Environmental Noise Impact Assessment for the Motuoane Exploration Right Application (ER386), Free State Province – Scoping Phase

Project done on behalf of **EIMS (Pty) Ltd**

Project Compiled by:

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Revision Record

Revision Number	Date	Reason for Revision
Rev 1	February 2025	For client review
Rev 2	February 2025	
Rev 3	April 2025	Updated to remove target areas 3 & 4

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LIST OF ACRONYMS AND SYMBOLS

Airshed	Airshed Planning Professionals (Pty) Ltd
AWD	Accelerated Weight Drop Survey
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.
DFFE	Department of Forestry, Fisheries and the Environment
EA	Environmental Authorisation
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EIMS	Environmental Impact Management Services (Pty) Ltd
ER	Exploration Right
GG	Government gazette
GN	Government notice
ha	Hectare
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
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_{AIeq} (T)	The impulse corrected A-weighted equivalent sound pressure level, where T indicates the time over which the noise is averaged (calculated or measured) (in dBA)
$L_{Req,d}$	The L_{Aeq} rated for impulsive sound and tonality in accordance with SANS 10103 for the day-time period, i.e., from 06:00 to 22:00.
$L_{Req,n}$	The L_{Aeq} rated for impulsive sound and tonality in accordance with SANS 10103 for the night-time period, i.e., from 22:00 to 06:00.
$L_{R,dn}$	The L_{Aeq} rated for impulsive sound and tonality in accordance with SANS 10103 for the period of a day and night, i.e. 24 hours, and wherein the $L_{Req,n}$ has been weighted with 10dB in order to account for the additional disturbance caused by noise during the night.
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
LNG	Liquid Natural Gas
m	Metre
mm	Millimetre
NEMAQA	National Environmental Management: Air Quality Act
NIA	Noise Impact Assessment
NSRs	Noise sensitive receptors
PEGs	Propelled Energy Generators
PR	Production Right
SABS	South African Bureau of Standards
SANS	South African National Standards

SLM	Sound level meter
SRTM	Shuttle Radar Topography Mission
TR	Thungela Resources
USGS	United States Geological Survey
WHO	World Health Organisation

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1 INTRODUCTION

Motuoane proposes to explore all saleable gases including but not limited to methane, carbon dioxide, helium, and nitrogen in the licensed area. Due to the large area and complex exploration methodology, the Exploration Right (ER) will be required for an initial period of three years with the option to renew three additional periods of two years resulting in a total of nine years. The accepted application for an exploration right (ER386) is located over an area of approximately 60 000 hectares (ha), covering three hundred and eighty-five (385) farm portions near the towns of Virginia, Welkom, Hennenman and Odendaalsrus in the Free State Province.

The main activities are core / percussion exploration drilling and seismic survey activities. The proposed approach is to first determine and map the geographic extent of all boreholes currently emitting gas on and near the ER area. Then measure rates and monitor pressures where possible and perform gas composition analysis. The geophysical wireline logging of existing boreholes (where possible) will include monitoring of water levels. If no existing gas emitting boreholes are identified near a target area, new drilling activities are proposed within that area using percussion or rotary drilling method. Although up to eleven (11) target drilling areas (TA) with 500 m buffer (1 km corridor) within the exploration right may be undertaken over the 9-year period, the current Works Program caters for only three (3) drilling wells. It must be noted that there may be a single, multiple or no drilling activities within some of the target drilling areas. Should more than 3 drilling wells be required within the ER, the current Works Program will be required to be updated accordingly. The majority of the drilling target areas are proposed within the western central area of the exploration right on the agricultural fields between Saaiplaas, Bronville, Thabong and Whites. Two target drilling areas are located in the south of ER386, approximately 7 km southeast of Meloding while TA11 is located approximately 4 km northeast of Phomolong on the eastern boundary of ER386 and TA9 and TA13 are located approximately 20 km northeast of Riebeeckstad on the northern boundary. Each exploration well will have an overall depth of approximately 650 m and a maximum width of 350 mm, commencing with a 6 m x 323 mm spud hole section, followed by 80 m x 254 mm conductor hole section, then an intermediate hole section of 450 m x 203 mm and finally an open hole section of 650 m x 144 mm. The actual casing sizes and configurations will vary depending on the specific geological characteristics and functional requirements. Each borehole will be steel cased and have cement barriers to prevent leaks as well as plugged at the end of exploration to prevent groundwater seepage.

The seismic survey activities are proposed throughout the exploration right as and when necessary. Motuoane will search records at the Council for Geoscience and the Petroleum Agency for seismic data that was acquired on the Exploration Right in the past. If no data are available, Motuoane will either acquire its own seismic or telluric data on the property, following proper environmental protocols and with the written permission of the landowner. The preliminary proposed transects for seismic / telluric survey are just over 100 km long around known structures and possible drill locations. Seismic and/or telluric locations and lengths are subject to be changed as knowledge increases.

Although the Vibroseis technique is the likely method to be undertaken for the seismic activities, there is also a potential alternative to the Vibroseis known as the Propelled Energy Generators (PEGs), more commonly referred to as the Accelerated Weight Drop Seismic (AWD) which Motuoane may consider over the Vibroseis.

Airshed Planning Professionals (Pty) Ltd (Airshed) was commissioned by Environmental Impact Management Services (Pty) Ltd (EIMS) to undertake an Environmental Noise Impact Assessment (NIA) for the proposed Motuoane Exploration Right Application (ER386) (hereafter referred to as the project) (**Figure 1-1**). This report details the scoping phase of the NIA undertaken for the project which will focus on the regulatory requirements from an environmental noise perspective and a description of the receiving environment.

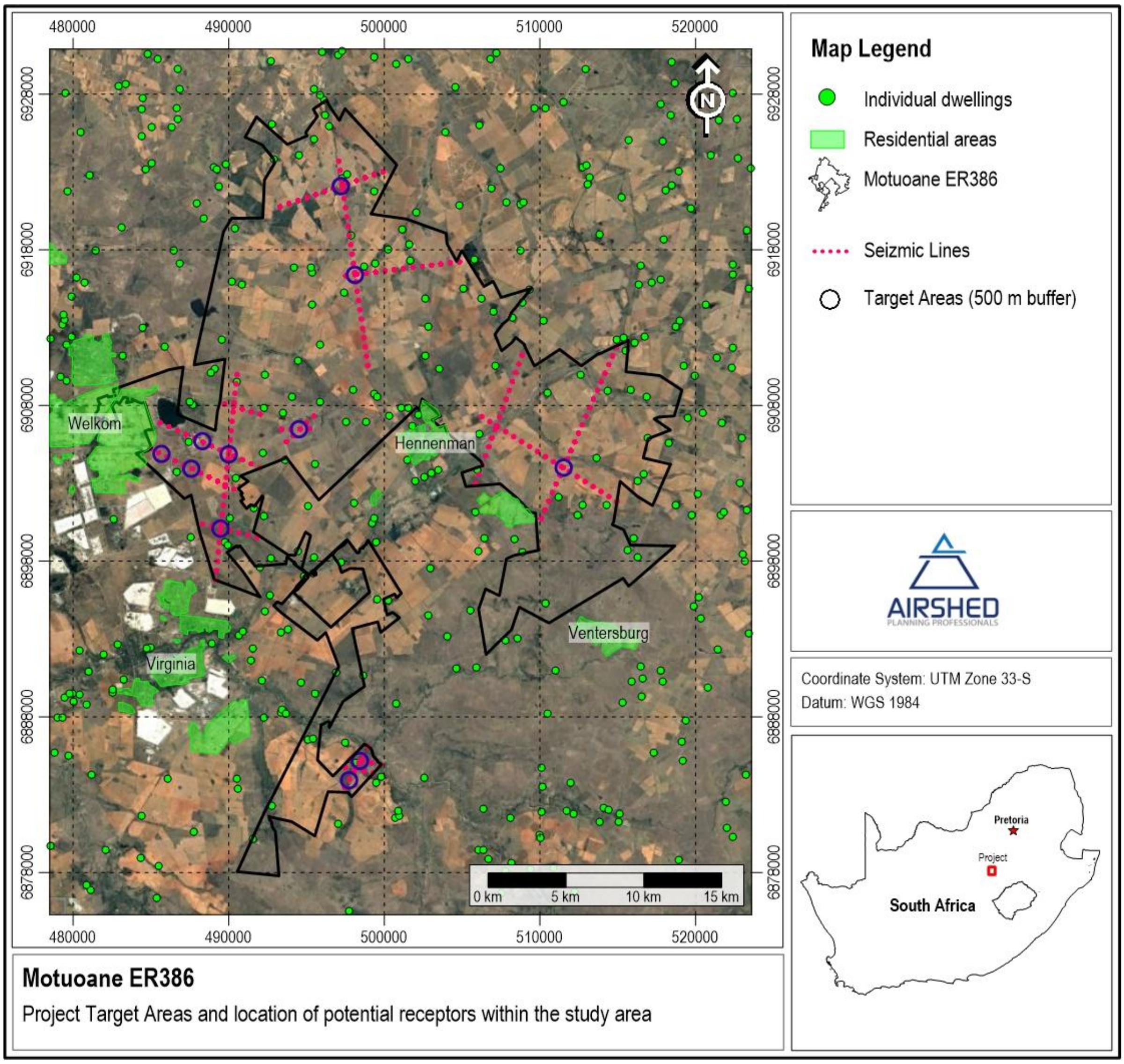

Figure 1-1: Location of the project site

1.1 Scope of Work

The scoping phase of the NIA study encompassed the following tasks:

- A review of the legal requirements and applicable environmental noise guidelines.
- A study of the receiving (baseline) acoustic environment, including:
  - The identification of noise sensitive receptors (NSRs) from available maps;
  - A study of environmental noise attenuation potential by meteorology, land use, and topography; and,
- A description of the methodology to be used for the noise baseline survey and environmental noise impact assessment.

1.2 Study Approach and Methodology

1.2.1 Identification of Applicable Environmental Noise Standards and Guidelines

In South Africa, provision is made for the regulation of noise under the National Environmental Management Air Quality Act (NEMAQA) (Act. 39 of 2004). Draft Environmental Noise Standards were published in June 2024 which are, at the time of this assessment, out for comment. These recommended Environmental Noise Standards reference the South African Bureau of Standards (SABS) standard SANS 10103 (2008) 'The measurement and rating of environmental noise with respect to annoyance and to speech communication' (**Table 2-1**). This standard has been widely applied in South Africa and is frequently used by local authorities when investigating noise complaints are in line with those published by the International Finance Corporation (IFC) in their General Environmental Health and Safety (EHS) Guidelines.

1.2.2 A Study of the Receiving Environment

The baseline acoustic environment was studied by taking into account:

- The position of potential NSRs in relation to the project; and
- The noise attenuation potential of the study area.

Potential NSRs were identified from maps of the area using Google Earth™ aerial imagery.

The ability of the environment to attenuate noise as it travels through the air was studied by considering meteorology, land use, and terrain data.

Readily available terrain data was obtained from the United States Geological Survey (USGS) web site (https://earthexplorer.usgs.gov/) in February 2025. A study was made of Shuttle Radar Topography Mission (STRM) 1 arc-sec data.

Measured noise levels from a sampling campaign to be conducted in the area in April/May 2025 will be accessed for the noise impact assessment study.

2 REGULATORY REQUIREMENTS AND ASSESSMENT CRITERIA

2.1 National Noise Control Regulations

The 1992 Noise Control Regulations (The Republic of South Africa, 1992) published in terms of Section 25 of the Environment Conservation Act (Act no. 73 of 1989) defines a “disturbing noise” as a noise level which exceeds the zone sound level or, if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more.

2.2 South African National Standards

In South Africa, provision is made for the regulation of noise under the National Environmental Management Air Quality Act (NEMAQA) (Act. 39 of 2004). Draft Environmental Noise Standards were published in June 2024 which are, at the time of this assessment, out for comment. These recommended Environmental Noise Standards reference the South African Bureau of Standards (SABS) standard SANS 10103 (2008) ‘The measurement and rating of environmental noise with respect to annoyance and to speech communication’ (**Table 2-1**). This standard has been widely applied in South Africa and is frequently used by local authorities when investigating noise complaints. The standard is also fully aligned with the World Health Organisation (WHO) guidelines for Community Noise (WHO, 1999). With regards to the NSRs for this study, the residential areas of Welkom, Hennenman, Virginia and Ventersburg will be considered as “Suburban districts”, while NSRs in all other areas will be considered as “Agricultural districts”.

Table 2-1: Draft South African National Standards for Environmental Noise

Type of district	Land use purpose	10-Minute L_{Aeq} dB(A) - Outdoor Noise	
		Day-time (06:00 – 22:00)	Night-time (22:00 – 06:00)
Agricultural districts	Agricultural purposes	45	35
Suburban districts	Residential purposes	50	40
Urban districts	Business purposes	55	45
Urban districts with one or more of the following: business premises; and main roads.	Business purposes	60	50
Central business districts	Business purposes	65	55
Industrial districts	Business purposes	70	60

SANS 10103 also 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
- Δ > 15 dB: 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.

2.3 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 2-2**, 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 2-2: 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

2.4 Regulations Regarding Report Writing

The specialist impact assessment report will comply with the requirements of the National Environmental Management Act, 1998 (NEMA, No. 107 of 1998) and the Environmental Impact Assessment (EIA) Regulations 2014, as amended).

2.5 Procedures for the Assessment

The specialist impact assessment report will comply with protocols for the assessment and minimum report content in terms of sections 24(5)(a), (h) and 44 of the National Environmental Management Act, 1998 (NEMA, No 107 of 1998) (Government Gazette [GG] No. 43110) published on 20 March 2020.

3 DESCRIPTION OF THE RECEIVING ENVIRONMENT

3.1 Potential Sensitive Receptors

Potential sensitive receptors within the project area (indicated in **Figure 1-1**), include individual households and residential areas (i.e., Welkom, Hennenman, Virginia and Ventersburg).

3.2 Environmental Noise Propagation and Attenuation potential

3.2.1 Atmospheric Absorption and Meteorology

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.

The wind field of an area can be presented using wind roses. Wind roses represent wind frequencies for the 16 cardinal wind directions. Frequencies are indicated by the length of the shaft when compared to the circles drawn to represent a frequency of occurrence. Wind speed classes are assigned to illustrate the frequencies with high and low winds occurring for each wind vector. The frequencies of calms, defined as periods for which wind speeds are below 1 m/s, are also indicated.

Reference was made to meteorological data from the South African Weather Services (SAWS) operated station located in Welkom, for the period January 2015 to January 2022. The measured data set indicates wind flow primarily from the northeastern sector (**Figure 3-1 (a)**) during the day with winds also frequent from the northwestern and southwestern sectors. At night, the wind field is mostly from a northeastern sector (**Figure 3-1 (b)**). Calm conditions occur 2.96% of time during the day and 3.11% during the night. On average, noise impacts are expected to be slightly more notable to the southeast and southwest of the project activities during the day and to the southwest of the project activities during the night.

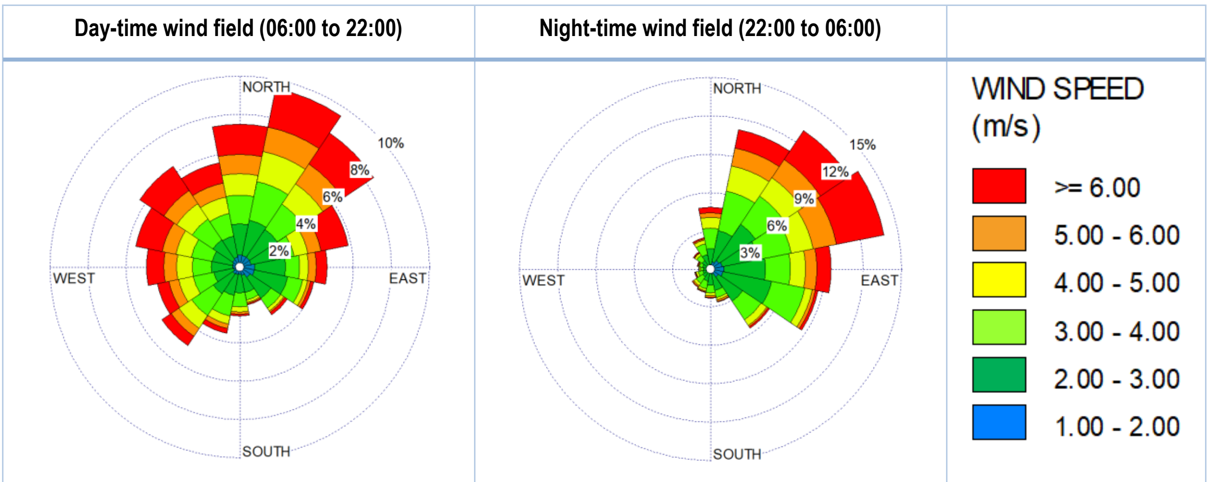

Figure 3-1: Wind rose for SAWS data, January 2015 to January 2022

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**).

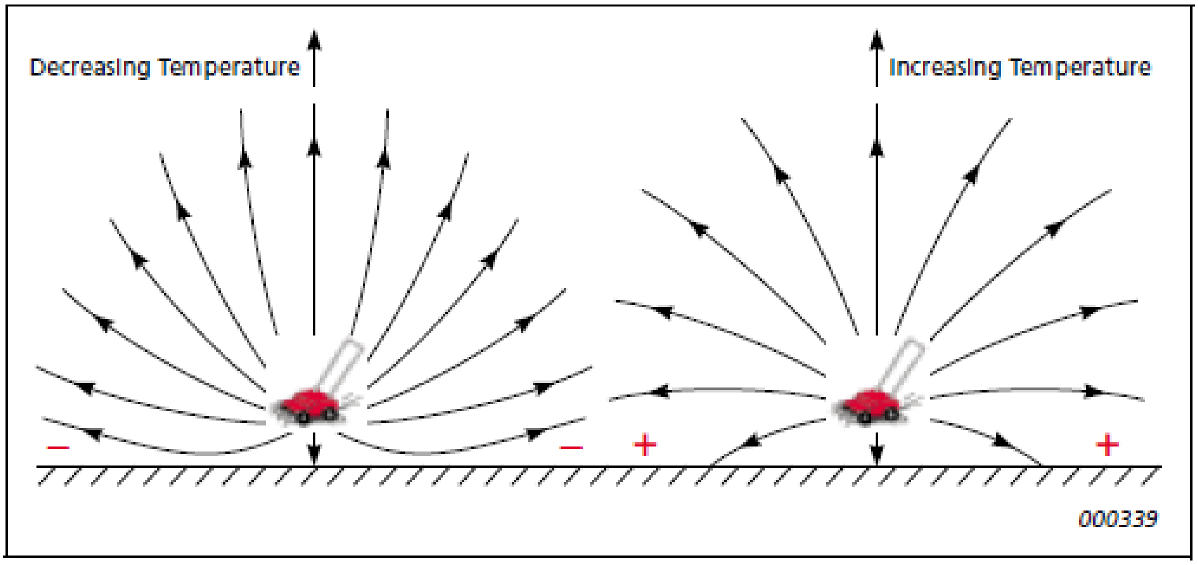

Figure 3-2: Bending the path of sound during typical day time conditions (image provided on the left) and night-time conditions (image provided on the right)

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 for the study area is provided in **Figure 3-3**. The topography of the study area is gently sloping, ranging from 1300 metres above mean sea level (mamsl) in the southwest to 1400 mamsl in the west. No major topographical features have been identified between project operations and noise sensitive receptor locations.

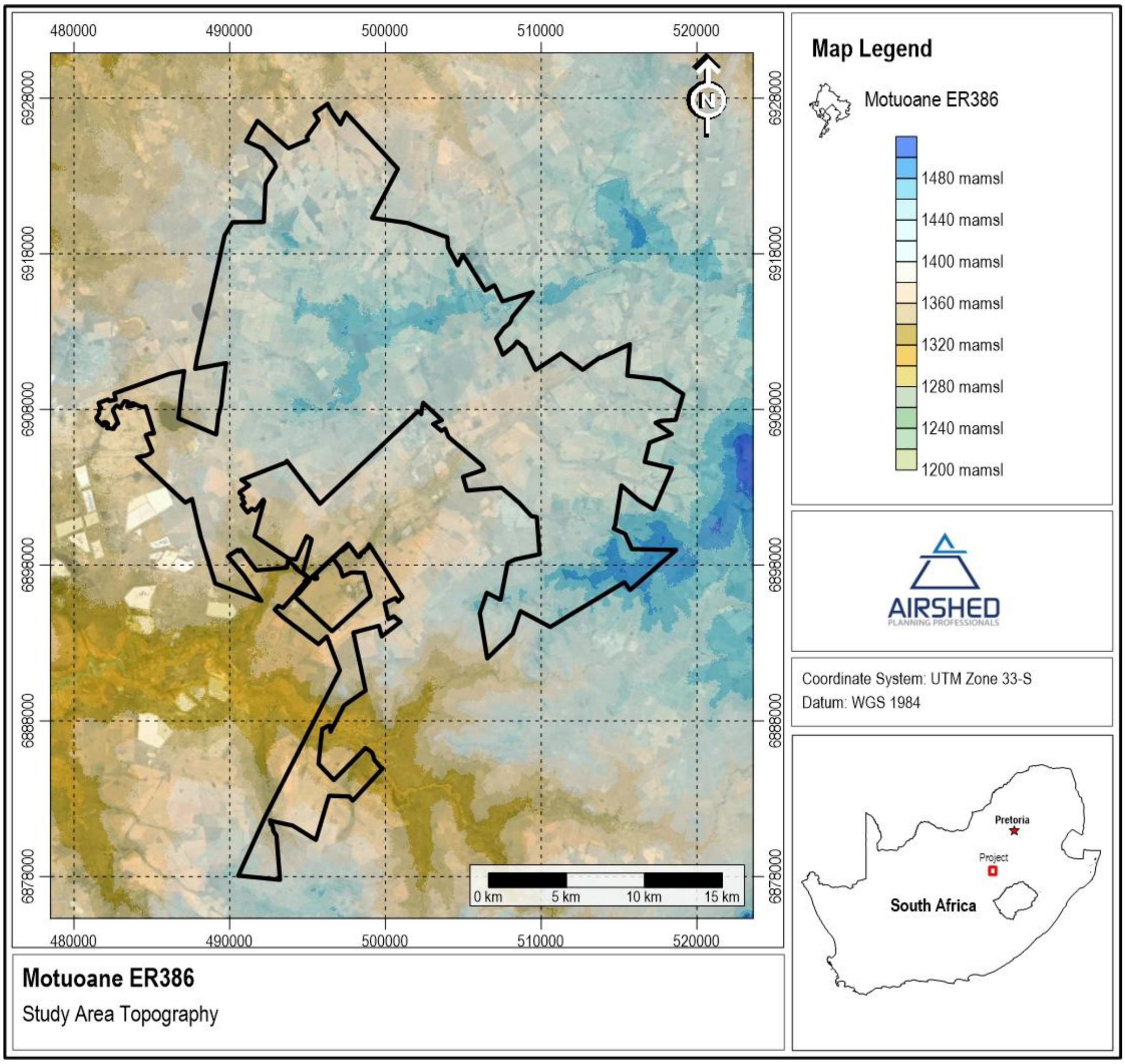

Figure 3-3: Study Area Topography

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). Ground cover is expected to be acoustically mixed, but this will be verified during the site visit conducted for the baseline noise survey.

3.3 Baseline Noise Survey

3.3.1 Site Selection

Survey sites will be selected after careful consideration of future activities and target areas, accessibility, potential noise sensitive receptors, and safety restrictions. A total of five survey sites will be selected for the survey to be conducted in

April/May 2025. The proposed locations of the survey sites, shown in **Figure 3-3**, are only for the general areas in which the survey will be conducted, and exact survey sites will be selected based on access and safety considerations.

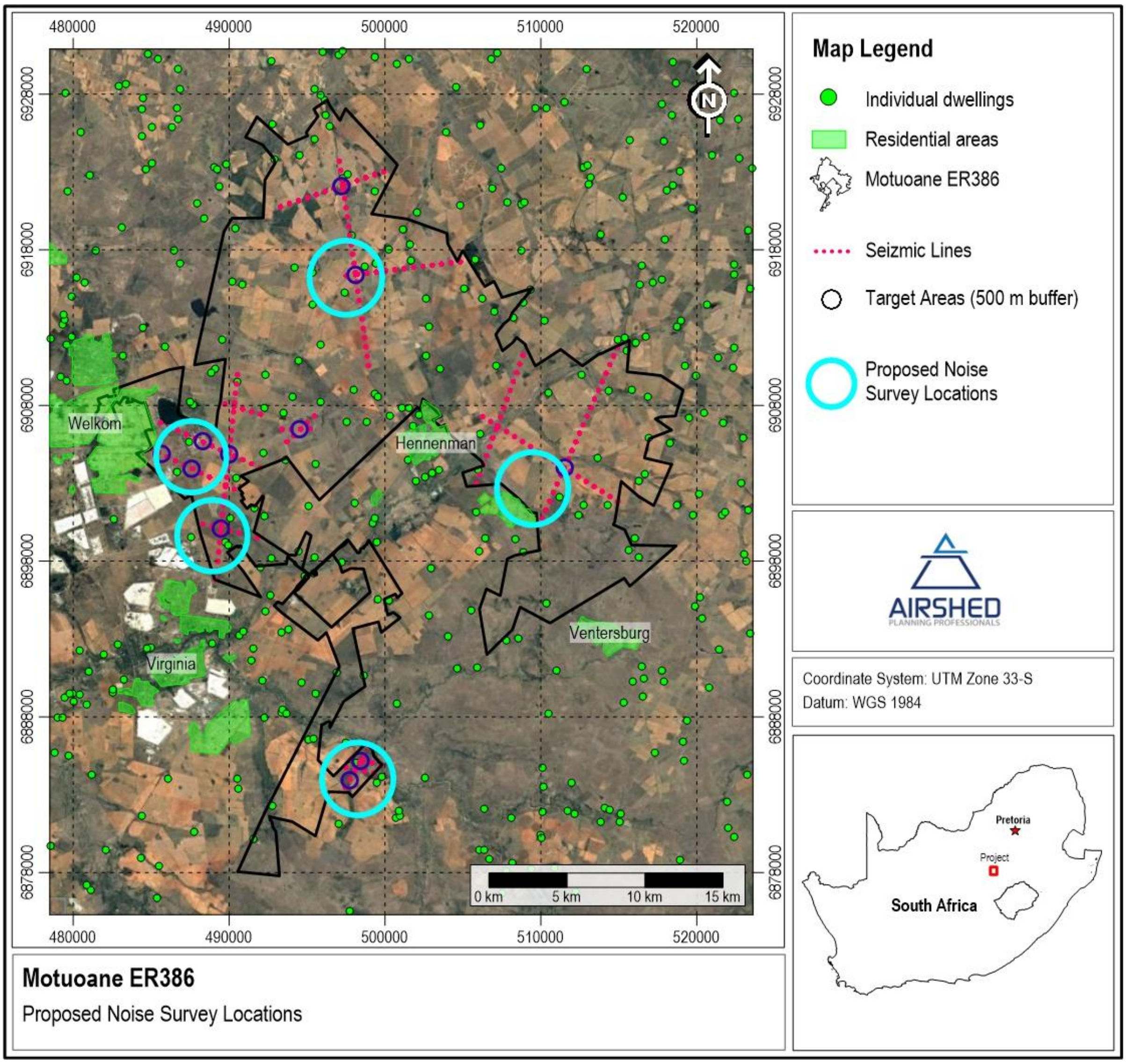

Figure 3-4: Proposed locations for the noise survey sites

3.3.2 Noise Survey Methodology

The survey methodology, which will closely follow guidance provided by the IFC General EHS Guidelines (IFC, 2007) and SANS 10103 (2008), is summarised below:

- The survey will be designed by a trained specialist.
- Sampling will be carried out using a Type 1 sound level meter (SLM) that meets all appropriate International Electrotechnical Commission (IEC) standards and is subject to annual calibration by an accredited laboratory. Equipment details are included in **Table 1-1**.

- The acoustic sensitivity of the SLM will be tested with a portable acoustic calibrator before and after each measurement session.

- Samples representative and sufficient for statistical analysis, will be taken with the use of the portable SLM capable of logging data continuously over the time. Measurements representative of the day- and night-time conditions will be taken.

- As generally recommended, the following acoustic indices will be recorded: L_{Aeq} (T), L_{AIeq} (T); L_{AFmax}; L_{AFmin}; statistics and 3rd octave frequency spectra.

- The SLM will be located approximately 1.5 m above the ground and 10 m from reflecting surfaces.

- SANS 10103 states that one must ensure (as far as possible) that the measurements are not affected by the residual noise and extraneous influences, e.g., wind, electrical interference and any other non-acoustic interference. All measurements will be taken during periods where wind speeds are less than 5 m/s.

Table 3-1: Noise survey equipment to be used for the assessment

Equipment	Serial Number	Purpose	Last Calibration Date
Svantek 977 sound level meter	S/N 36183	Noise sampling	March 2025
Svantek 7052E ½" microphone	S/N 78692		
Svantek SV 12L ½" pre-amplifier	S/N 40659		
SVANTEK SV33 Class 1 Acoustic Calibrator	S/N 43170	Testing of the acoustic sensitivity before and after each daily sampling session.	March 2025
Kestrel 4000 Pocket Weather Tracker	S/N 559432	Determining wind speed, temperature and humidity during sampling.	Not Applicable

4 IMPACT SIGNIFICANCE BASED ON SCOPING PHASE ASSESSMENT

The impact significance of the project is provided below based on the understanding of the baseline at the scoping phase and follows the method provided by EIMS (Appendix A). The project is expected to have the following significance rating:

- Construction Phase:
  - Without mitigation: medium negative significance rating.
  - With mitigation: low negative significance rating.
- Operation Phase:
  - Without mitigation: medium negative significance rating.
  - With mitigation: medium negative significance rating (but this will be dependent on the distance between project activities and noise sensitive receptor locations).
- Decommissioning Phase:
  - Without mitigation: medium negative significance rating.
  - With mitigation: low negative significance rating.

Table 4-1: Significance rating for potential environmental noise impacts due to the project activities

Impact Description		Pre-Mitigation						Pre-mitigation environmental risk	Post Mitigation						Post-mitigation environmental risk	Confidence	Priority Factor Criteria		Priority Factor	Final score
Impact	Phase	Nature	Extent	Duration	Magnitude	Reversibility	Probability		Nature	Extent	Duration	Magnitude	Reversibility	Probability			Cumulative Impact	Irreplaceable loss		
Increase in noise levels	Construction	-1	3	2	3	2	4	-10 (medium)	-1	3	2	3	2	3	-7.5 (low)	Medium	1	1	1.00	-7.5
Increase in noise levels	Operation	-1	3	4	3	3	3	-9.75 (medium)	-1	3	4	2	3	3	-9 (medium)	Medium	1	1	1.00	-9
Increase in noise levels	Decommis-sioning	-1	3	2	3	2	4	-10 (medium)	-1	3	2	3	2	3	-7.5 (low)	Medium	1	1	1.00	-7.5

5 SENSITIVITY MAPPING

Sensitivity mapping was conducted in accordance with the EIMS methodology, which focusses on scoring the proposed project impact on landscape features. The sensitivity map as provided in **Figure 5-1** to **Figure 5-3** and is based on the expected impact extent due to noise from the proposed project activities.

The sensitivity mapping was based on potential sensitive receptors within the study area. The sensitivity was classified as follows (**Figure 5-1**):

- Construction (site establishment, well workover and intervention, clearance of vegetation, drilling, surveying):
  - Medium sensitivity: 600 m around residential receptors;
  - Least concern: other areas.
- Operation (day-time) (sampling, gas composition analysis):
  - Medium sensitivity: 200 m around residential receptors;
  - Least concern: other areas.
- Operation (night-time) (night-time activity is expected to be limited during the exploration):
  - Medium sensitivity: 600 m around residential receptors;
  - Least concern: other areas.

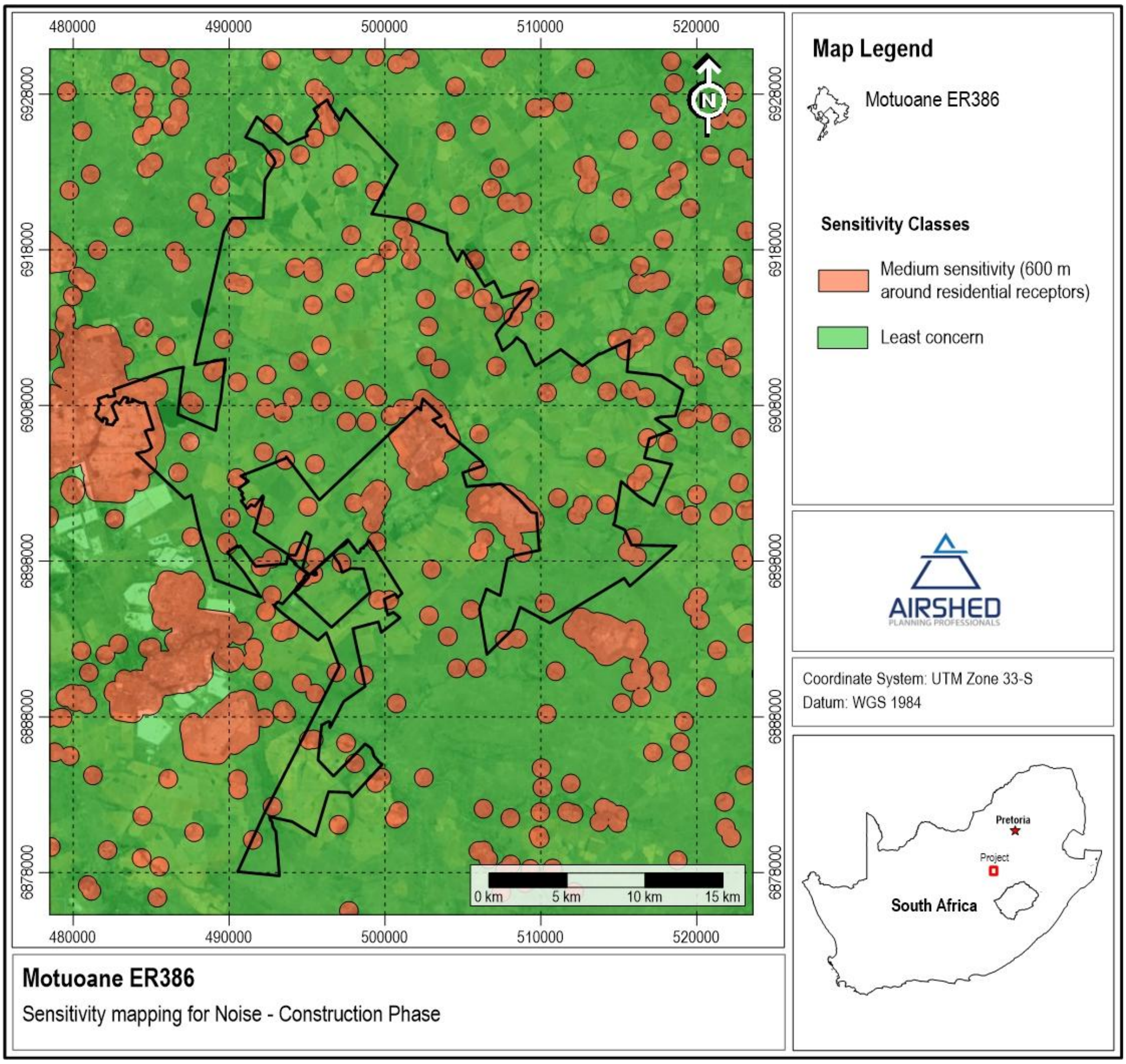

Figure 5-1: Sensitivity mapping for the project construction phase (600 m around NSRs)

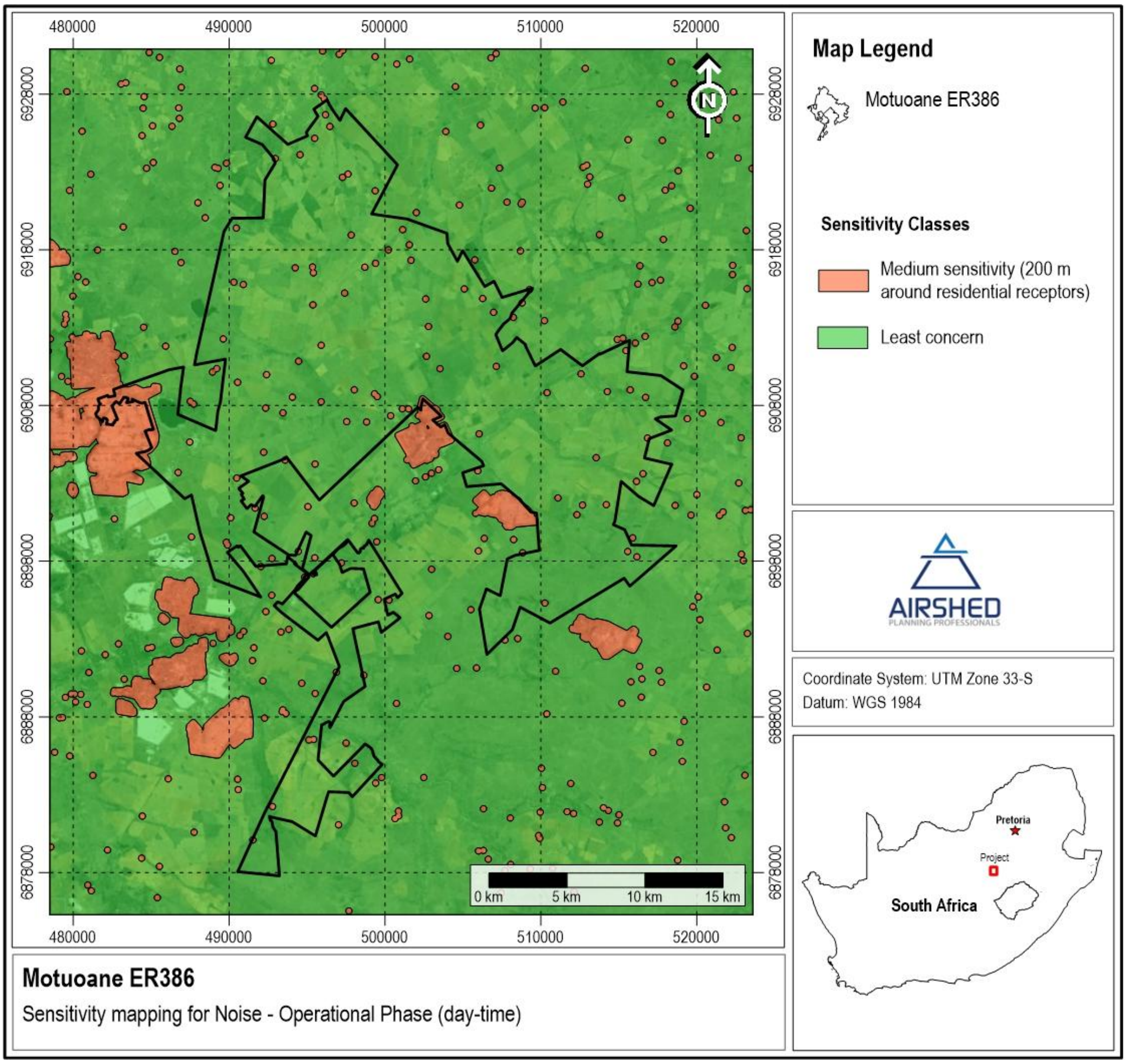

Figure 5-2: Sensitivity mapping for the project day-time operation phase (200 m around NSRs)

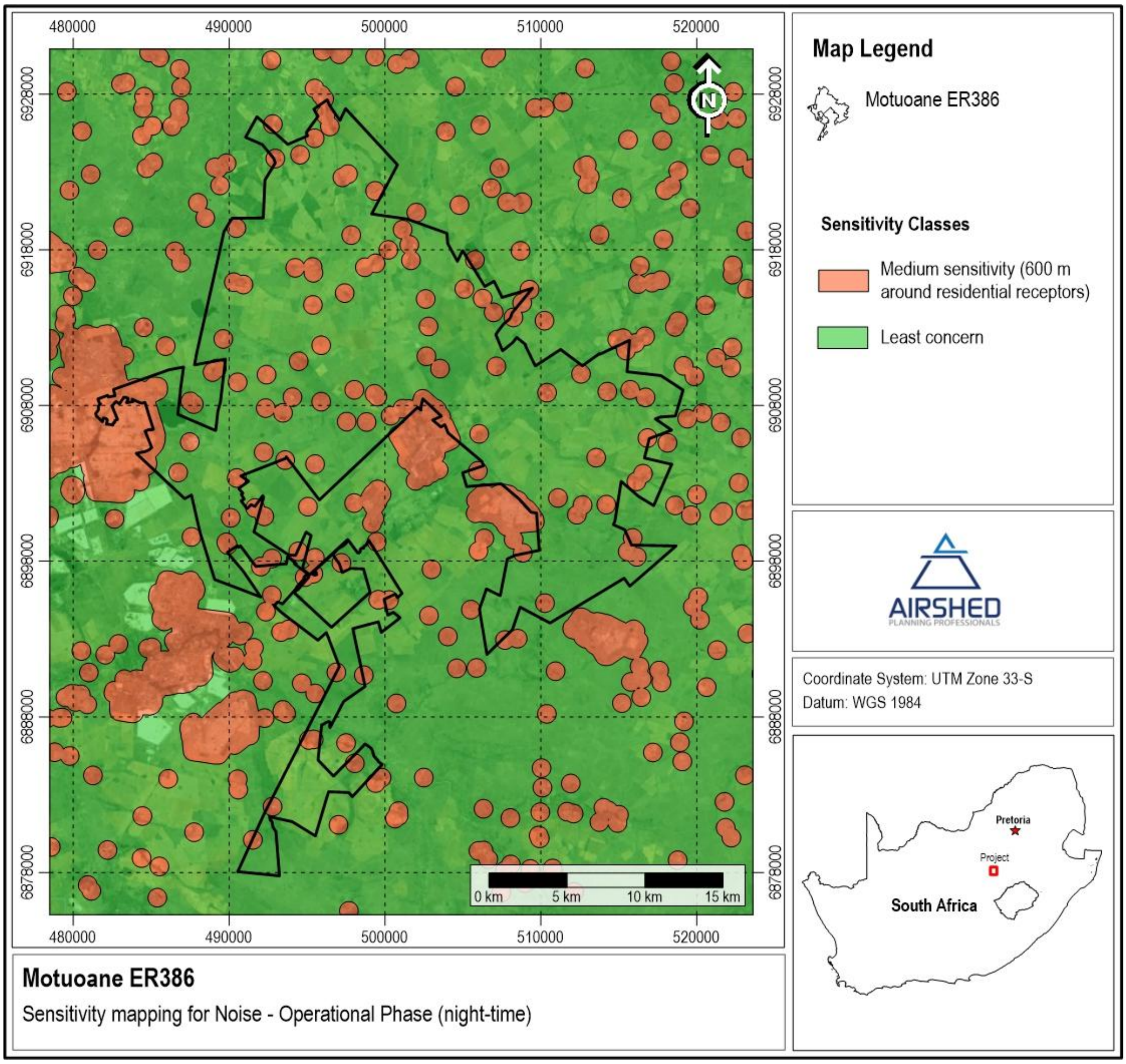

Figure 5-3: Sensitivity mapping for the project night-time operation phase (600 m around NSRs)

6 PLAN OF STUDY FOR THE IMPACT ASSESSMENT

The receiving environment was described in terms of the location of NSRs and the ability of the environment to attenuate noise over long distances. The following was found:

- Potential sensitive receptors within the project area include individual households and residential areas (i.e. Welkom, Hennenman, Virginia and Ventersburg).
- The wind field in the study area is mainly from the northeastern and northwestern sector, therefore, noise impacts are expected to be slightly more pronounced to the southeast and southwest of the project activities during the day and to the southwest of the project activities during the night.
- There are no major topographical features between proposed project activities and identified sensitive receptor locations.

The main aim of this investigation was to provide the basis for the environmental noise impact assessment plan to be conducted for the proposed project. The following will be included in the environmental noise impact assessment study:

- A baseline noise survey, to be conducted in April/May 2025 will take into account sensitive receptor locations, project operations and target areas, as well as accessibility and safety considerations. Five areas in which noise measurements will be conducted has been identified.
- Attenuation modelling of all potential noise sources due to project operations;
- Evaluation of potential noise impacts on human receptors due to project activities; and,
- Determination of environmental noise risk according to the EIMS stipulated Impact Assessment methodology.

7 REFERENCES

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APPENDIX A – IMPACT SIGNIFICANCE RATING METHODOLOGY

The impact significance rating methodology, as presented herein and utilised for all EIMS Impact Assessment Projects, is guided by the requirements of the NEMA EIA Regulations 2014 (as amended). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/ likelihood (P) of the impact occurring. The ER is determined for the pre- and post-mitigation scenario. In addition, other factors, including cumulative impacts and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S). The impact assessment will be applied to all identified alternatives.

Determination of Environmental Risk:

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER). The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and Reversibility (R) applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:

$$C = \frac{(E + D + M + R) * N}{4}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in **Table A-1** below.

Table A-1: Criteria for determining impact consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),

Aspect	Score	Definition
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/scored as per **Table A-2**.

Table A-2: Probability scoring

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

$$ER = C \times P$$

Table A-3: Determination of environmental risk

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	Probability					

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in **Table A-4**.

Table A-4: Significance classes

Environmental Risk Score	
Value	**Description**
< 9	Low (i.e. where this impact is unlikely to be a significant environmental risk),
≥9; <17	Medium (i.e. where the impact could have a significant environmental risk),
≥ 17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures <u>(pre-mitigation)</u>, as well as post implementation of relevant management and mitigation measures <u>(post-mitigation)</u>. This allows for a prediction in the degree to which the impact can be managed/mitigated.

Impact Prioritisation:

Further to the assessment criteria presented in the section above, it is necessary to assess each potentially significant impact in terms of:

- Cumulative impacts; and
- The degree to which the impact may cause irreplaceable loss of resources.

To ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

Table A-5: Criteria for determining prioritisation

Public response (PR)	Low (1)	Issue not raised in public response.
	Medium (2)	Issue has received a meaningful and justifiable public response.
	High (3)	Issue has received an intense meaningful and justifiable public response.
Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable loss of resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in **Table A-5**. The impact priority is therefore determined as follows:

$$Priority = Cl + LR$$

The result is a priority score which ranges from 2 to 6 and a consequent PF ranging from 1 to 1.5 (refer to **Table A-6**).

Table A-6: Determination of prioritisation factor

Priority	Prioritisation Factor
2	1
3	1.125
4	1.25
5	1.375
6	1.5

In order to determine the final impact significance, the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is an attempt to increase the post mitigation environmental risk rating by a factor of 0.5, if all the priority attributes are high (i.e., if an impact comes out with a high medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table A-7: Final environmental significance rating

Significance Rating	Description
≥-17	High negative (i.e. where the impact must have an influence on the decision process to develop in the area).
≥-17, ≤-9	Medium negative (i.e. where the impact could influence the decision to develop in the area).
>-9, <0	Low negative (i.e. where this impact would not have a direct influence on the decision to develop in the area).
0	No impact
>0, <9	Low positive (i.e. where this impact would not have a direct influence on the decision to develop in the area).
≥9, ≤17	Medium positive (i.e. where the impact could influence the decision to develop in the area).
>17	High positive (i.e. where the impact must have an influence on the decision process to develop in the area).

The significance ratings and additional considerations applied to each impact will be used to provide a quantitative comparative assessment of the alternatives being considered. In addition, professional expertise and opinion of the specialists and the environmental consultants will be applied to provide a qualitative comparison of the alternatives under consideration. This process will identify the best alternative for the proposed project.