageable scale from 0 dB at the threshold of hearing (20 micro-pascals (μPa)) to 130 dB at the threshold of pain (~100 Pa) (Brüel & Kjær Sound & Vibration Measurement A/S, 2000).

As explained, noise is reported in dB. "dB" is the descriptor that is used to indicate 10 times a logarithmic ratio of quantities that have the same units, in this case sound pressure. The relationship between sound pressure and sound pressure level is illustrated in this equation.

$$L_p = 20 \cdot \log_{10}\left(\frac{p}{p_{ref}}\right)$$

Where:

***L_p** is the sound pressure level in dB;*

***p** is the actual sound pressure in Pa; and*

***p_{ref}** is the reference sound pressure (p_{ref} in air is 20 μPa).*

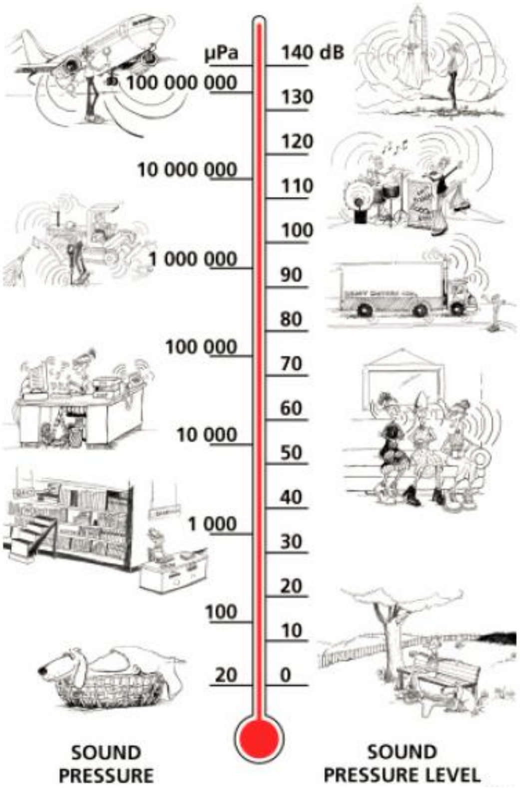


Figure 1-2: The decibel scale and typical noise levels (Brüel & Kjær Sound & Vibration Measurement A/S, 2000)

1.5.1 Perception of Sound

Sound has already been defined as any pressure variation that can be detected by the human ear. The number of pressure variations per second is referred to as the frequency of sound and is measured in hertz (Hz). The hearing frequency of a young, healthy person ranges between 20 Hz and 20 000 Hz.

In terms of L_P, audible sound ranges from the threshold of hearing at 0 dB to the pain threshold of 130 dB and above. Even though an increase in sound pressure level of 6 dB represents a doubling in sound pressure, an increase of 8 to 10 dB is required before the sound subjectively appears to be significantly louder. Similarly, the smallest perceptible change is about 1 dB (Brüel & Kjær Sound & Vibration Measurement A/S, 2000).

1.5.2 Frequency Weighting

Since human hearing is not equally sensitive to all frequencies, a 'filter' has been developed to simulate human hearing. The 'A-weighting' filter simulates the human hearing characteristic, which is less sensitive to sounds at low frequencies than at high frequencies (Figure 1-3). "dBA" is the descriptor that is used to indicate 10 times a logarithmic ratio of quantities, that have the same units (in this case sound pressure) that has been A-weighted.

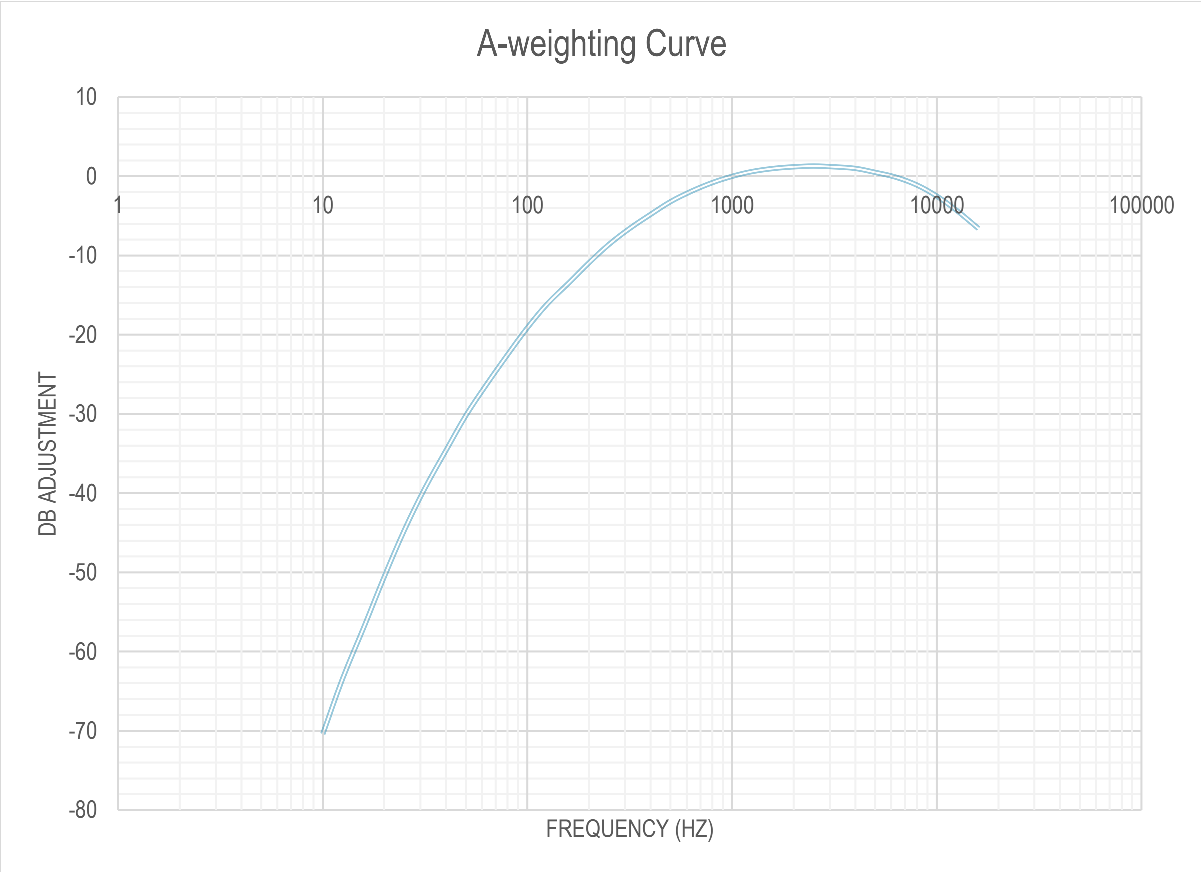


Figure 1-3: A-weighting curve

1.5.3 Adding Sound Pressure Levels

Since sound pressure levels are logarithmic values, the sound pressure levels as a result of two or more sources cannot just simply be added together. To obtain the combined sound pressure level of a combination of sources such as those at an industrial plant, individual sound pressure levels must be converted to their linear values and added using:

$$L_{p\_combined} = 10 \cdot \log\left(10^{\frac{L_{p1}}{10}} + 10^{\frac{L_{p2}}{10}} + 10^{\frac{L_{p3}}{10}} + \cdots 10^{\frac{L_{pi}}{10}}\right)$$

This implies that if the difference between the sound pressure levels of two sources is nil the combined sound pressure level is 3 dB more than the sound pressure level of one source alone. Similarly, if the difference between the sound pressure levels of two sources is more than 10 dB, the contribution of the quietest source can be disregarded (Brüel & Kjær Sound & Vibration Measurement A/S, 2000).

1.5.4 Environmental Noise Propagation

Many factors affect the propagation of noise from source to receiver. The most important of these are:

- The type of source and its sound power (L_W);
- The distance between the source and the receiver;
- Atmospheric conditions (wind speed and direction, temperature and temperature gradient, humidity etc.);
- Obstacles such as barriers or buildings between the source and receiver;
- Ground absorption; and
- Reflections.

To arrive at a representative result from either measurement or calculation, all these factors must be taken into account (Brüel & Kjær Sound & Vibration Measurement A/S, 2000).

1.5.5 Environmental Noise Indices

In assessing environmental noise either by measurement or calculation, reference is made to the following indices:

- **L_{Aeq} (T)** – The A-weighted equivalent sound pressure level, where T indicates the time over which the noise is averaged (calculated or measured).
- **L_{A90}** – The A-weighted 90% statistical noise level, i.e., the noise level that is exceeded during 90% of the measurement period. It is a very useful descriptor which provides an indication of what the L_{Aeq} could have been in the absence of noisy single events and is considered representative of background noise levels.
- **L_{AFmax}** – The maximum A-weighted noise level measured with the fast time weighting. It's the highest level of noise that occurred during a sampling period.
- **L_{AFmin}** – The minimum A-weighted noise level measured with the fast time weighting. It's the lowest level of noise that occurred during a sampling period.

1.6 Approach and Methodology

The assessment included a study of the legal requirements pertaining to environmental noise impacts, a study of the physical environment of the area surrounding the project and the analyses of existing noise levels in the area. The impact assessment focused on the estimation of L_W's (noise 'emissions') and L_P's (noise impacts) associated with the exploration phase. The findings of the assessment components informed recommendations of management measures, including mitigation and monitoring. Individual aspects of the noise impact assessment methodology are discussed in more detail below.

1.6.1 Information Review

The following information was supplied for inclusion in the study:

- Baseline noise survey measurements;
- Layout maps; and,
- List of equipment for project activities.

1.6.2 Review of Assessment Criteria

In the absence of local guidelines and standards, this study refers to noise level guidelines published by the International Finance Corporation (IFC) in their '*General Environmental, Health, and Safety (EHS) Guidelines'* (IFC, 2007).

In addition to the above reference is also made to very useful indicators of likely community response to an intruding industrial noise as set out by the South African Bureau of Standards' (SABS) South African National Standard (SANS) 10103 of 2008 (SANS 10103, 2008).

1.6.3 Noise Propagation Simulations

The propagation of noise from the project was simulated with the DataKustic CadnaA software. Use was made of the International Organisation for Standardization's (ISO) 9613 module for outdoor noise propagation from industrial noise sources.

ISO 9613 specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level under meteorological conditions favourable to propagation from sources of known sound emission. These conditions are for downwind propagation or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night.

The method also predicts an average A-weighted sound pressure level. The average A-weighted sound pressure level encompasses levels for a wide variety of meteorological conditions. The method specified in ISO 9613 consists specifically of octave-band algorithms (with nominal midband frequencies from 63 Hz to 8 kHz) for calculating the attenuation of sound which originates from a point sound source, or an assembly of point sources. The source (or sources) may be moving or stationary. Specific terms are provided in the algorithms for the following physical effects, geometrical divergence, atmospheric absorption, ground surface effects, reflection and obstacles. A basic representation of the model is given in the equation below:

$$L_P = L_W - \sum[K_1, K_2, K_3, K_4, K_5, K_6]$$

Where;

L_P is the sound pressure level at the receiver;

L_W is the sound power level of the source;

K_1 is the correction for geometrical divergence;

K_2 is the correction for atmospheric absorption;

K_3 is the correction for the effect of ground surface;

K_4 is the correction for reflection from surfaces; and

K_5 is the correction for screening by obstacles.

This method is applicable in practice to a great variety of noise sources and environments. It is applicable, directly or indirectly, to most situations concerning road or rail traffic, industrial noise sources, construction activities, and many other ground-based noise sources.

To apply the method of ISO 9613, several parameters need to be known with respect to the geometry of the source and of the environment, the ground surface characteristics, and the source strength in terms of octave-band sound power levels for directions relevant to the propagation.

If the dimensions of a noise source are small compared with the distance to the listener, it is called a point source. All sources of noise were quantified as point sources or areas/lines represented by point sources. The sound energy from a point source spreads out spherically, so that the sound pressure level is the same for all points at the same distance from the source and decreases by 6 dB per doubling of distance. This holds true until ground and air attenuation noticeably affect the level. The impact of an intruding industrial noise on the environment will therefore rarely extend over more than 5 km from the source and is therefore always considered “local” in extent.

The propagation of noise was calculated over an area of 13 km east-west by 9.6 km north-south. The area was divided into a grid matrix with a 20 m resolution. The model was set to calculate L_P’s (L_{Aeq}) at each grid and discrete receptor point at a height of 1.5 m above ground level.

1.6.4 Study of the Receiving Environment

NSRs generally include private residences, community buildings such as schools, hospitals and any publicly accessible areas outside an industrial facility’s property. Residential areas included in the assessment as NSRs were identified from available maps and satellite imagery.

1.6.5 Noise Survey

The extent of noise impacts as a result of an intruding noise depends largely on existing noise levels in an area. Higher ambient noise levels will result in less noticeable noise impacts and a smaller impact area. The opposite also holds true. Increases in noise will be more noticeable in areas with low ambient noise levels. The data from a baseline noise survey conducted by ECC on the 28th and 29th September 2023 was studied to determine baseline noise levels within the area.

1.6.6 Source Inventory

To determine the change in noise impacts associated with the project, a source inventory had to be developed. A list of equipment was provided and used to compile the source inventory. L_W's for these were calculated using predictive equations for industrial machinery as per the Handbook of Acoustics, Chapter 69, by Bruce and Moritz (1998).

1.6.7 Presentation of Results

Results are presented in isopleth form. An isopleth is a line on a map connecting points at which a given variable (in this case sound pressure, L_P) has a specified constant value. This is analogous to contour lines on a map showing terrain elevation. In the assessment of environmental noise, isopleths present lines of constant noise level as a function of distance.

1.6.8 Recommendations of Management and Mitigation

The findings of the noise specialist study informed the recommendation of suitable noise management and mitigation measures.

1.7 Management of Uncertainties

The following limitations and assumptions should be noted:

- The quantification of sources of noise was limited to the exploration phase of the project only.
- Project exploration was provided to be during day-time hours only. It was assumed that exploration would thus take place from 06:00 to 18:00.
- The environmental noise assessment focussed on the evaluation of impacts for humans.
- The attenuation modelling was conservatively undertaken assuming equal distribution of wind in all directions to assess the maximum potential noise impact.

2 Legal Requirements and Noise Level Guidelines

The IFC best practice guidelines were adopted in the absence of Namibian legislation.

2.1 International Finance Corporation Guidelines on Environmental Noise

The IFC General Environmental Health and Safety Guidelines on noise address impacts of noise beyond the property boundary of the facility under consideration and provides noise level guidelines.

The IFC states that noise impacts **should not exceed the levels presented in Table 2-1**, or result in a maximum **increase above background levels of 3 dBA** at the nearest receptor location off-site (IFC, 2007). For a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level is not detectable. Δ = 3 dBA is, therefore, a useful significance indicator for a noise impact.

It is further important to note that the IFC noise level guidelines for residential, institutional and educational receptors correspond with the SANS 10103 guidelines for urban districts.

Table 2-1: IFC noise level guidelines

Area	One Hour L_{Aeq} (dBA) 07:00 to 22:00	One Hour L_{Aeq} (dBA) 22:00 to 07:00
Industrial receptors	70	70
Residential, institutional and educational receptors	55	45

2.2 SANS 10103 Guidance on Estimating Community Response

SANS 10103 (2008) provides a useful guideline for estimating community response to an increase in the general ambient noise level caused by intruding noise. If Δ is the increase in noise level, the following criteria are of relevance:

- $\Delta \leq 0$ dB: There will be no community reaction;
- 0 dB < $\Delta \leq$ 10 dB: There will be 'little' reaction with 'sporadic complaints';
- 5 dB < $\Delta \leq$ 15 dB: There will be a 'medium' reaction with 'widespread complaints'. Δ = 10 dB is subjectively perceived as a doubling in the loudness of the noise;
- 10 dB < $\Delta \leq$ 20 dB: There will be a 'strong' reaction with 'threats of community action'; and,
- 15 dB < Δ: There will be a 'very strong' reaction with 'vigorous community action'.

The categories of community response overlap because the response of a community does not occur as a stepwise function, but rather as a gradual change.

3 Description of the Receiving Environment

This chapter provides details of the receiving acoustic environment which is described in terms of:

- Local NSRs;
- The local environmental noise propagation and attenuation potential; and
- Baseline noise levels and the existing acoustic climate.

3.1 Noise Sensitive Receptors

NSRs generally include places of residence and areas where members of the public may be affected by noise generated by proposed activities. Potential noise sensitive receptors within the study area are provided in Figure 3-1.

3.2 Environmental Noise Propagation and Attenuation Potential

3.2.1 Atmospheric Absorption and Meteorology

Atmospheric absorption and meteorological conditions have already been mentioned with regards to their role in the propagation on noise from a source to receiver (Section 1.5.4). The main meteorological parameters affecting the propagation of noise include wind speed, wind direction and temperature. These, along with other parameters such as relative humidity, air pressure, solar radiation and cloud cover affect the stability of the atmosphere and the ability of the atmosphere to absorb sound energy.

Wind speed increases with altitude. This results in the 'bending' of the path of sound to 'focus' it on the downwind side and creating a 'shadow' on the upwind side of the source. Depending on the wind speed, the downwind level may increase by a few dB but the upwind level can drop by more than 20 dB (Brüel & Kjær Sound & Vibration Measurement A/S, 2000). It should be noted that at wind speeds of more than 5 m/s, ambient noise levels are mostly dominated by wind generated noise.

Temperature gradients in the atmosphere create effects that are uniform in all directions from a source. On a sunny day with no wind, temperature decreases with altitude and creates a 'shadowing' effect for sounds. On a clear night, temperatures may increase with altitude thereby 'focusing' sound on the ground surface. Noise impacts are therefore generally more notable during the night (Figure 3-2).

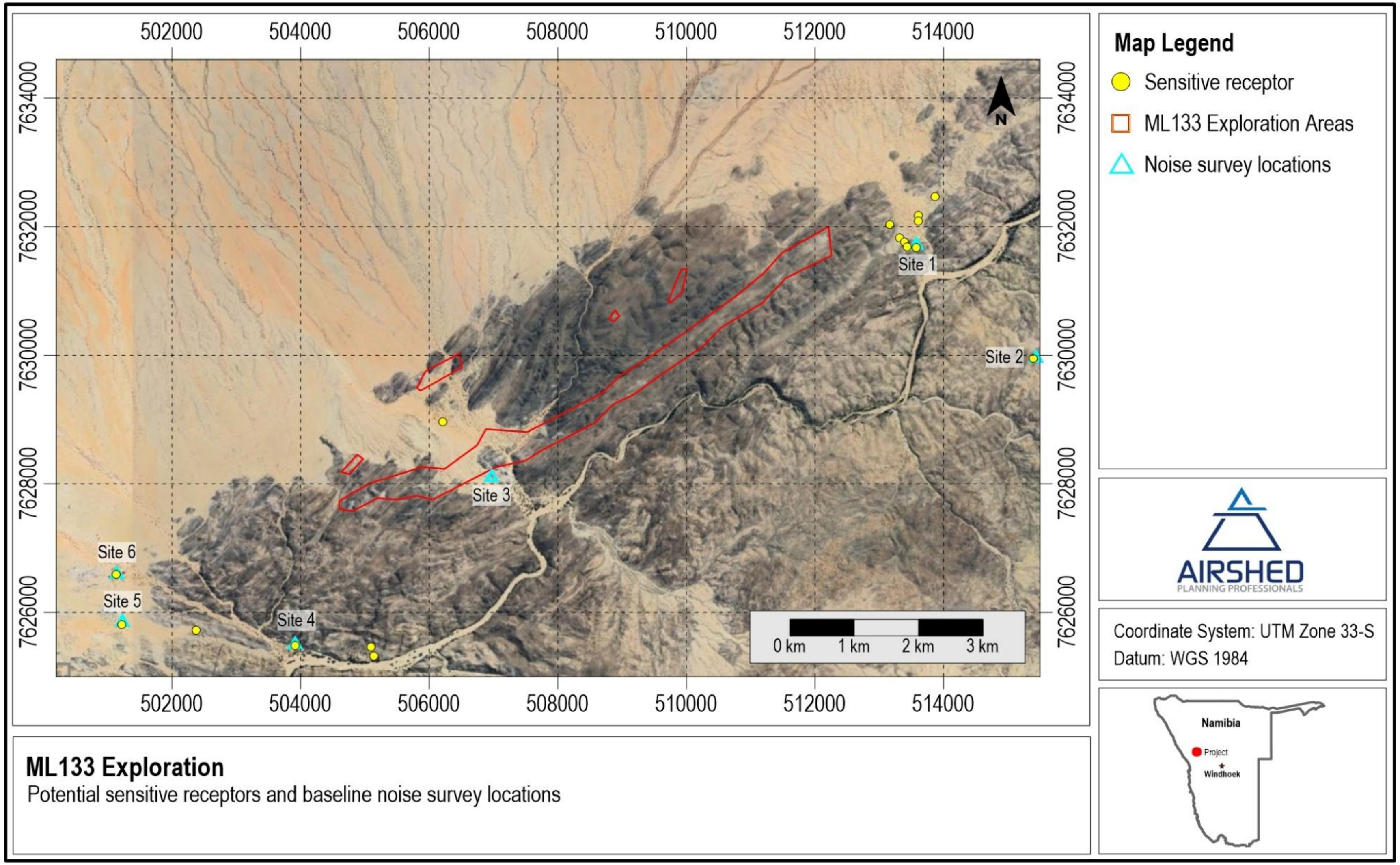


Figure 3-1: Project layout and potential noise sensitive receptors

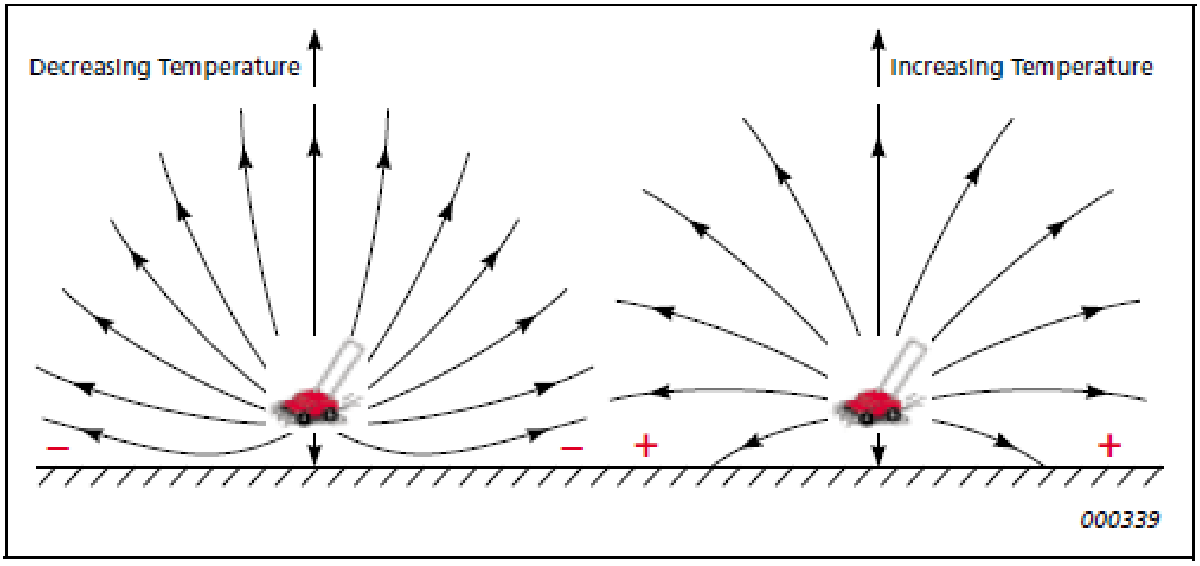


Figure 3-2: Bending the path of sound during typical day time conditions (image provided on the left) and night-time conditions (image provided on the right)

3.2.2 Terrain, Ground Absorption and Reflection

Noise reduction caused by a barrier (i.e., natural terrain, installed acoustic barrier, building) feature depends on two factors namely the path difference of a sound wave as it travels over the barrier compared with direct transmission to the receiver and the frequency content of the noise (Brüel & Kjær Sound & Vibration Measurement A/S, 2000). The topography[1] for the study area is provided in Figure 3-3.

Sound reflected by the ground interferes with the directly propagated sound. The effect of the ground is different for acoustically hard (e.g., concrete or water), soft (e.g., grass, trees or vegetation) and mixed surfaces. Ground attenuation is often calculated in frequency bands to take into account the frequency content of the noise source and the type of ground between the source and the receiver (Brüel & Kjær Sound & Vibration Measurement A/S, 2000). Based on observations, ground cover was found to be acoustically mixed.

[1] SRTM1 from the United States Geological Survey at https://earthexplorer.usgs.gov

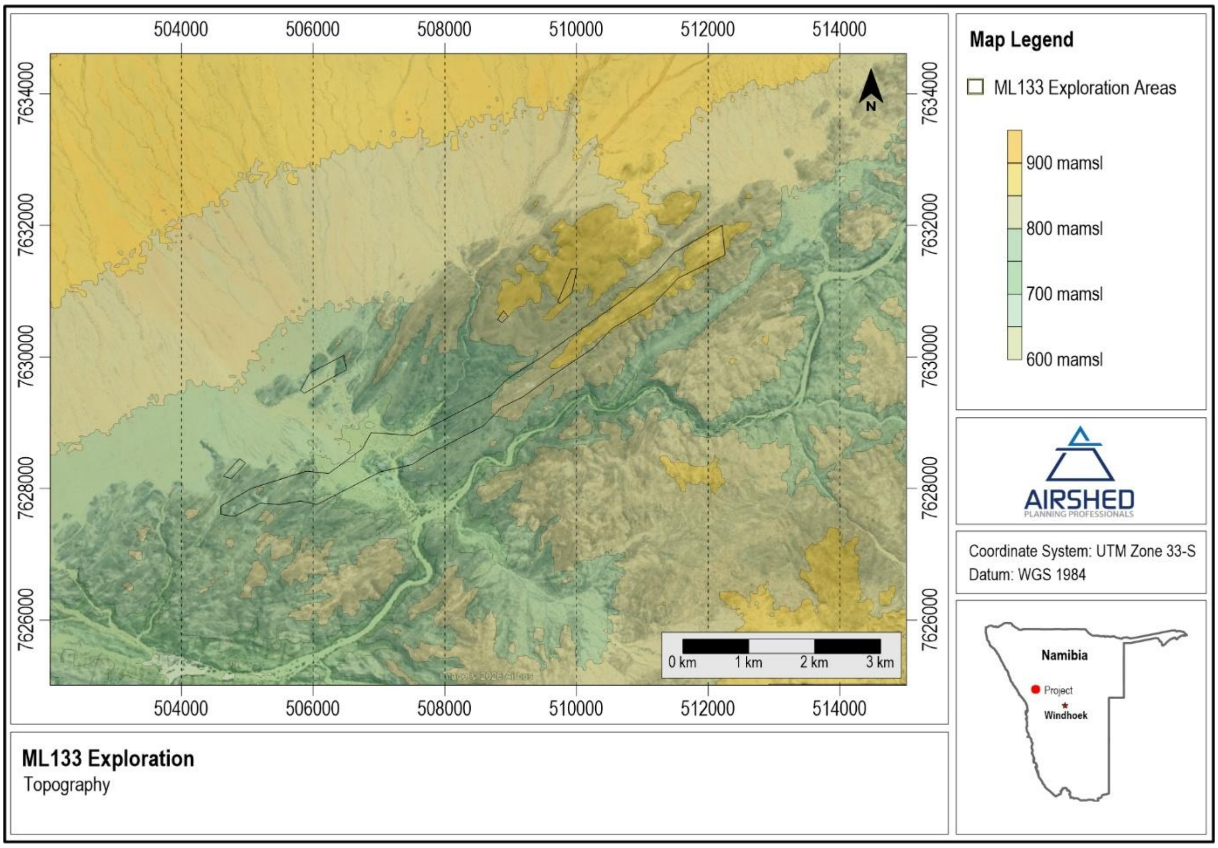


Figure 3-3: Topography for the study area

3.3 Noise Survey and Results

A total of six survey sites were selected for the baseline noise survey conducted by ECC using a SVANTEK Class 1 Sound Level Meter (SLM). Samples of 20-minute duration were conducted during the day- and night-time for each of the sampling sites. The location of the noise survey sites, which were chosen based on the closest noise sensitive receptors, are provided in Figure 3-1 and Table 3-1.

Table 3-1: Noise survey site locations

Site	Latitude	Longitude
1	-21.417280	15.130294
2	-21.432229	15.148644
3	-21.450136	15.066590
4	-21.473481	15.037469
5	-21.469505	15.012108
6	-21.463871	15.011216

The noise survey campaign was undertaken on the 28th and 29th of September 2023. The survey results are summarised in Table 3-2. For comparison purposes, the measured noise levels (L_{Aeq}) are presented in Figure 3-4 (day-time results) and Figure 3-5 (night-time results). The measured baseline noise levels were well below the IFC noise guidelines for residential areas at all 6 survey sites. From the log sheets provided for the survey, the predominant noises in the area included birds, insects, goats and vehicle traffic. For detailed time-series, frequency spectra and statistical results, the reader is referred to Appendix C.

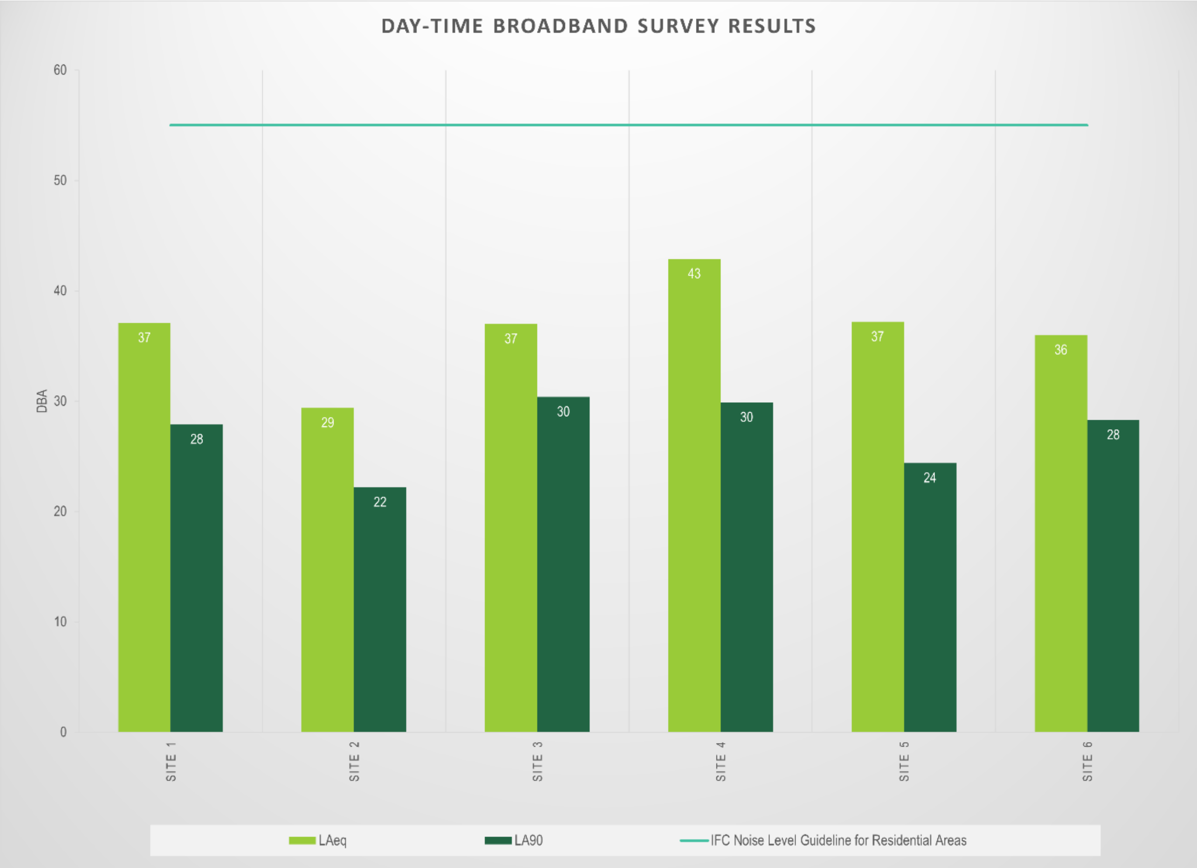


Figure 3-4: Day-time broadband survey results

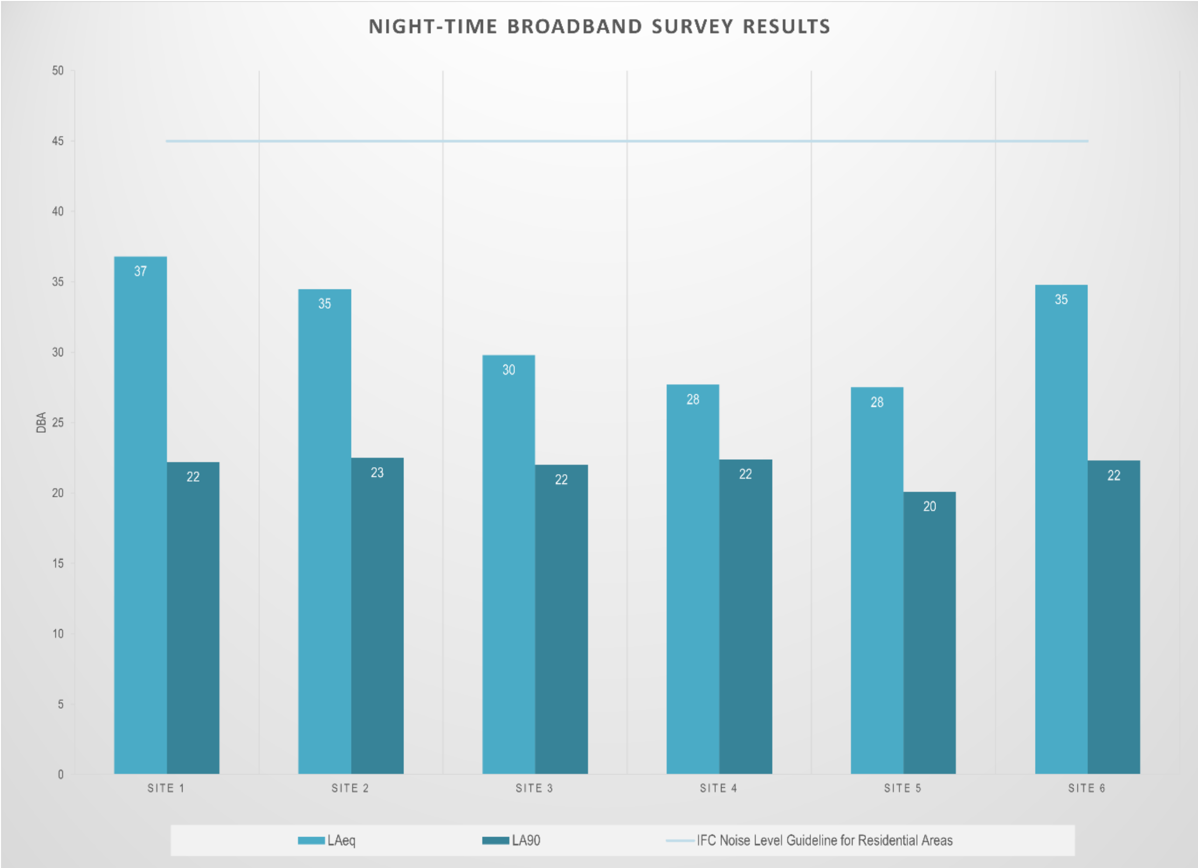


Figure 3-5: Night-time broadband survey results

Table 3-2: Project baseline environmental noise survey results summary

Sampling point	Visual and acoustic observations	General weather conditions	Time of day	Start date and time	Duration	L_{AFmax} (dBA)	L_{AFmin} (dBA)	L_{Aeq} (dBA)	L_{AIeq} (dBA)	L_{A90} (dBA)	IFC Noise Guideline to be compared to the L_{Aeq} (dBA)
Site 1	Survey site located near houses. Noise sources include birds, insects, goats and community activity.	Winds of 0.9 m/s (N); 34.1°C; 11.3% humidity; no cloud cover	Day	2023/09/28 11:18	00:20:02	69.1	25.2	37.1	52.5	27.9	55
		Winds of 0.4 m/s (W); 18°C; 54% humidity; no cloud cover	Night	2023/09/28 23:31	00:20:33	66.7	21.2	36.8	65.5	22.2	45
Site 2	Survey site is located to the north of a residential dwelling. Noise sources include birds, goats, community activity and vehicle traffic.	Winds of 1.2 m/s (N); 34°C; 9.5% humidity; no cloud cover	Day	2023/09/28 12:03	00:20:46	49.2	20.4	29.4	51.4	22.2	55
		Winds of 2.1 m/s (W); 17°C; 61% humidity; no cloud cover	Night	2023/09/29 00:08	00:20:43	69.1	21.5	34.5	50.5	22.5	45
Site 3	Survey site was located in open uncultivated land. Noise sources include birds, insects, goats, people passing and distant vehicle traffic.	Winds of 2.9 m/s (N); 30°C; 11.8% humidity; no cloud cover	Day	2023/09/28 10:01	00:20:06	63.0	26.8	37.0	56.2	30.4	55
		Winds of 0.8 m/s (W); 19°C; 60% humidity; no cloud cover	Night	2023/09/28 23:31	00:20:11	61.5	20.7	29.8	54.1	22.0	45
Site 4	Survey site was located in open uncultivated land. Noise sources	Winds of 4.1 m/s (N); 34°C; 22% humidity; no cloud cover	Day	2023/09/28 14:44	00:20:01	63.7	26.7	42.9	52.7	29.9	55

Sampling point	Visual and acoustic observations	General weather conditions	Time of day	Start date and time	Duration	L_{AFmax} (dBA)	L_{AFmin} (dBA)	L_{Aeq} (dBA)	L_{AIeq} (dBA)	L_{A90} (dBA)	IFC Noise Guideline to be compared to the L_{Aeq} (dBA)
	include birds, insects and aircraft traffic.	Winds of 0.3 m/s (W); 13°C; 58% humidity; no cloud cover	Night	2023/09/29 02:34	00:20:08	57.3	21.4	27.7	54.3	22.4	45
Site 5	Survey site was located in an open area, north of an old house. Noise sources include birds, dogs and goats.	Winds of 4.4 m/s (N); 35.6°C; 25% humidity; no cloud cover	Day	2023/09/28 14:06	00:20:08	62.5	22.0	37.2	52.8	24.4	55
		Winds of 0.5 m/s (W); 16°C; 54% humidity; no cloud cover	Night	2023/09/29 01:58	00:20:43	52.4	17.8	27.5	52.4	20.1	45
Site 6	Survey site was located near homesteads. Noise sources include birds, dogs and vehicle traffic.	Winds of 1.9 m/s (N); 35°C; 23% humidity; no cloud cover	Day	2023/09/28 13:29	00:20:02	64.1	25.1	36.0	51.7	28.3	55
		Winds of 1.7 m/s (W); 15°C; 73% humidity; no cloud cover	Night	2023/09/29 01:26	00:20:12	59.7	21.4	34.8	56.0	22.3	45

4 Impact Assessment on Human Receptors

The noise source inventory, noise propagation modelling and results for the project are discussed in the following section.

4.1 Noise Sources and Sound Power Levels

A list of equipment was provided for the project which includes 2 watercarts, 3 drill rigs, and 5 light duty vehicles. Noise sound pressure levels were calculated for all the equipment with the total octave band frequency spectra LW's provided in Table 4-1.

The reader is reminded of the non-linearity in the addition of L_W's. If the difference between the sound power levels of two sources is nil the combined sound power level is 3 dB more than the sound pressure level of one source alone. Similarly, if the difference between the sound power levels of two sources is more than 10 dB, the contribution of the quietest source can be disregarded (Brüel & Kjær Sound & Vibration Measurement A/S, 2000).

Table 4-1: Octave band frequency spectra L_W's for project activities

Equipment	Type	L_W octave band frequency spectra (dB)								L_W (dB)	L_{WA} (dBA)	Source
		63	125	250	500	1000	2000	4000	8000			
Watercart	L_W	116.1	121.1	124.1	119.1	117.1	114.1	108.1	102.1	127.8	122.4	L_W Predictions (Bruce & Moritz, 1998)
Drill Rigs	L_W	111.5	116.5	119.5	114.5	112.5	109.5	103.5	97.5	123.1	117.8	L_W Predictions (Bruce & Moritz, 1998)
Light vehicles	L_W	108.8	113.8	116.8	111.8	109.8	106.8	100.8	94.8	120.4	115.1	L_W Predictions (Bruce & Moritz, 1998)

4.2 Noise Propagation and Simulated Noise Levels

The propagation of noise generated during the exploration phase was calculated with CadnaA in accordance with ISO 9613. Site-specific acoustic parameters as discussed in Section 3.2 along with source data discussed in 4.1, were applied in the model.

The project activities will only occur during the day-time. Table 4-2 provides a summary of simulated noise levels for the project at NSRs (residential dwellings) within the study area. Simulated noise levels due to project only are also presented in the form of isopleth plots (Figure 4-1).

Noise levels due to project activities are within the IFC Noise Guideline for residential areas at all off-site NSRs (residential dwellings) (Table 4-2). For a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level is not detectable. With the exception of R6, the simulated noise impacts due to project activities is not expected to result in any perceptible change to baseline noise levels at the identified NSRs (residential dwellings) and will therefore not result in any community reactions (Table 4-4). Due to the close proximity of R6 to project activities, the increase in noise levels at may result in a 'medium' community reaction with widespread complaints.

Table 4-2: Summary of simulated noise levels (provided as dBA) due to the proposed project activities at the closest NSRs (residential dwellings)

Noise Sensitive Receptor	IFC Noise Guidelines	Project activities [a]	Baseline [b]	Increase Above Baseline [c]
R1	55	14.5	36	0.0
R2	55	13.9	37	0.0
R3	55	22.4	37	0.1
R4	55	22.6	43	0.0
R5	55	25.0	43	0.1
R6	55	48.2	37	11.5
R7	55	27.6	29	2.2
R8	55	29.5	37	0.7
R9	55	27.9	37	0.5
R10	55	26.1	37	0.3
R11	55	8.4	37	0.0

Notes:

(a) Exceedance of the IFC Noise Guideline for residential areas is provided in bold.

(b) Baseline noise levels based on the closest surveyed data to the receptor locations.

(c) Likely community response in accordance with the SANS 10103:

< 3 dBA	*< 5 dBA*	*< 10 dBA*	*< 15 dBA*	*< 20 dBA*
Change imperceptible	*No reaction*	*'Little' reaction with sporadic complaints*	*'Medium' reaction with widespread complaints*	*'Strong' to 'very strong' reaction with threats of community action or vigorous community action.*

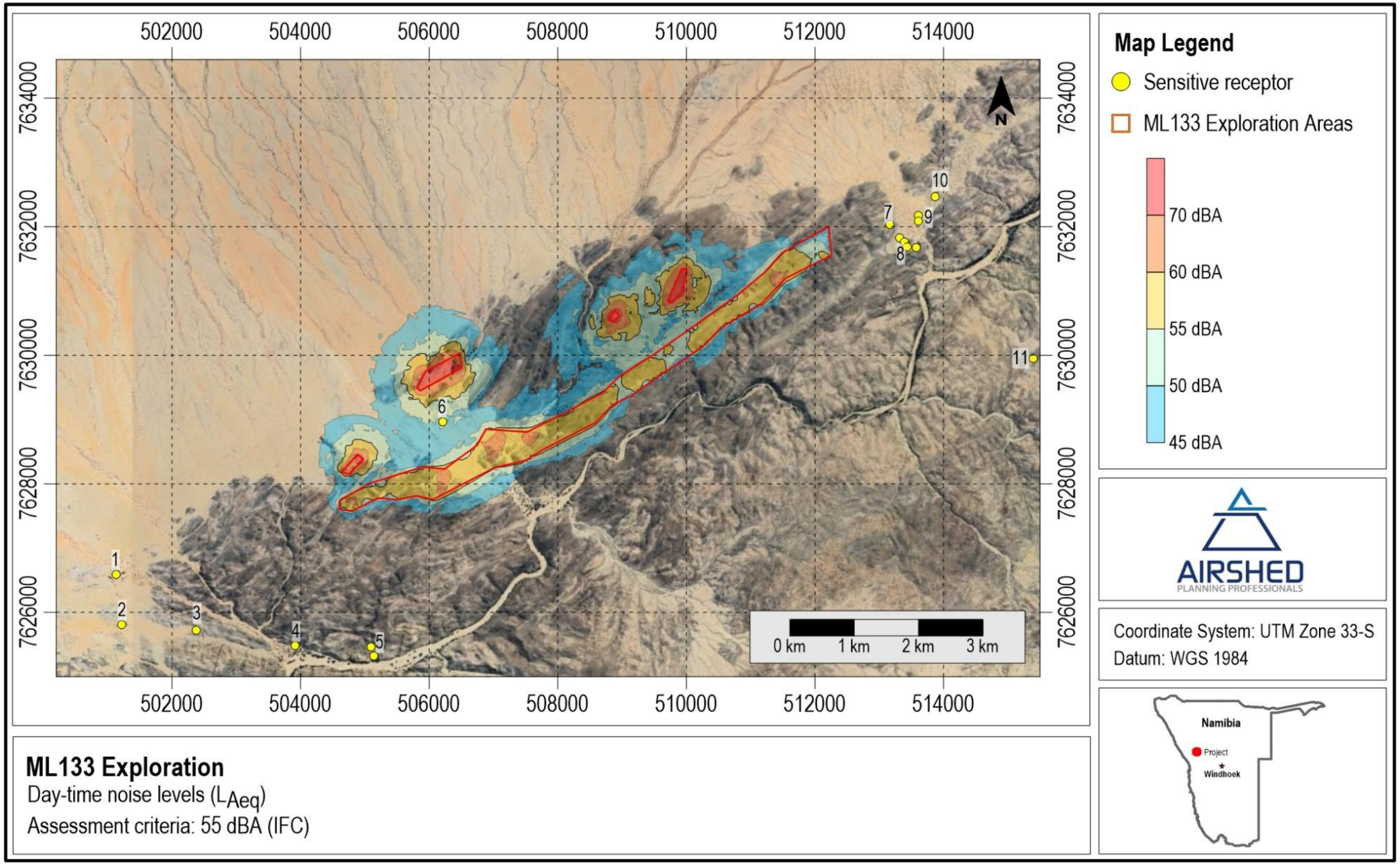


Figure 4-1: Simulated day-time noise levels due to project activities

5 Management Measures

In the quantification of noise emissions and simulation of noise levels as a result of the project, it was found that IFC environmental noise evaluation criteria for residential, educational, and institutional receptors will be met for day-time conditions at off-site NSRs for project activities.

The measures discussed in this section are measures typically applicable to industrial sites and are considered good practice by the IFC (2007) and British Standard BSI (2014).

It should be noted that not all mitigation measures are to be implemented, but should the need arise the mitigation measures as discussed in this section can be considered.

5.1 General Good Practice Measures

Good engineering and operational practices will reduce levels of annoyance. For general activities, the following good engineering practice should be applied to all project phases:

- All diesel-powered equipment and plant vehicles should be kept at a high level of maintenance. This should particularly include the regular inspection and, if necessary, replacement of intake and exhaust silencers. Any change in the noise emission characteristics of equipment should serve as a trigger for withdrawing it for maintenance.
- In managing noise specifically related to vehicle traffic, efforts should be directed at:
  - Minimising individual vehicle engine, transmission, and body noise/vibration. This is achieved through the implementation of an equipment maintenance program.
  - Maintain road surfaces regularly to repair potholes etc.
  - Keep all roads well maintained and avoid steep inclines or declines to reduce acceleration/brake noise.
  - Avoid unnecessary idling times at all times.
- Project activities should be limited to day-time hours.
- A noise complaints register must be kept.

5.2 Activities near Receptors

When exploration activities are close to receptors, activities should be clearly communicated, coordinated and scheduled with the residents of this homestead.

5.1 Monitoring

In the event that noise related complaints are received short term ambient noise measurements should be conducted as part of investigating the complaints. The results of the measurements should be used to inform any follow up interventions. The investigation of complaints should include an investigation into equipment or machinery that likely result or resulted in noise levels annoying to the community. This could be achieved with source noise measurements.

The following procedure should be adopted for all noise surveys:

- Any surveys should be designed and conducted by a **trained specialist**.
- Sampling should be carried out using a **Type 1** Sound Level Meter (SLM) that meets all appropriate International Electro Technical Commission (IEC) standards and is subject to **annual calibration** by an accredited laboratory.
- The **acoustic sensitivity of the SLM should be tested** with a portable acoustic calibrator before and after each sampling session.
- Samples sufficient for statistical analysis should be taken with the use of portable SLM's capable of logging data continuously over the time period. Samples representative of the day- and night-time acoustic environment should be taken.
- The following acoustic indices should be recoded and reported: L_{Aeq} (T), statistical noise level $L_{A90,}$ L_{AFmin} and $L_{AFmax,}$ octave band or 3rd octave band frequency spectra.
- The SLM should be located approximately 1.5 m above the ground and no closer than 3.5 m to any reflecting surface.
- Efforts should be made to ensure that measurements are not affected by the residual noise and extraneous influences, e.g., wind, electrical interference and any other non-acoustic interference, and that the instrument is operated under the conditions specified by the manufacturer. It is good practice to avoid conducting measurements when the wind speed is more than 5 m/s, while it is raining or when the ground is wet.
- A detailed log and record should be kept. Records should include site details, weather conditions during sampling and observations made regarding the acoustic environment of each site.

6 Conclusion

It is recommended that when exploration activities are close to receptors, activities should be clearly communicated, coordinated and scheduled with the residents of this homestead.

Given that the noise levels due to project exploration activities are below IFC noise guidelines, it is the specialist opinion that, from an environmental noise perspective, the project may be authorised.

7 References

Bruce, R. D. & Moritz, C. T., 1998. Sound Power Level Predictions for Industrial Machinery. In: M. J. Crocker, ed. *Handbook of Acoustics.* Hoboken: John Whiley & Sons, Inc, pp. 863-872.

Brüel & Kjær Sound & Vibration Measurement A/S, 2000. *www.bksv.com.* [Online] Available at: http://www.bksv.com [Accessed 14 October 2011].

IFC, 2007. *General Environmental, Health and Safety Guidelines,* s.l.: s.n.

SANS 10103, 2008. *The measurement and rating of environmental noise with respect to annoyance and to speech communication,* Pretoria: Standards South Africa.

SANS 10103, 2008. *The Measurement and Rating with Environemntal Noise with Respect to Annoyance and to Speech Communication,* Pretoria: Standards South Africa.

Appendix A – Specialist Curriculum Vitae

CURRICULUM VITAE	RENEÉ VON GRUENEWALDT

FULL CURRICULUM VITAE

Name of Firm	Airshed Planning Professionals (Pty) Ltd
Name of Staff	Reneé von Gruenewaldt (*nee* Thomas)
Profession	Air Quality and Environmental Noise Scientist
Position	Principal consultant
Date of Birth	13 May 1978
Years with Firm	Since January 2002
Nationalities	South African

MEMBERSHIP OF PROFESSIONAL SOCIETIES

- Registered Professional Natural Scientist (Registration Number 400304/07) with the South African Council for Natural Scientific Professions (SACNASP)
- Member of the National Association for Clean Air (NACA)

KEY QUALIFICATIONS

Reneé von Gruenewaldt (Air Quality Scientist): Reneé joined Airshed Planning Professionals (Pty) Ltd (previously known as Environmental Management Services cc) in 2002. She has, as a Specialist, attained over twenty (20) years of experience in the Earth and Natural Sciences sector in the field of Air Quality and nine (9) years of experience in the field of environmental noise assessments. As an environmental practitioner, she has provided solutions to both large-scale and smaller projects within the mining, minerals, and process industries.

She has developed technical and specialist skills in various air quality modelling packages including the AMS/EPA Regulatory Models (AERMOD and AERMET), UK Gaussian plume model (ADMS), EPA Regulatory puff-based model (CALPUFF and CALMET), puff-based HAWK model and line-based models, Lagrangian GRAL model. Her experience with air emission models includes Tanks 4.0 (for the quantification of tank emissions), WATER9 (for the quantification of wastewater treatment works) and GasSim (for the quantification of landfill emissions). Noise propagation modelling proficiency includes CONCAWE, South African National Standards (SANS 10210) for calculating and predicting road traffic noise and CadnaA for propagation of industrial, road and rail noise sources.

Having worked on projects throughout Africa (i.e., South Africa, Mozambique, Malawi, Kenya, Angola, Democratic Republic of Congo, Namibia, Madagascar and Egypt for Air Quality Impact Assessments and Mozambique, Namibia, Botswana, Kenya, Ghana, Suriname and Afghanistan for Environmental Noise Impact Assessments) Reneé has developed a broad experience base. She has a good understanding of the laws and regulations associated with ambient air quality and emission limits in South Africa and various other African countries, as well as the World Bank Guidelines, European Community Limits and World Health Organisation.

RELEVANT EXPERIENCE (AIR QUALITY)

Mining and Ore Handling

Reneé has undertaken numerous air quality impact assessments and management plans for coal, platinum, uranium, copper, cobalt, chromium, fluorspar, bauxite, manganese and mineral sands mines. These include: compilation of emissions databases for Landau and New Vaal coal collieries (SA), impact assessments and management plans for numerous mines over Mpumalanga (viz. Schoonoord, Belfast, Goedgevonden, Mbila, Evander South, Driefontein, Hartogshoop, Belfast, New Largo, Geluk, etc.), Mmamabula Coal Colliery (Botswana), Moatize Coal Colliery (Mozambique), Revuboe Coal Colliery (Mozambique), Toliera Sands Heavy Minerals Mine and Processing (Madagascar), Corridor Sands Heavy Minerals Mine monitoring assessment, El Burullus Heavy Minerals Mine and processing (Egypt), Namakwa Sands Heavy Minerals Mine (SA), Tenke Copper Mine and Processing Plant (DRC), Rössing Uranium (Namibia), Lonmin platinum mines including operations at Marikana, Baobab, Dwaalkop and Doornvlei (SA), Impala Platinum (SA), Pilannesburg Platinum (SA), Aquarius Platinum, Hoogland Platinum Mine (SA), Tamboti PGM Mine (SA), Sari Gunay Gold Mine (Iran), chrome mines in the Steelpoort Valley (SA), Mecklenburg Chrome Mine (SA), Naboom Chrome Mine (SA), Kinsenda Copper Mine (DRC), Kassinga Mine (Angola) and Nokeng Flourspar Mine (SA), etc.

Mining monitoring reviews have also been undertaken for Optimum Colliery's operations near Hendrina Power Station and Impunzi Coal Colliery with a detailed management plan undertaken for Morupule (Botswana) and Glencor (previously known as Xstrata Coal South Africa).

Air quality assessments have also been undertaken for mechanical appliances including the Durban Coal Terminal and Nacala Port (Mozambique) as well as rail transport assessments including BHP-Billiton Bauxite transport (Suriname), Nacala Rail Corridor (Mozambique and Malawi), Kusile Rail (SA) and WCL Rail (Liberia).

Metal Recovery

Air quality impact assessments have been carried out for Highveld Steel, Scaw Metals, Lonmin's Marikana Smelter operations, Saldanha Steel, Tata Steel, Afro Asia Steel and Exxaro's Manganese Pilot Plant Smelter (Pretoria).

Chemical Industry

Comprehensive air quality impact assessments have been completed for NCP (including Chloorkop Expansion Project, Contaminated soils recovery, C3 Project and the 200T Receiver Project), Revertex Chemicals (Durban), Stoppani Chromium Chemicals, Foskor (Richards Bay), Straits Chemicals (Coega), Tenke Acid Plant (DRC), and Omnia (Sasolburg).

Petrochemical Industry

Numerous air quality impact assessments have been completed for Sasol (including the postponement/exemption application for Synfuels, Infrachem, Natref, MIBK2 Project, Wax Project, GTL Project, re-commissioning of boilers at Sasol Sasolburg and Ekandustria), Engen Emission Inventory Functional Specification (Durban), Sapref refinery (Durban), Sasol (at Elrode) and Island View (in Durban) tanks quantification, Petro SA and Chevron (including the postponement/exemption application).

Pulp and Paper Industry

Air quality studies have been undertaken or the expansion of Mondi Richards Bay, Multi-Boiler Project for Mondi Merebank (Durban), impact assessments for Sappi Stanger, Sappi Enstra (Springs), Sappi Ngodwana (Nelspruit) and Pulp United (Richards Bay).

Power Generation

Air quality impact assessments have been completed for numerous Eskom coal fired power station studies including the ash expansion projects at Kusile, Kendal, Hendrina, Kriel and Arnot; Fabric Filter Plants at Komati, Grootvlei, Tutuka, Lethabo and Kriel Power Stations; the proposed Kusile, Medupi (including the impact assessment for the Flue Gas Desulphurization) and Vaal South Power Stations. Reneé was also involved and the cumulative assessment of the existing and return to service Eskom power stations assessment and the optimization of Eskom's ambient air quality monitoring network over the Highveld.

In addition to Eskom's coal fired power stations, various Eskom nuclear power supply projects have been completed including the air quality assessment of Pebble Bed Modular Reactor and nuclear plants at Duynefontein, Bantamsklip and Thyspunt.

Apart from Eskom projects, power station assessments have also been completed in Kenya (Rabai Power Station) and Namibia (Paratus Power Plant).

Waste Disposal

Air quality impact assessments, including odour and carcinogenic and non-carcinogenic pollutants were undertaken for the Waste Water Treatment Works in Magaliesburg, proposed Waterval Landfill (near Rustenburg), Tutuka Landfill, Mogale General Waste Landfill (adjacent to the Leipardsvlei Landfill), Cape Winelands District Municipality Landfill, the Tsoeneng Landfill (Lesotho) and the FG Landfill (near the Midstream Estate). Air quality impact assessments have also been completed for the BCL incinerator (Cape Town), the Ergo Rubber Incinerator and the Ecorevert Pyrolysis Plant.

Cement Manufacturing

Impact assessments for ambient air quality have been completed for the Holcim Alternative Fuels Project (which included the assessment of the cement manufacturing plants at Ulco and Dudfield as well as a proposed blending platform in Roodepoort).

Management Plans

Reneé undertook the quantification of the baseline air quality for the first declared Vaal Triangle Airshed Priority Area. This included the establishment of a comprehensive air pollution emissions inventory, atmospheric dispersion modelling, focusing on impact area "hotspots" and quantifying emission reduction strategies. The management plan was published in 2009 (Government Gazette 32263).

Reneé has also been involved in the Provincial Air Quality Management Plan for the Limpopo Province.

RELEVANT EXPERIENCE (GREENHOUSE GAS EMISSION FOOT-PRINTING AND CLIMATE CHANGE IMPACT STATEMENTS)

Mining and Tailings Storage Facilities

Reneé has quantified the direct and indirect (Scope 2 and Scope 3) emissions for numerous mines over the highveld of South Africa and the Democratic Republic of Congo. She has also assessed the climate risks and vulnerabilities of the project and surrounding communities due to increasing ambient temperatures, water scarcity, risk of intense storms.

Gas to Power Plants

Reneé has quantified the direct and indirect (Scope 2 and Scope 3) emissions for gas to power plants proposed for South Africa. She has also assessed the climate risks and vulnerabilities of the project and surrounding communities due to increasing ambient temperatures, water scarcity, risk of intense storms.

RELEVANT EXPERIENCE (NOISE)

Mining

Reneé has undertaken numerous environmental noise assessments for mining operations. These include environmental noise impact assessments including baseline noise surveys for numerous coal, platinum, manganese, tin and zinc mines. Projects include, but are not limited to, Balama (Mozambique), Masama Coal (Botswana), Lodestone (Namibia), Osino (Namibia), Kurmuk (Ethiopia), Gamsberg (SA), Prieska (SA), Kolomela (SA), Heuningkranz (SA), Syferfontein (SA), South 32 (SA), Mamatwan (SA), Alexander (SA) and Marula Platinum Mine (SA), etc.

Power Generation

Environmental noise assessments have been completed for numerous Eskom coal fired power station studies in SA including the Kriel Fabric Filter Plant, Kendal ash facility, Medupi ash facility. Apart from Eskom projects, power plant assessments have also been completed in Botswana (Morupule), Kenya (geothermal power plants), Suriname (EBS power plant) and SA (combined cycle power plants and thermal power plants).

Process Operations

Environmental noise assessments have been undertaken for various process operations including waste disposal facilities (Bon Accord in Gauteng), bottling and drink facilities (Imali and Isanti Project in Gauteng) and Smelter (Gamsberg in Northern Cape).

Transport

An environmental noise assessment was completed for the Obetsebi road expansion and flyover project in Ghana, the Scorpion Zinc Mine transport route in Namibia and the Sisian-Kajaran (North-South Corridor) Road Project in Armenia.

Gas Pipelines

An environmental noise assessment was completed for the Sheberghan gas pipeline in Afghanistan.

Baseline Noise Surveys

Baseline noise surveys have been undertaken for numerous mining and process operation activities (including Raumix quarries, Kolomela and Sibanye Stillwater Platinum Mines (SA)) in support of onsite Environmental Management Programmes.

OTHER EXPERIENCE (2001)

Research for B.Sc. Honours degree was part of the "Highveld Boundary Layer Wind" research group and was based on the identification of faulty data from the Majuba Sodar. The project was THRIP funded and was a joint venture with the University of Pretoria, Eskom and Sasol (2001).

EDUCATION

M.Sc. Earth Sciences	University of Pretoria, RSA, Cum Laude (2009) Title: *An Air Quality Baseline Assessment for the Vaal Airshed in South Africa*
B.Sc. Hons. Earth Sciences	University of Pretoria, RSA, Cum Laude (2001) Environmental Management and Impact Assessments
B.Sc. Earth Sciences	University of Pretoria, RSA, (2000) Atmospheric Sciences: Meteorology

ADDITIONAL COURSES

CALMET/CALPUFF	Presented by the University of Johannesburg, RSA (March 2008)
Air Quality Management	Presented by the University of Johannesburg, RSA (March 2006)

COUNTRIES OF WORK EXPERIENCE

South Africa, Mozambique, Botswana, Ghana, Suriname, Afghanistan, Malawi, Liberia, Kenya, Angola, Democratic Republic of Congo, Ethiopia, Afghanistan, Lesotho, Namibia, Madagascar, Egypt, Suriname and Iran.

EMPLOYMENT RECORD

January 2002 - Present

Airshed Planning Professionals (Pty) Ltd, (previously known as Environmental Management Services cc until March 2003), Principal Air Quality and Environmental Noise Scientist, Midrand, South Africa.

2001

University of Pretoria, Demi for the Geography and Geoinformatics department and a research assistant for the Atmospheric Science department, Pretoria, South Africa.

Department of Environmental Affairs and Tourism, assisted in the editing of the Agenda 21 document for the world summit (July 2001), Pretoria, South Africa.

1999 - 2000

The South African Weather Services, vacation work in the research department, Pretoria, South Africa.

CONFERENCE AND WORKSHOP PRESENTATIONS AND PAPERS

- Understanding the Synoptic Systems that lead to Strong Easterly Wind Conditions and High Particulate Matter Concentrations on The West Coast of Namibia, H Liebenberg-Enslin, R von Gruenewaldt, H Rauntenbach and L Burger. National Association for Clean Air (NACA) conference, October 2017.
- Topographical Effects on Predicted Ground Level Concentrations using AERMOD, R.G. von Gruenewaldt. National Association for Clean Air (NACA) conference, October 2011.
- Emission Factor Performance Assessment for Blasting Operations, R.G. von Gruenewaldt. National Association for Clean Air (NACA) conference, October 2009.
- Vaal Triangle Priority Area Air Quality Management Plan – Baseline Characterisation, R.G. Thomas, H Liebenberg-Enslin, N Walton and M van Nierop. National Association for Clean Air (NACA) conference, October 2007.
- A High-Resolution Diagnostic Wind Field Model for Mesoscale Air Pollution Forecasting, R.G. Thomas, L.W. Burger, and H Rautenbach. National Association for Clean Air (NACA) conference, September 2005.
- Emissions Based Management Tool for Mining Operations, R.G. Thomas and L.W. Burger. National Association for Clean Air (NACA) conference, October 2004.
- An Investigation into the Accuracy of the Majuba Sodar Mixing Layer Heights, R.G. Thomas. Highveld Boundary Layer Wind Conference, November 2002.

LANGUAGES

	Speak	Read	Write
English	Excellent	Excellent	Excellent
Afrikaans	Fair	Fair	Fair

CERTIFICATION

I, the undersigned, certify that to the best of my knowledge and belief, these data correctly describe me, my qualifications, and my experience.

____________________ 11/02/2026 ____________________

Signature of staff member Date (Day / Month / Year)

Full name of staff member: Reneé Georgeinna von Gruenewaldt

Appendix B – Declaration of Independence

DECLARATION OF INDEPENDENCE - PRACTITIONER

Name of Practitioner: Reneé von Gruenewaldt
Name of Registration Body: South African Council for Natural Scientific Professions
Professional Registration No.: 400304/07

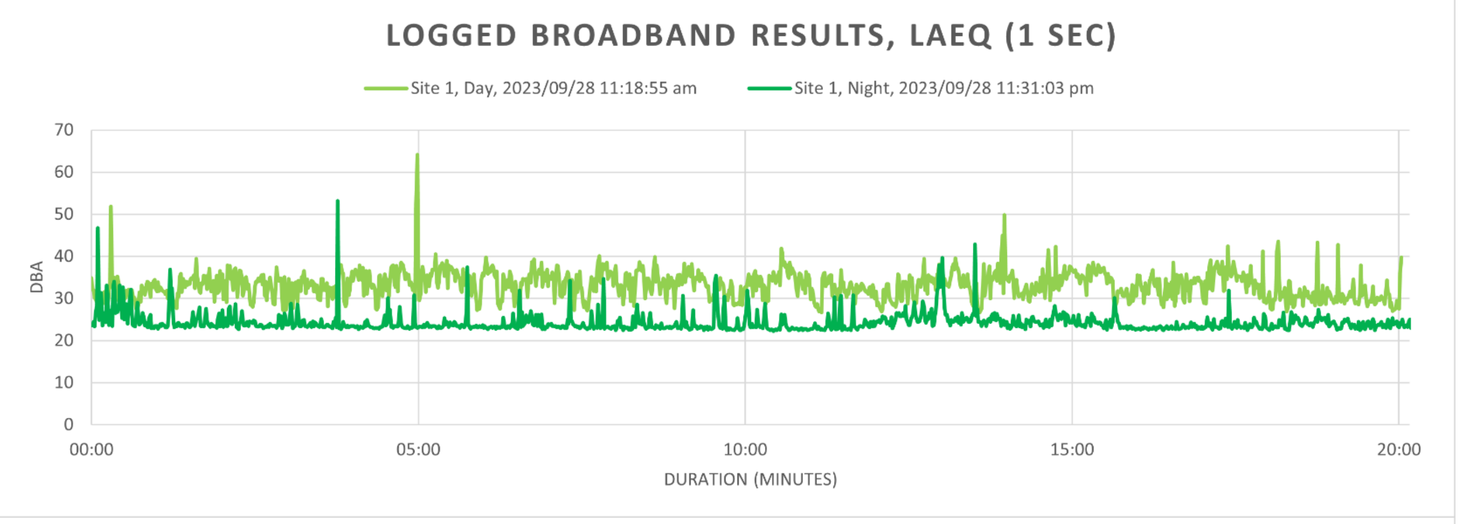
Declaration of independence and accuracy of information provided:
Environmental Noise Impact Assessment for the ML133, Namibia

I, René von Gruenewaldt, declare that I am independent of the applicant. I have the necessary expertise to conduct the assessments required for the report and will perform the work relating the application in an objective manner, even if this results in views and findings that are not favourable to the applicant. I will disclose to the applicant and the air quality officer all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the air quality officer. The additional information provided in this atmospheric impact report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an air quality officer is a criminal offence in terms of section 51(1)(g) of this Act.

Signed at Pretoria on this 31st of March 2026.

SIGNATURE
Principal Noise Scientist
CAPACITY OF SIGNATORY

Appendix C – Time-Series, Statistical, and Frequency Spectrum Results



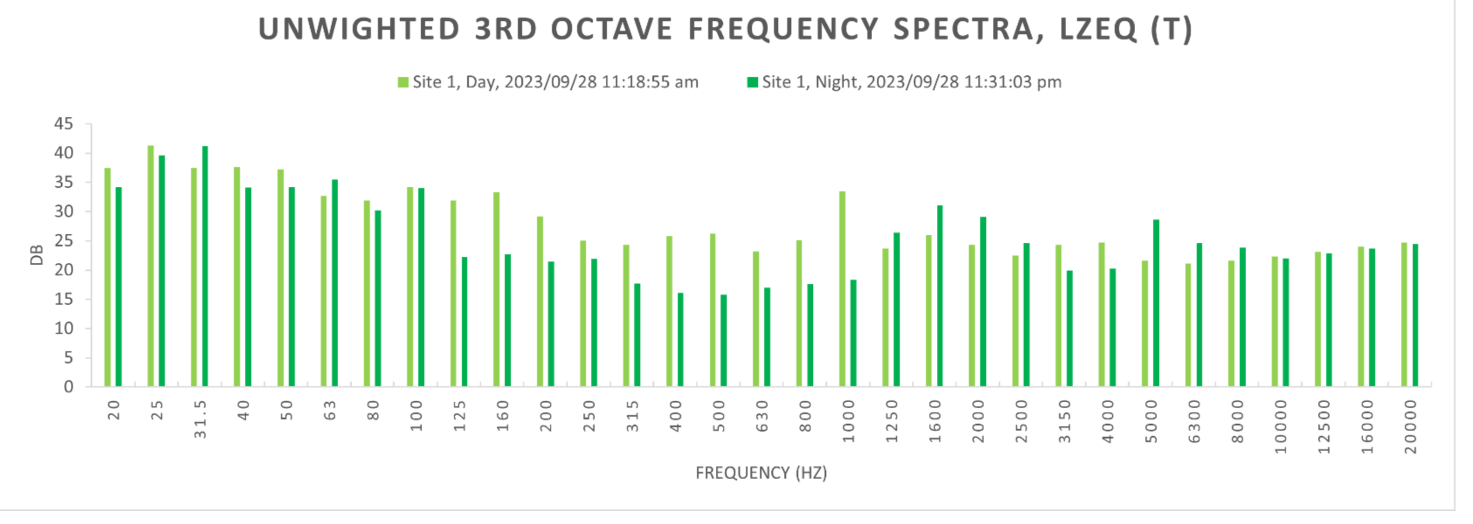


Figure C-1: Detailed noise survey results for Site 1

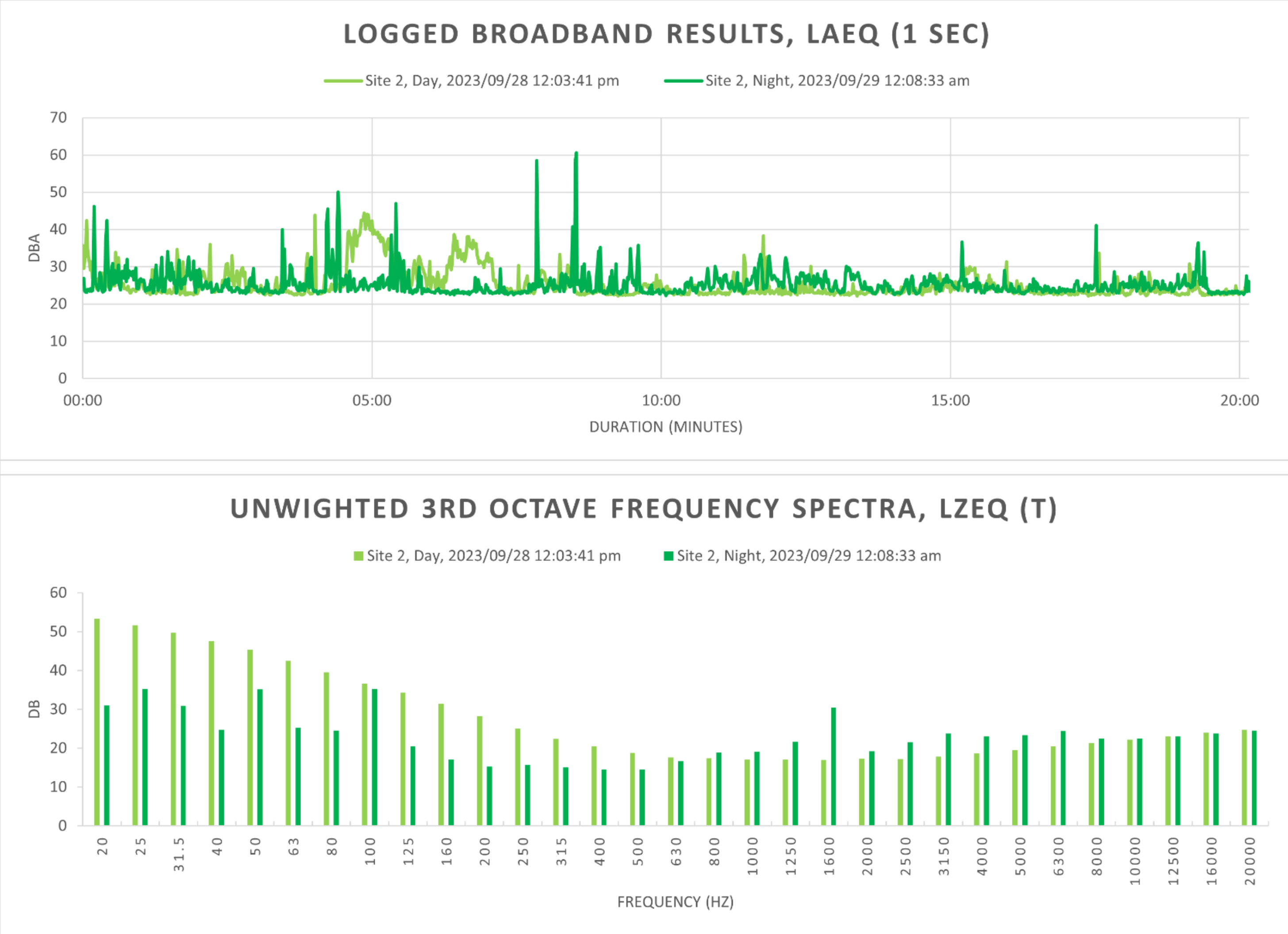


Figure C-2: Detailed noise survey results for Site 2

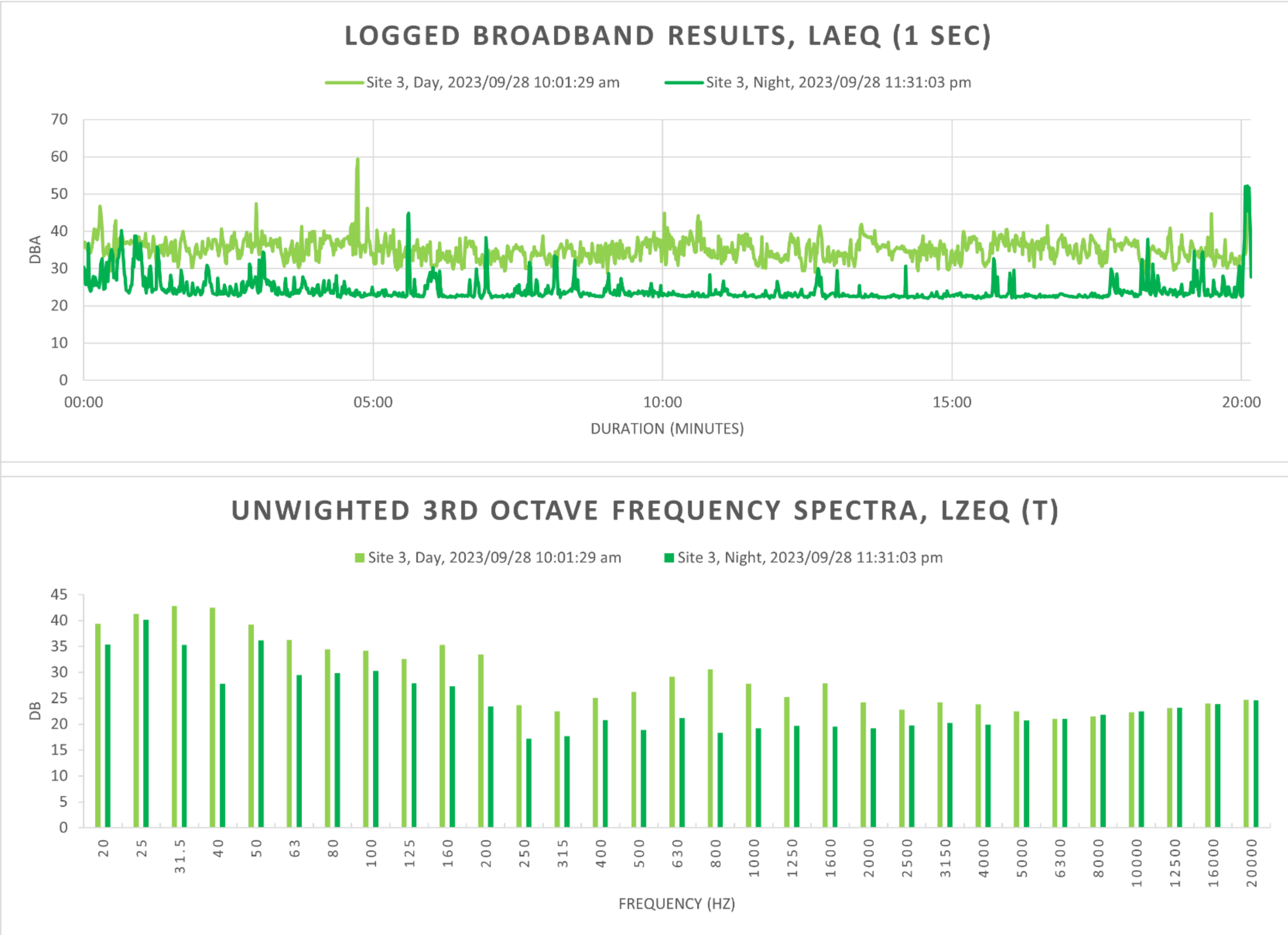


Figure C-3: Detailed noise survey results for Site 3

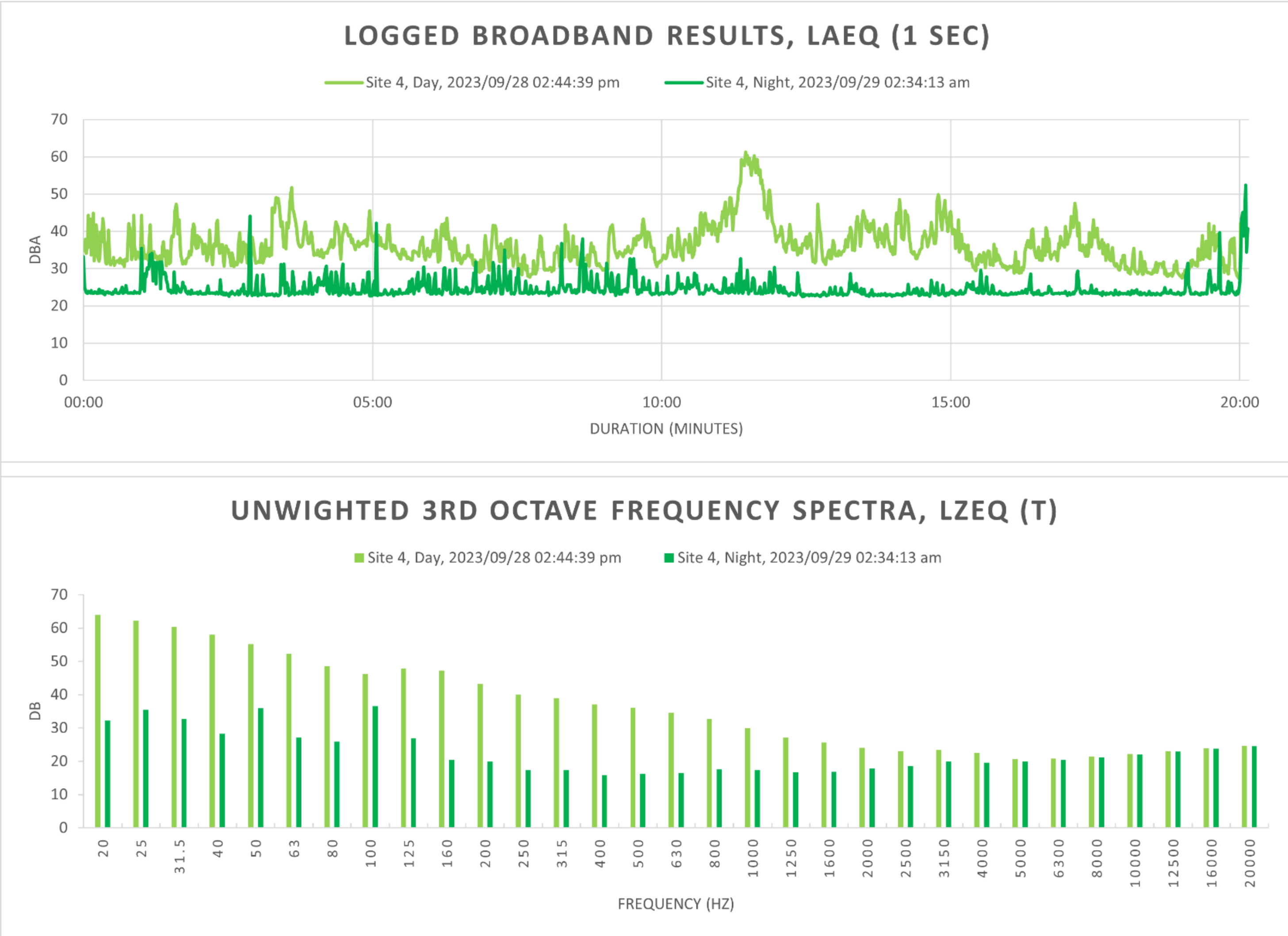
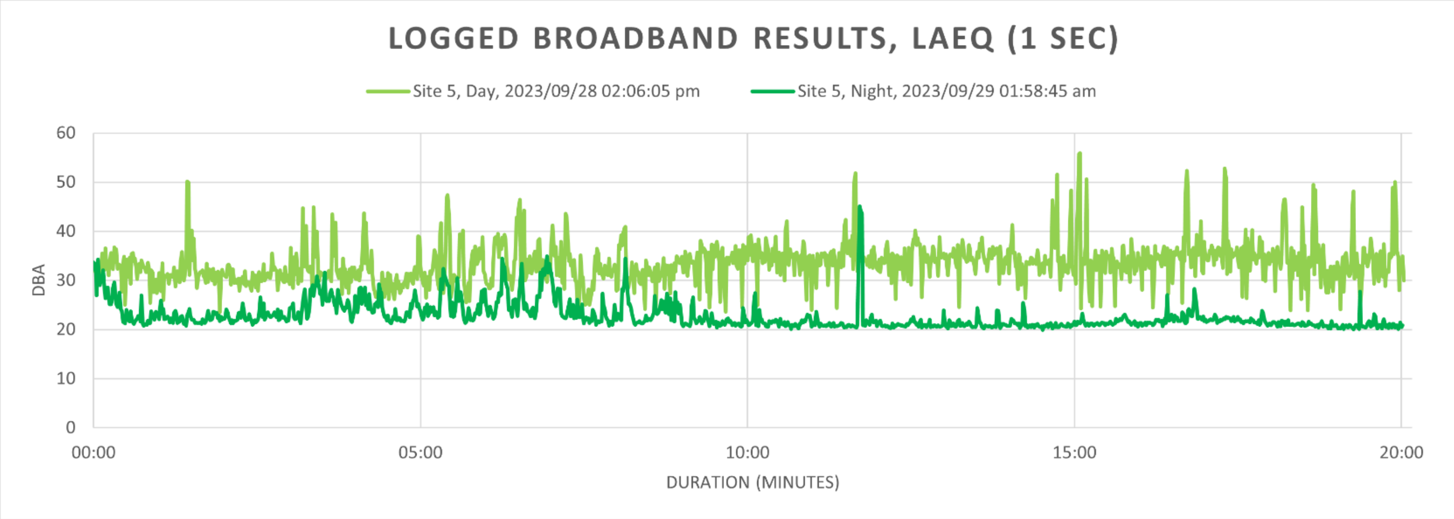


Figure C-4: Detailed noise survey results for Site 4



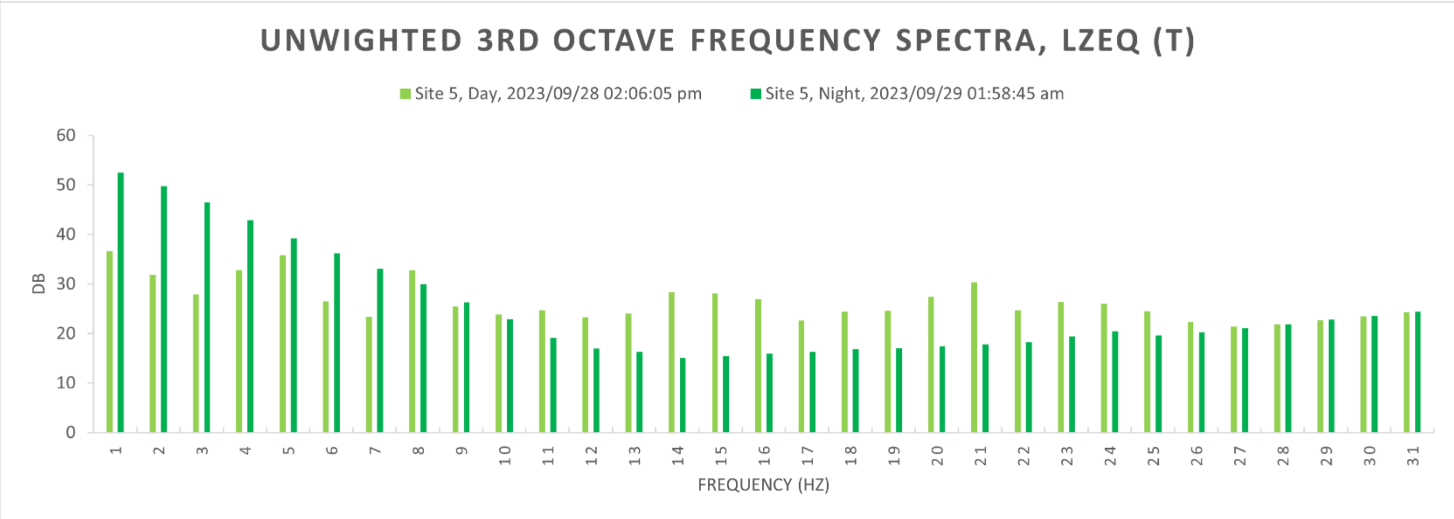


Figure C-5: Detailed noise survey results for Site 5

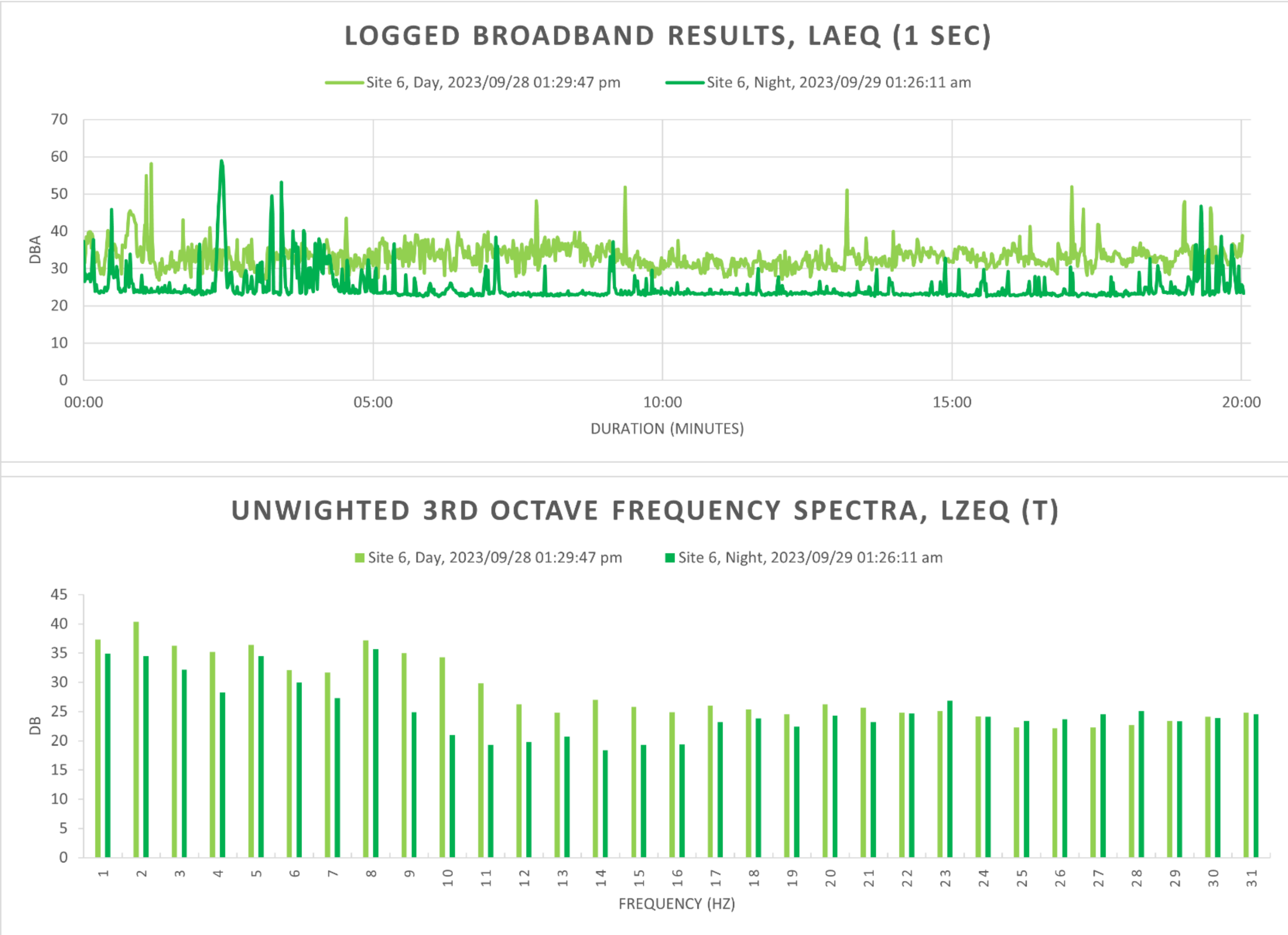


Figure C-6: Detailed noise survey results for Site 6