Noise Impact Assessment for the Mamatwan Mine

Project done for **SLR Consulting (South Africa)(Pty) Ltd**

Report compiled by:
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Report Details

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Revision Record

Version	Date	Comments
Rev 0	July 2020	For client review
Rev 0.1	September 2020	Incorporation of clients comments

Glossary and Abbreviations

Airshed	Airshed Planning Professionals (Pty) Ltd
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.
EC	European Commission
EHS	Environmental, Health, and Safety (IFC)
Hz	Frequency in Hertz
IEC	International Electro Technical Commission
IFC	International Finance Corporation
ISO	International Standards Organisation
Kn	Noise propagation correction factor
K1	Noise propagation correction for geometrical divergence
K2	Noise propagation correction for atmospheric absorption
K3	Noise propagation correction for the effect of ground surface;
K4	Noise propagation correction for reflection from surfaces
K5	Noise propagation correction for screening by obstacles
kW	Power in kilowatt
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
L_P	Sound pressure level (in dB)
Ltd	Limited
L_W	Sound Power Level (in dB)
masl	Meters above sea level
m^2	Area in square meters

m/s	Speed in meters per second
NSR	Noise sensitive receptor
p	Pressure in Pa
Pa	Pressure in Pascal
μPa	Pressure in micro-pascal
p_{ref}	Reference pressure, 20 μPa
Pty	Proprietary
SABS	South African Bureau of Standards
SANS	South African National Standards
SLM	Sound Level Meter
SoW	Scope of Work
STRM	Shuttle Radar Topography Mission
USGS	United States Geological Survey
WG-AEN	Working Group – Assessment of Environmental Noise (EC)
WHO	World Health Organisation
%	Percentage

Executive Summary

Mamatwan Mine, situated south of Hotazel and north of Kuruman, is an open cast manganese mine which is proposing to undertake an integrated regulatory process to cater for layout/activity changes that have already taken place at the mine as well as proposed layout/activity changes (hereafter referred to as "the project").

The existing/proposed activities associated with the project which may have an influence on noise levels will consist of:

- a crushing and screening plant at the top-cut stockpile;
- changes to waste rock dump height;
- upgraded railway and railway loadout station;
- a screening plant at the Adam's pit; and,
- a crushing and screening plant for the waste rock.

Airshed Planning Professionals (Pty) Ltd. was appointed by SLR Consulting (South Africa) (Pty) Ltd. to undertake a Noise Impact Assessment for the project.

The main objective of the noise specialist study was to determine the potential impact (due to proposed activities only) on the acoustic environment and noise sensitive receptors (NSRs) as a result of the project and to recommend suitable management and mitigation measures.

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

1. A review of available technical project information.
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. A study of environmental noise attenuation potential by referring to available weather records; land use and topography data sources; and,
    c. Determining representative baseline noise levels.
4. An impact assessment, including:
    a. The establishment of a source inventory for proposed activities;
    b. Noise propagation simulations to determine environmental noise levels as a result of the project; and,
    c. The screening of simulated noise levels against environmental noise criteria.
5. The identification and recommendation of suitable mitigation measures and monitoring requirements.
6. The preparation of a comprehensive specialist noise impact assessment report.

In the assessment of simulated noise levels, reference was made to the IFC noise level guidelines for residential, institutional and educational receptors (55 dBA during the day and 45 dBA during the night) which is also in line with the SANS 10103 rating for urban districts.

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.

Source emissions were obtained from a database of measurements.

Noise propagation was simulated using the CadnaA, ISO 9613 model. The source inventory, local meteorological conditions and information on local land use were used to populate the noise propagation model. The propagation of noise was calculated over an area of 11 km east-west by 10.88 km north-south. The area was divided into a grid matrix with a 20-m resolution.

Three railway and railway loadout station upgrades were provided:

- Option 1: The reduction of the loading times to 12 hours to load a train with 125 waggons. This option requires the reconfiguration of the train station. All activities will be located in already disturbed areas.
- Option 2: The reduction of the loading times to 8 hours to load a train with 125 waggons. This option requires upgrading the existing load out station and conveyor system and as such all activities will be located in already disturbed areas.
- Option 3: The reduction of the loading time to 4 hours to load a train with 125 waggons. This option requires the establishment of a new railway loop, new loadout station, product stockpile areas, stackers and reclaimers.

Option 1 and Option 2 would result in similar noise levels to current activities. Option 3 would include additional noise sources such as a stacker and reclaimer as well as new loadout area, conveyor, and railway loop.

The proposed activities to prepare the waste rock material for sale were not finalised at the time of the assessment. Two scenarios were therefore assessed:

- No crushing and screening for the waste rock material
- The use of crushing and screening for the waste rock material

The main findings of the impact assessment were as follows:

- The simulated equivalent continuous day-time rating level ($L_{Req,d}$) of 55 dBA (IFC residential guideline level and SANS rating for urban districts) due to project operations extended ~340 m to the east of the Mamatwan mining right area for railway loadout station Option 3 (with and without crushing and screening activities on the waste rock material).
- The simulated equivalent continuous night-time rating level ($L_{Req,n}$) of 45 dBA (IFC residential guideline level and SANS rating for urban districts) due to project operations extended ~200 m to the east of the Mamatwan mining right area for railway loadout station Option 1 and ~480 m to the west and ~750 m to the east of the Mamatwan mining right area for railway loadout station Option 3 (with and without crushing and screening activities on the waste rock material).
- The simulated equivalent continuous day/night-time rating level ($L_{Req,dn}$) of 55 dBA (SANS rating for urban districts) due to project operations extended ~30 m to the east of the Mamatwan mining right area for

railway loadout station Option 1 and ~300 m to the west and ~750 m to the east of the Mamatwan mining right area for railway loadout station Option 3 (with and without crushing and screening activities on the waste rock material).

- The project activities (assuming railway loadout station Option 1, Option 2 or Option 3) were predicted to be within IFC residential and industrial guideline levels and SANS rating for urban and industrial districts at all potential noise sensitive receptors.
- The predicted increase in noise levels due to project operations were less than 1 dBA above baseline at all potential noise sensitive receptors within the study area. For a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level is not detectable.
- A general management and mitigation plan, as stipulated in Section 5, is recommended to minimise noise impacts from the project on the surrounding area.
- The significance of the project is low (without mitigation) to very low (with mitigation).

Based on the findings of the assessment and provided the recommended management and mitigation measures are in place, it is the specialist opinion that the project may be authorised.

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1 Introduction

Mamatwan Mine, situated 15 km south of Hotazel and 43 km west of Kuruman, is an open cast manganese mine which commenced mining in 1963. The mine falls within the Joe Morolong Local Municipality and the John Taolo Gaetsewe District Municipality in the Northern Cape Province (Figure 1). Tshipi Borwa Mine, also an open pit manganese mine, borders Mamatwan Mine to the west.

SLR Consulting South Africa (pty) Ltd (SLR) is undertaking an integrated regulatory process on behalf of Mamatwan Mine to cater for layout/activity changes that have already taken place at the mine as well as proposed layout/activity changes (hereafter referred to as the project). These changes are as follows:

- Layout changes already taken place:
  - Expansion of the north eastern and south eastern waste rock dump;
  - Establishment and changes to the rehabilitation criteria of waste rock dumps;
  - Expansion of the stockyard; and
  - Potable and process water storage facilities.
- Activities that already take place:
  - The use of Adam's pit for the disposal of mine waste water, tailings and storage of product;
  - Abstraction of mine water from Adam's pit for dust suppression; and
  - Irrigation of gardens and veld using treated sewage effluent.
- Proposed layout changes:
  - Establishment of a top-cut stockpile and associated crushing and screening plant;
  - Establishment of stormwater management infrastructure;
  - Changes to waste rock dump height;
  - Establishment of a pipeline to transport abstracted water from Middelplaats Mine to Mamatwan Mine; and
  - Upgrading the railway and railway loadout station.
- Proposed activity changes:
  - Sale of waste rock as aggregate; and
  - Re-processing of DMS and sinter fines.

1.1 Study Objective

The proposed activities associated with the project which may have an influence on noise levels will consist of:

- a crushing and screening plant at the top-cut stockpile;
- changes to waste rock dump height;
- upgraded railway and railway loadout station;
- a screening plant at the Adam's pit; and,
- crushing and screening plant for the waste rock (Figure 2).

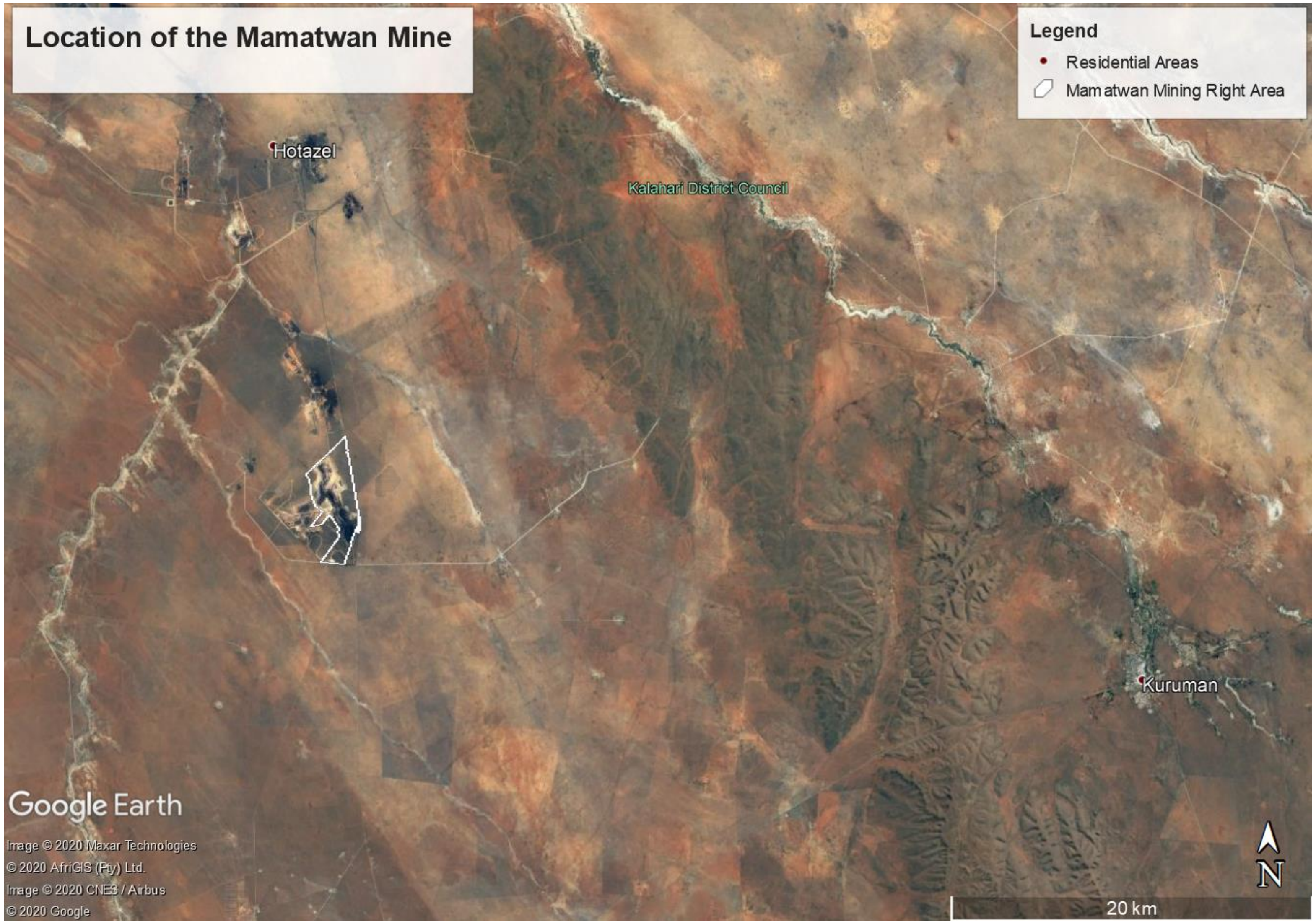


Figure 1: Location of the Mamatwan Mine

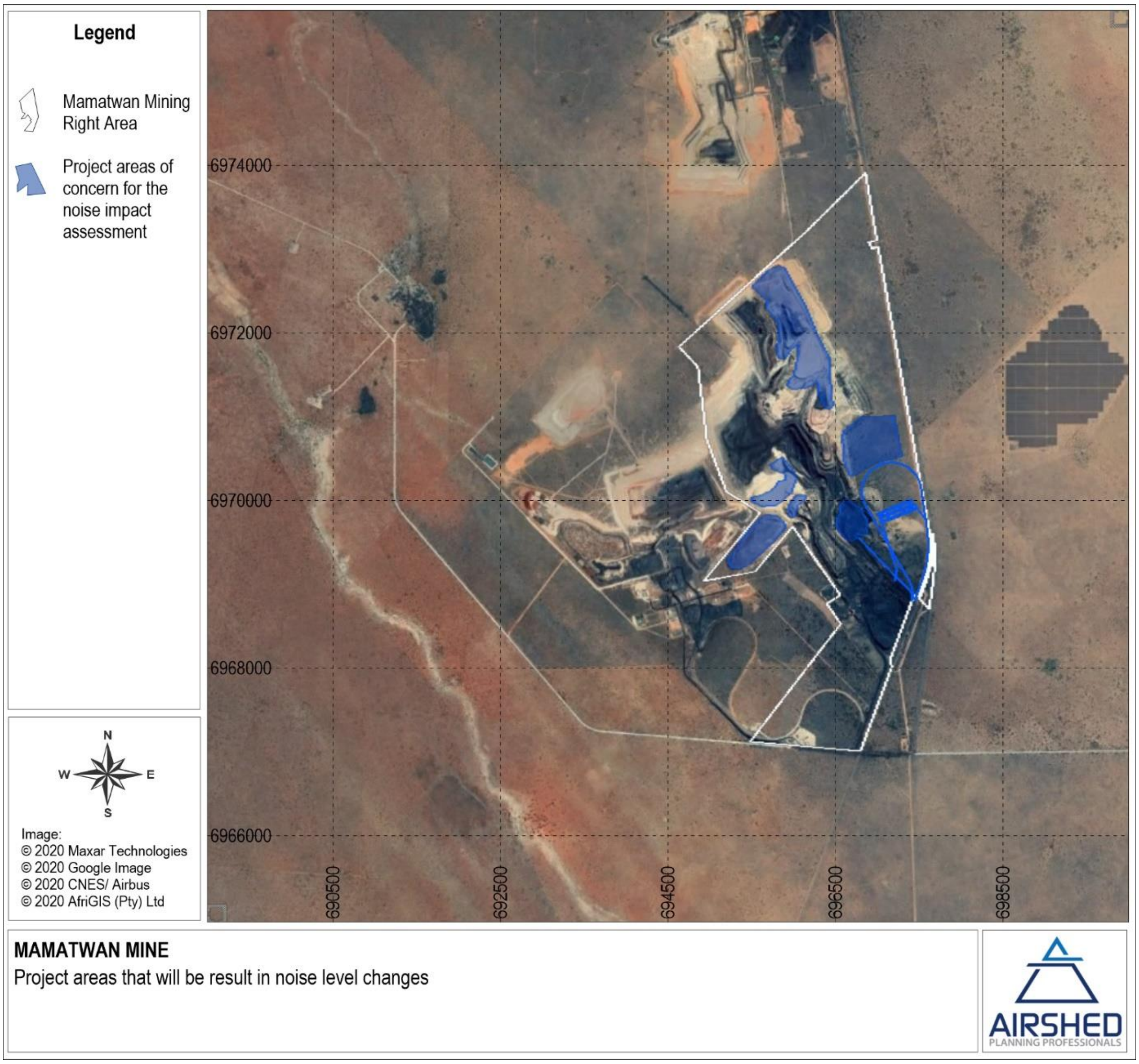


Figure 2: Location of noise sources due to the proposed project activities

Airshed Planning Professionals (Pty) Ltd. was appointed by SLR to undertake a Noise Impact Assessment for the project.

The main objective of this study is to determine the significance of the potential impact on the acoustic environment and noise sensitive receptors (NSRs).

1.2 Scope of Work

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

1. A review of available technical project information.
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 and field observations.

   b. A study of environmental noise attenuation potential by referring to available weather records, land use and topography data sources.
   c. Determining representative baseline noise levels.
4. An impact assessment, including:
   a. The establishment of a source inventory for proposed activities.
   b. Noise propagation simulations to determine environmental noise levels 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 mitigation measures and monitoring requirements.
6. The preparation of a comprehensive specialist noise impact assessment report.

1.3 Specialist Details

1.3.1 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.

1.3.2 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, and strategic air pollution impact assessment and management services and policy support to assist clients in addressing a wide variety of air pollution and environmental noise related assessments.

She has experience on the various components of environmental noise assessments from 2015 to present. Her project experience range over various countries in Africa, providing her with an inclusive knowledge base of international legislation and requirements pertaining to noise impacts.

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

1.4 Background to Environmental Noise and the Assessment Thereof

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. 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 3. 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).

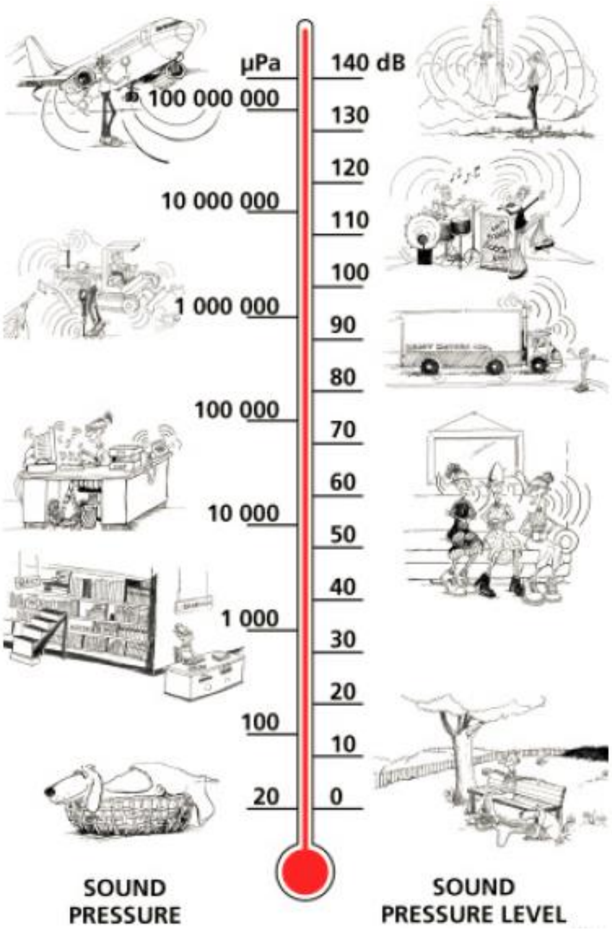


Figure 3: The decibel scale and typical noise levels (Brüel & Kjær Sound & Vibration Measurement A/S, 2000)

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).*

1.4.1 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).

1.4.2 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 4). "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) and have been A-weighted.

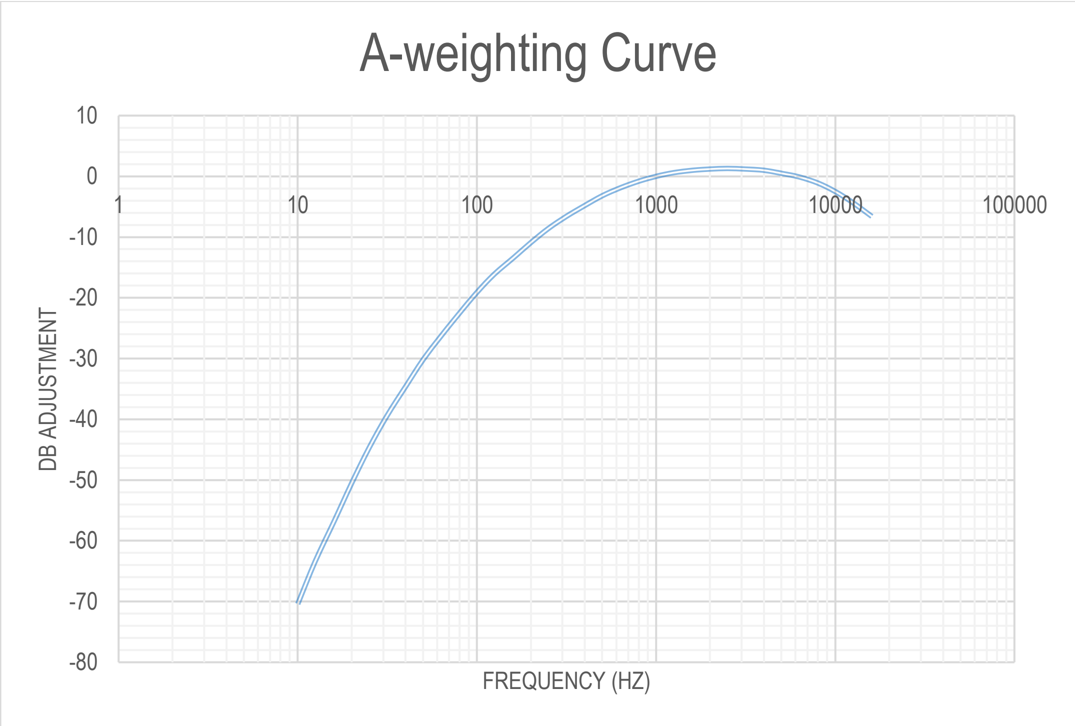


Figure 4: A-weighting curve

1.4.3 Adding Sound Pressure Levels

Since sound pressure levels are logarithmic values, the sound pressure levels as a result of two or more sources cannot 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).

1.4.4 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).

1.4.5 Environmental Noise Indices

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

- **L_{Zeq} (T)** – The unweighted equivalent sound pressure level, where T indicates the time over which the noise is averaged (calculated or measured).
- **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.

1.5 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 sound power levels (L_W's) (noise 'emissions') and sound pressure levels (L_P's) (noise impacts) associated with the operational 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.

1.5.1 Information Review

An information requirements list was sent to SLR at the onset of the project. In response to the request, the following information was supplied:

- Layout maps; and,
- Process descriptions.

1.5.2 Review of Assessment Criteria

The SANS 10103 guidelines of 2008 '*The measurement and rating of environmental noise with respect to annoyance and to speech communication'* are in line with the IFC in their *General EHS Guidelines* (IFC 2007) and

World Health Organisation (WHO) *Guidelines for Community Noise* (WHO 1999), and were considered in the assessment.

1.5.3 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.

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

Readily available terrain data was obtained from the United States Geological Survey (USGS) web site (https://earthexplorer.usgs.gov/) accessed in June 2020. A study was made of Shuttle Radar Topography Mission (STRM) 1 arc-sec data.

1.5.4 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 surveys conducted on 18 July 2019 was studied to determine current noise levels within the area.

The survey methodology, which closely followed guidance provided by the IFC (2007) and SANS 10103 (2008), is summarised below:

- The survey was designed and conducted by a trained specialist.
- Sampling was carried out using a Type 1 sound level meter (SLM) that meet all appropriate International Electrotechnical Commission (IEC) standards and is subject to calibration by an accredited laboratory (Appendix D). Equipment details are included in Table 1.
- The acoustic sensitivity of the SLM was tested with a portable acoustic calibrator before and after each sampling session.
- Samples, 15 to 60 minutes minutes in duration, representative and sufficient for statistical analysis were taken with the use of the portable SLM capable of logging data continuously over the sampling time period. Samples representative of the day- and night-time acoustic environment were taken. SANS 10103 defines day-time as between 06:00 and 22:00 and night-time between 22:00 and 06:00 (SANS 10103, 2008).
- L_{AIeq} (T), L_{Aeq} (T); L_{AFmax}; L_{AFmin}; L_{90} and 3rd octave frequency spectra were recorded.
- The SLM was located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface.
- 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, and that the instrument is operated under the conditions specified by the manufacturer.

- A detailed log and record were kept. Records included site details, weather conditions during sampling and observations made regarding the acoustic environment of each site (Appendix C).

Table 1: Sound level meter details

Equipment	Serial Number	Purpose	Last Calibration Date (a)
Brüel & Kjær Type 2250 Lite SLM	S/N 2731851	Attended 30-minute sampling.	Not Applicable
Brüel & Kjær Type 4950 ½" Pre-polarized microphone	S/N 3177677	Attended 30-minute sampling.	24 July 2018
SVANTEK SV33 Class 1 Acoustic Calibrator	S/N 57649	Testing of the acoustic sensitivity before and after each daily sampling session.	20 September 2018
Kestrel 4000 Pocket Weather Tracker	S/N 559432	Determining wind speed, temperature and humidity during sampling.	Not Applicable

(a) Prior to the baseline survey conducted on the 18 July 2019

1.5.5 Source Inventory

To determine the change in noise impacts associated with the project, a source inventory had to be developed. A list of noise sources was provided for the study. L_W's were obtained from the database of François Malherbe Acoustic Consulting cc (FMAC) based on source measurements for similar operations. All source measurements were carried out in accordance with the procedures specified in SANS 10103.

1.5.6 Noise Propagation Simulations

The propagation of noise from proposed activities 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 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 mid-band 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 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 11 km east-west by 10.88 km north-south and encompasses the project site. The area was divided into a grid matrix with a 20 m resolution. The model was set to calculate L_P’s at each grid and discrete receptor point at a height of 1.5 m above ground level.

1.5.7 Presentation of Results

Results are presented in tabular and 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.

Simulated noise levels were assessed according to guidelines published in SANS 10103 and by the IFC. To assess annoyance at nearby places of residence, the increase in noise levels above the baseline at NSRs were calculated and compared to guidelines published in SANS 10103.

1.5.8 Recommendations of Management and Mitigation

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

1.5.9 Impact Significance Assessment

The significance of environmental noise impacts was assessed according to the methodology provided by SLR and considered both an unmitigated and mitigated scenario. Refer to Appendix F of this report for the methodology.

1.6 Management of Uncertainties

The following limitations and assumptions should be noted:

- Meteorological data: As no onsite meteorological data was available, use was made of measured meteorological data from the closest SAWS monitoring station located at Kuruman approximately 43 km east of the project site. Data for the period 2015 to 2018 was considered for this assessment.
- The quantification of sources of noise was limited to the operational phase of the project. Construction and closure phase activities are expected to be similar or less significant and its impacts only assessed qualitatively. Noise impacts will cease post-closure.
- The assessment is based on the list of noise sources provided by SLR Consulting (South Africa) (Pty) Ltd. The list was found to be appropriate. The assumption is that this information is correct and reflects the routine operational phase of the project.
- Process activities such as the crushing and screening plants and the stacker reclaimer for railway loadout station Option 3, were assumed to be 24 hours per day.
- The loadout station Option 3 was assumed to receive one train per day during day-time hours.
- Location of the crushing and screening plant for the waste material was assumed to be below the western waste rock dumps.
- The change in noise due to the increase in dump height was tested and shown to have minimal change in noise impacts. This source was therefore not modelled for the current assessment as the list of equipment operating on the waste rock dumps was not available.
- Although other existing sources of noise within the area were identified during the survey, such sources were not quantified but were taken into account during the baseline sampling.

2 Legal Requirements and Noise Level Guidelines

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) but legally enforceable environmental noise limits have yet to be set. It is believed that when published, national criteria will make extensive reference to 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'*. 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 WHO guidelines for Community Noise (WHO, 1999). It should be noted that the values given in Table 2 are typical rating levels that it is recommended should not be exceeded outdoors in the different districts specified. Outdoor ambient noise exceeding these levels will be annoying to the community.

Table 2: Typical rating levels for outdoor noise

Type of district	Equivalent Continuous Rating Level ($L_{Req,T}$) for Outdoor Noise		
	Day/night $L_{R,dn}$[c] (dBA)	Day-time $L_{Req,d}$[a] (dBA)	Night-time $L_{Req,n}$[b] (dBA)
Rural districts	45	45	35
Suburban districts with little road traffic	50	50	40
Urban districts	55	55	45
Urban districts with one or more of the following: business premises; and main roads.	60	60	50
Central business districts	65	65	55
Industrial districts	70	70	60

Notes

(a) $L_{Req,d}$ =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.

(b) $L_{Req,n}$ =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.

(c) $L_{R,dn}$ =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.

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
- 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.

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 3**, 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 3: 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

This report complies with the requirements of the National Environmental Management Act, 1998 (NEMA, No 107 of 1998) and the environmental impact assessment (EIA) regulations (GNR 982 of 2014), as amended in 2017. The table below provides a summary of the requirements, with cross references to the report sections where these requirements have been addressed.

Table 4: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2014), as amended in 2017

A specialist report prepared in terms of the Environmental Impact Regulations of 2014 (as amended in 2017) must contain:	Relevant section in report
Details of the specialist who prepared the report	Section 1.3
The expertise of that person to compile a specialist report including a curriculum vitae	Section 1.3.2 Appendix A
A declaration that the person is independent in a form as may be specified by the competent authority	Section 1.3.1
An indication of the scope of, and the purpose for which, the report was prepared	Section 1.2
An indication of the quality and age of base data used for the specialist report;	Section 3.2 Section 3.3
A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 4
The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 3.3 Section 4.2
A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1.5
Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative;	Section 3.1
An identification of any areas to be avoided, including buffers	Section 3.1 Section 4.2
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 4.2
A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.6
A description of the findings and potential implications of such findings on the impact of the proposed activity or activities	Section 4.2
Any mitigation measures for inclusion in the EMPr	Section 5
Any conditions for inclusion in the environmental authorisation	Section 5
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 5
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 7
Regarding the acceptability of the proposed activity or activities; and	Section 4.2
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 4.2 Section 5 Section 7
A description of any consultation process that was undertaken during the course of carrying out the study	Not applicable
A summary and copies if any comments that were received during any consultation process	None received
Any other information requested by the competent authority.	Not applicable

2.5 Procedures for the Assessment

This report complies 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 No. 43110) published on 20 March 2020. The table below provides a summary of the requirements, with cross references to the report sections where these requirements have been addressed.

Table 5: Specialist assessment requirements in terms of Government Gazette No. 43110 (2020)

Assessment and Reporting on Noise Impacts	Section in Report
The assessment must be undertaken by a noise specialist	Section 1.3 and Appendix A
The assessment must be undertaken based on a site inspection as well as applying the noise standards and methodologies stipulated in SANS 10103:2008 and SANS 10328:2008 (or latest versions) for residential and non -residential areas as defined in these standards.	Section 2, Section 3.3 and Section 4
A baseline description must be provided of the potential receptors and existing ambient noise levels. The receptors could include places of residence or tranquillity that have amenity value associated with low noise levels. As a minimum, this description must include the following:	Section 3.3
• current ambient sound levels recorded at relevant locations (e.g. receptors and proposed new noise sources) over a minimum of two nights and that provide a representative measurement of the ambient noise climate, with each sample being a minimum of ten minutes and taken at two different times of the night (such as early evening and late at night) on each night, in order to record typical ambient sound levels at these different times of night;	The noise survey was conducted in 2019 prior to these procedures being published. Day- and night-time measurements were taken but no evening measurements.
• records of the approximate wind speed at the time of the measurement;	Section 3.3 and Appendix C
• mapped distance of the receiver from the proposed development that is the noise source; and	Section 3.1
• discussion on temporal aspects of baseline ambient conditions.	Section 3.3
Assessment of impacts done in accordance to SANS 10103:2008 and SANS 10328:2008 (or latest versions) must include the following aspects which must be considered as a minimum in the predicted impact of the proposed development:	Section 4
• characterisation and determination of noise emissions from the noise source, where characterization could include types of noise, frequency, content, vibration and temporal aspects;	Section 4.1
• projected total noise levels and changes in noise levels as a result of the construction, commissioning and operation of the proposed development for the nearest receptors using industry accepted models and forecasts; and	Section 4.2
• desired noise levels for the area.	Section 4.2 and Section 6
The findings of the Noise Specialist Assessment must be written up in a Noise Specialist Report that must contain as a minimum the following information:	
• details and relevant qualifications and experience of the noise specialist preparing the assessment including a curriculum vitae;	Section 1.3 and Appendix A
• a signed statement of independence by the specialist;	Appendix B

Assessment and Reporting on Noise Impacts	Section in Report
• the duration and date of the site inspection and the relevance of the season and weather conditions to the outcome of the assessment;	Section 3.2 and Section 3.3
• a description of the methodology used to undertake the on-site assessment inclusive of the equipment and models used, as relevant, together with results of the noise assessment;	Section 1.5.4, Section 1.5.6 and Section 4
• a map showing the proposed development footprint (including supporting infrastructure) with a 50m buffered development envelope;	Figure 2
• confirmation from the specialist that all reasonable measures have been considered, or not, in the micro- siting of the proposed development to minimise disturbance of receptors;	The site layout was provided for the assessment. Siting recommendations are provided in 5.1.4
• a substantiated statement from the specialist on the acceptability, or not, of the proposed development and a recommendation on the approval, or not, of the proposed development;	Section 7
• any conditions to which this statement is subjected;	Section 5 and Section 7
• the assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered;	Section 4
• a motivation must be provided if there were development footprints identified as per paragraph 2.5.9. above that were identified as having a "low" noise sensitivity and that were not considered appropriate;	Not applicable
• where identified, proposed impact management outcomes, mitigation measures for noise emissions during the construction and commissioning phases that may be of relative short duration, or any monitoring requirements for inclusion in the Environmental Management Programme (EMPr); and	Section 5
• a description of the assumptions made and any uncertainties or gaps in knowledge or data.	Section 1.6

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

Noise sensitive receptors generally include places of residence and areas where members of the public may be affected by noise generated by project activities.

As mentioned in Section 1.4.4, the impact of an intruding activity noise on the environment rarely extends more than 5 km from the source. Noise sensitive receptors within 5 km of the project include (Figure 5):

- NSR1 – Farmstead (A Pyper)
- NSR2 – Farmstead (Farm workers)
- NSR3 – Farmstead (Dries Van Den Berg)
- NSR4 – Farmstead (Nic Fourie)
- NSR5 – Farmstead (M Kruger)
- NSR6 – Operations and management offices for the Solar PV Plant

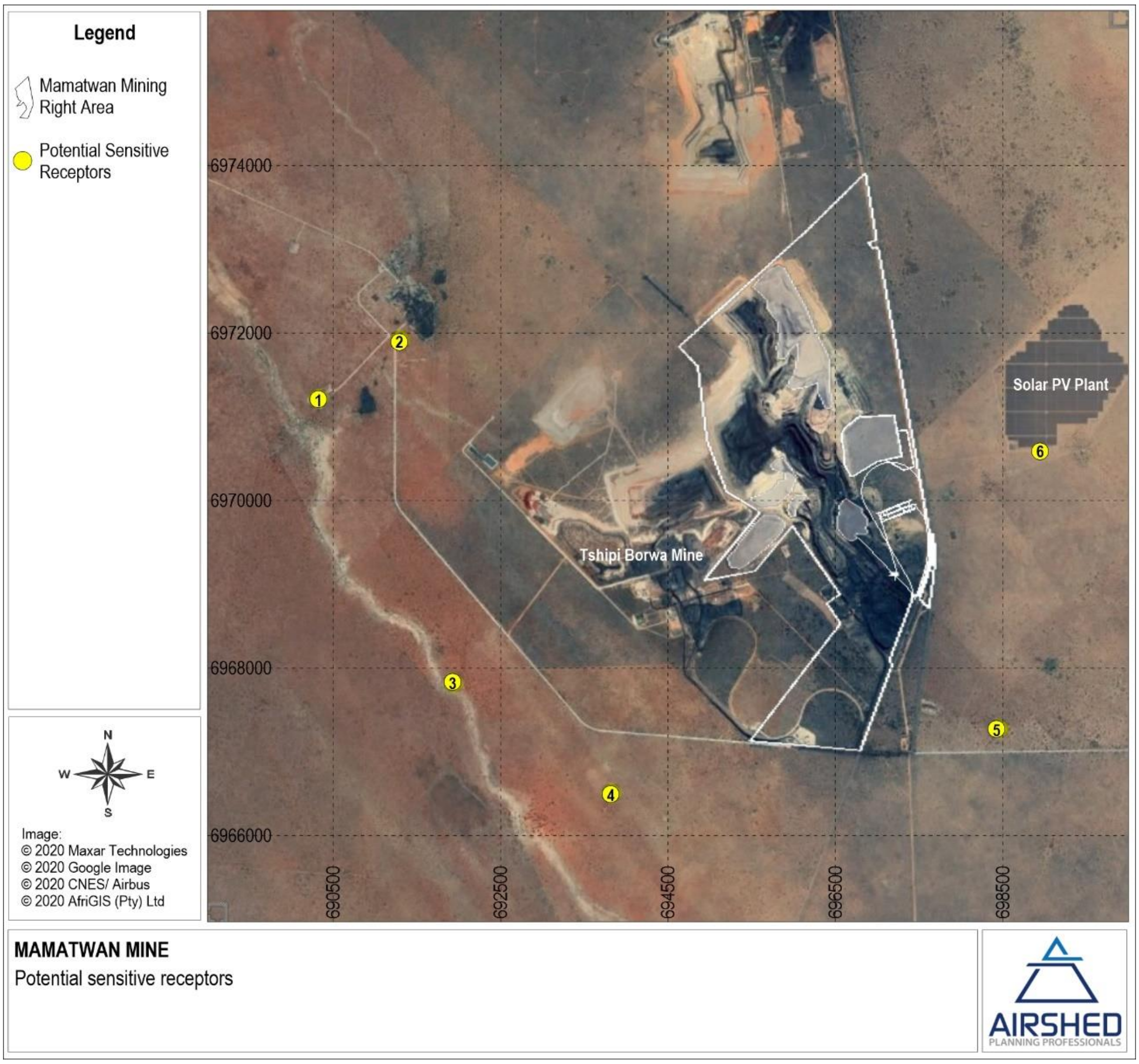


Figure 5: Sensitive receptors within the study area

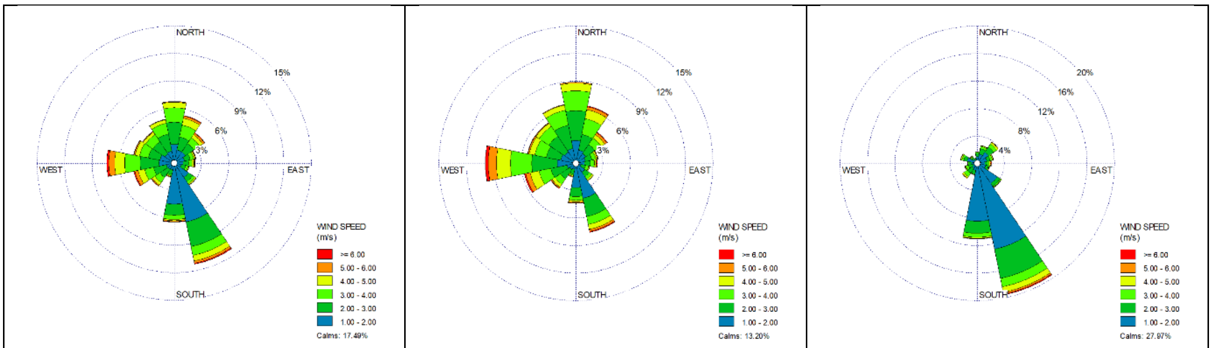
3.2 Environmental Noise Propagation and Attenuation potential

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 1.4.4). 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, resulting 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.

Use was made of data from the South African Weather Services (SAWS) Kuruman Weather Station (located approximately 43 km to the west of Mamatwan Mine). Data for the period 1 January 2015 – 31 December 2018 was obtained for inclusion in the study. The modelled data set indicates wind flow primarily from the south-southeast (Figure 6 (a)). During the day (06:00 – 22:00), the predominant wind direction is from the west, north and south-southeast while during the night (22:00 – 06:00) the predominant wind direction is from the south-southeast. On average, noise impacts are expected to be more notable south, east and north-northwest of the project activities during the day and north-northwest of the project activities during the night.



(a) Period average wind rose	(b) Day-time wind rose (06:00 – 22:00)	(c) Night-time wind rose (22:00 – 06:00)

Figure 6: Wind rose for SAWS Kuruman data (2015-2018)

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 7). The average temperature for the area is 19°C (as obtained from the SAWS Kuruman data for the period 2015 to 2018).

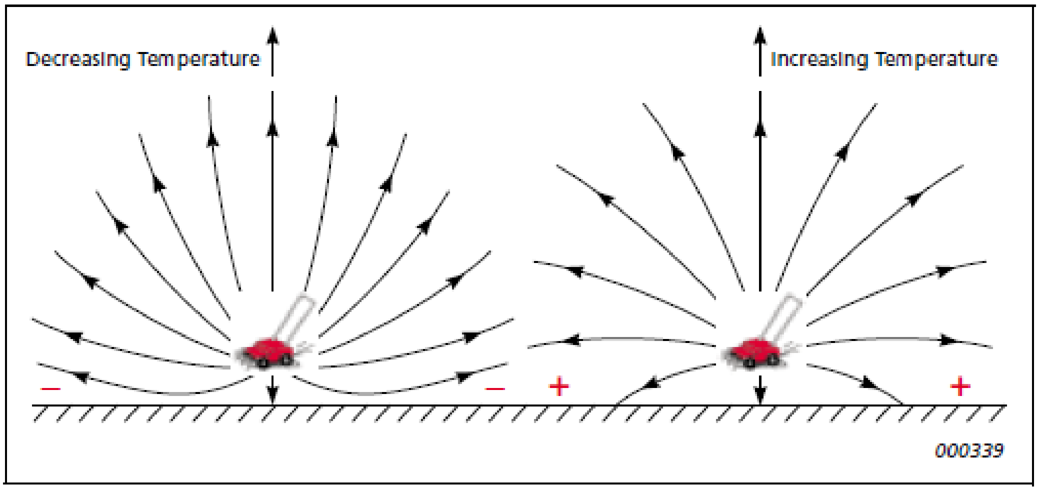


Figure 7: Bending the path of sound during typical day time conditions (image provided on the left) and night-time conditions (image provided on the right)

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). Topography was included in the simulation of noise levels. The topography for the area is fairly flat with no notable features.

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 made, ground cover was found to be acoustically mixed.

3.3 Baseline Noise Survey and Results

Sampling points were selected based on proposed project activities and position of sensitive receptors (Figure 5). Survey results for the campaign undertaken on 18 July 2019 are summarised in Table 6 and for comparison purposes, visually presented in Figure 9 (day-time results) and Figure 10 (night-time results). Figure 11 provides ambient baseline noise levels for all noise sampling surveys conducted in the study area.

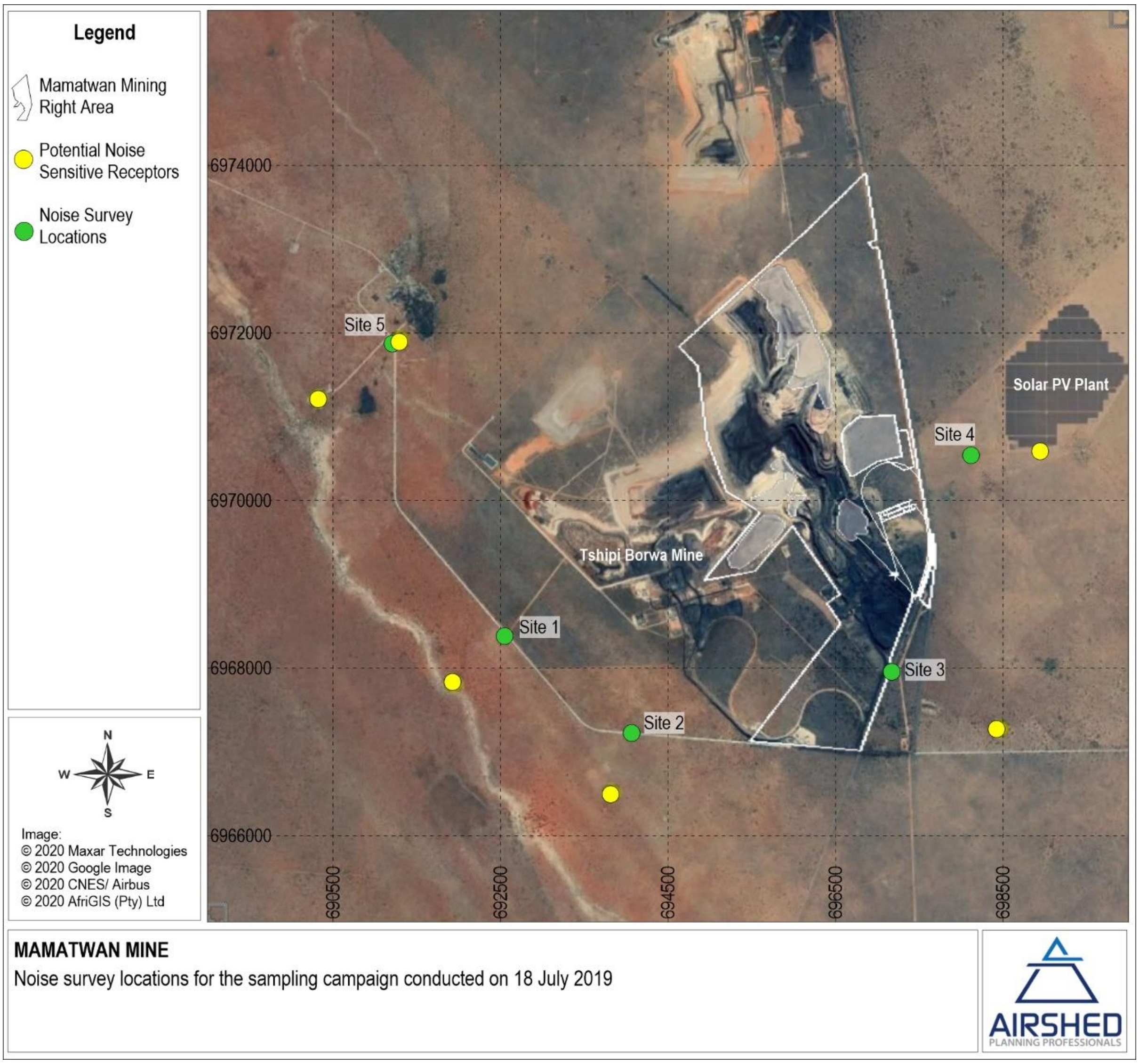


Figure 8: Locations of environmental baseline noise survey sites

Table 6: The environmental noise survey results summary

Site	Date and time	Duration (hour)	L_{AFmax} (dBA)	L_{AIeq} (dBA)	L_{Aeq} (dBA)	L_{AF90} (dBA)	Observations
Daytime							
Site 1	18/07/2019 11:50	01:00:00	57.2	39.1	32.1	24.2	Noise background from the Mamatwan and Tshipi mines operations, gusty winds, leaves on shrubs and trees rustling in the wind
Site 2	18/07/2019 13:09	01:00:00	65.6	42.5	37.6	28.9	Gusty winds, leaves on shrubs and trees rustling in the wind
Site 3	18/07/2019 16:24	01:00:00	89.5	65.2	62.2	46.3	Train hooting & passing, birds chirping, shrubs and trees rustling in the wind, mining operations

Site	Date and time	Duration (hour)	L_{AFmax} (dBA)	L_{AIeq} (dBA)	L_{Aeq} (dBA)	L_{AF90} (dBA)	Observations
Site 4	18/07/2019 14:55	01:00:00	74.9	51.8	40.8	32.6	Leaves on shrubs and trees rustling in the wind, traffic from the road, community activities
Site 5	18/07/2019 10:36	1:00:00	73.3	49.3	44.0	24.9	Cars passing, leaves on shrubs and trees rustling in the wind, gusty winds, birds chirping
Night-time							
Site 1	18/07/2019 22:24	00:15:00	55.7	41.8	34.4	32.0	Sound of insects, noise background from the mining operations (hooter from the mines)
Site 2	18/07/2019 22:46	00:15:00	66.7	45.1	36.3	32.0	Sound of insects & noise background from the mining operations
Site 3	18/07/2019 23:35	00:15:00	73.1	54.0	50.5	46.0	Sounds of generator (mechanical noise), mining operations, insects, sound of insects, trucks & cars passing and hooting.
Site 4	18/07/2019 23:11	00:15:00	80.4	67.6	66.3	64.6	Road traffic (trucks hooting & passing), noise background from the mine operations (mechanical noise or generator)
Site 5	18/07/2019 21:59	00:15:00	58.0	43.8	38.3	34.4	Dogs barking, noise background from the mining operations, sound of insects

The following was noted:

- Measurements were conducted on 18 July 2019.
    - The weather condition was sunny, with temperatures between 22ºC and 27ºC, and 0% cloud cover for the day. Wind speeds were mostly from the west to northwest direction and ranged between 1.1 m/s (average) and 3.1 m/s (maximum).
    - At night, skies were partly cloudy with temperatures between 8.9 ºC and 9.5 ºC. Slight wind conditions prevailed with wind speeds between 0.1 m/s (average) and 0.6 m/s (maximum) mostly from the south to southwest.
- Day-time broadband survey results:
    - Measurements indicate day-time ambient noise levels that are comparatively quiet but influenced by occasional noisy incidents such as vehicles and a train passing by.
    - Daytime $L_{Aeq's}$ ranged between 32.1 dBA and 62.2 dBA. L_{AF} values at residential areas indicate that background noise levels are exceptionally low.
    - Measured daytime $L_{Aeq's}$ at Sites 1, 2, 4 and 5 were typical of rural environments as described by SANS 10103, while baseline noise levels at Site 3 are more akin to urban or industrial areas. This is expected considering the proximity of Site 3 to the operations.
    - All recorded $L_{Aeq's}$ were in compliance with IFC guidelines for industrial receptors.

- The recorded daytime L_{Aeq} at Site 3 exceeded the IFC guideline for residential receptors, but were below the guideline for industrial receptors. This sampling location is located at the mine boundary and not at a NSR
- Night-time broadband survey results of MMT:
  - Measurements indicate night-time ambient noise levels were mostly affected by mining operational activities such as machinery/ generator and vehicles(trucks) passing by from the main public road.
  - Night-time $L_{Aeq's}$ ranged between 34.4 dBA and 66.3 dBA.
  - Measured night-time $L_{Aeq's}$ at the residential sampling locations (Sites 1, 2 and 5) were typical of night-time noise levels in rural areas (SANS 10103) and were below the IFC residential guideline (45 dBA) for night-time noise. Night-time noise levels at Sites 2 and 5 (36.3 dBA and 38.3 dBA respectively) were however slightly higher than the SANS 10103 typical rating level for rural areas (35 dBA) due to insects and background mining operational noise.
  - Measured night-time L_{Aeq} at Site 3 was well below what is typical for industrial areas, while the L_{A90} recorded at this location indicates that the noise level is generally typical of rural areas, with sporadic noise incidents such as vehicles passing by. This can also be observed as peaks on the time series graph (Figure 29).
  - Conversely, the small difference between the measured night-time L_{Aeq} and L_{A90} values at Site 4 indicate that there is a constant (fairly loud) source of noise (that was noted during the field survey as originating from the mining operations) that is audible at this location. Night-time noise levels recorded at this location are typical of (even higher than) industrial areas according to SANS 10103, but the levels are below the IFC guideline for industrial areas. The constant noise source can be observed on the time-series graph (Figure 30). This noise source was not observed during the day-time measurements, meaning that the daytime L_{Aeq} for Site 4 is lower than the night-time L_{Aeq}.

For detailed time-series, frequency spectra and statistical results, the reader is referred to Appendix E.

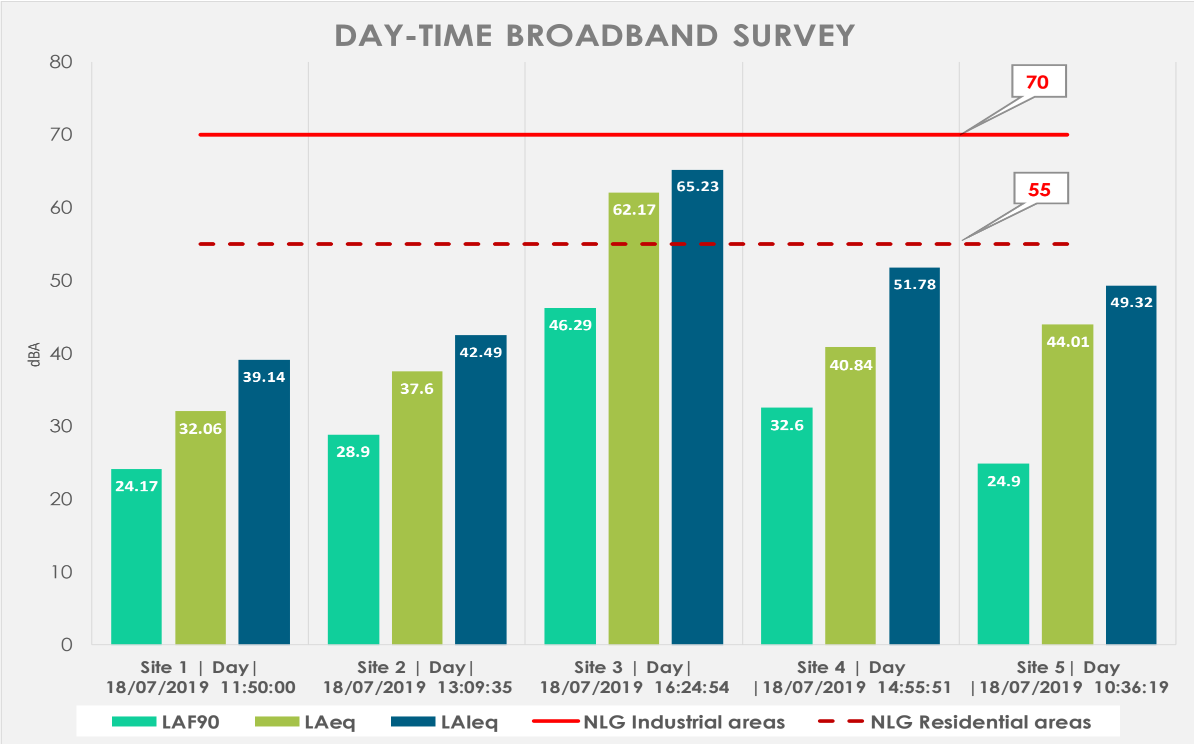


Figure 9: Day-time broadband survey results of Mamatwan Mine

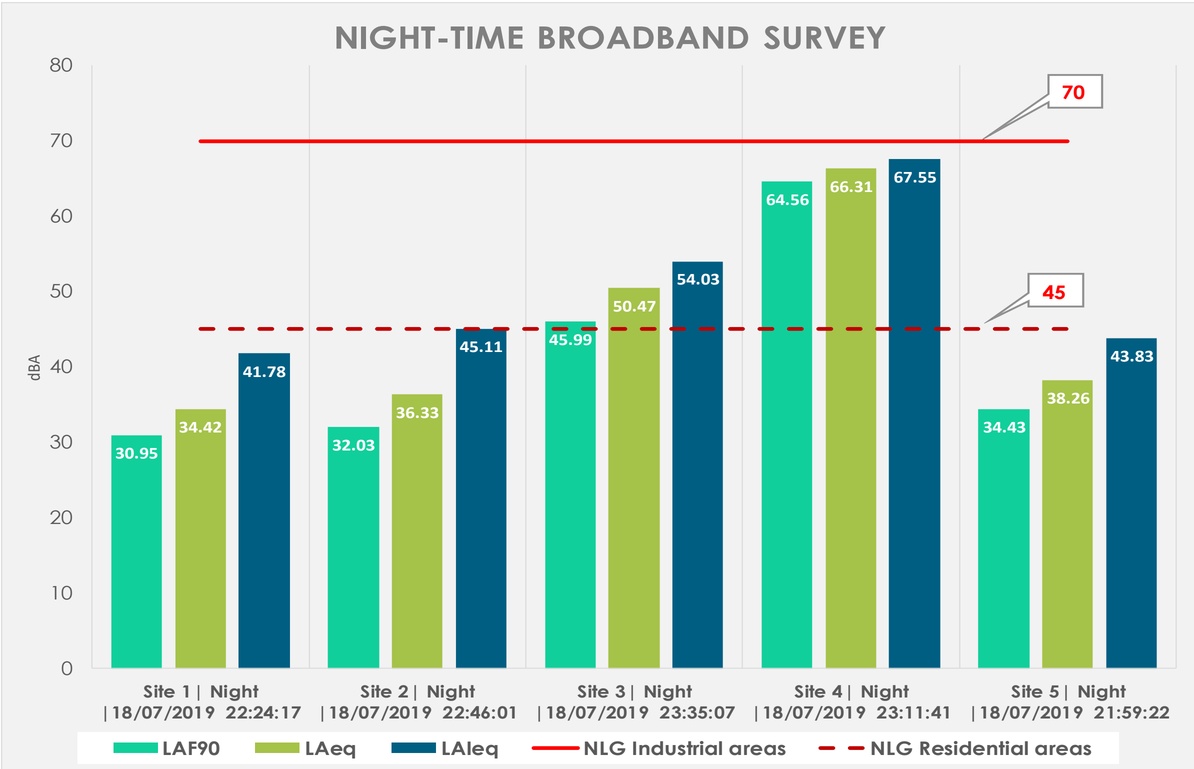


Figure 10: Night-time broadband survey results of Mamatwan Mine

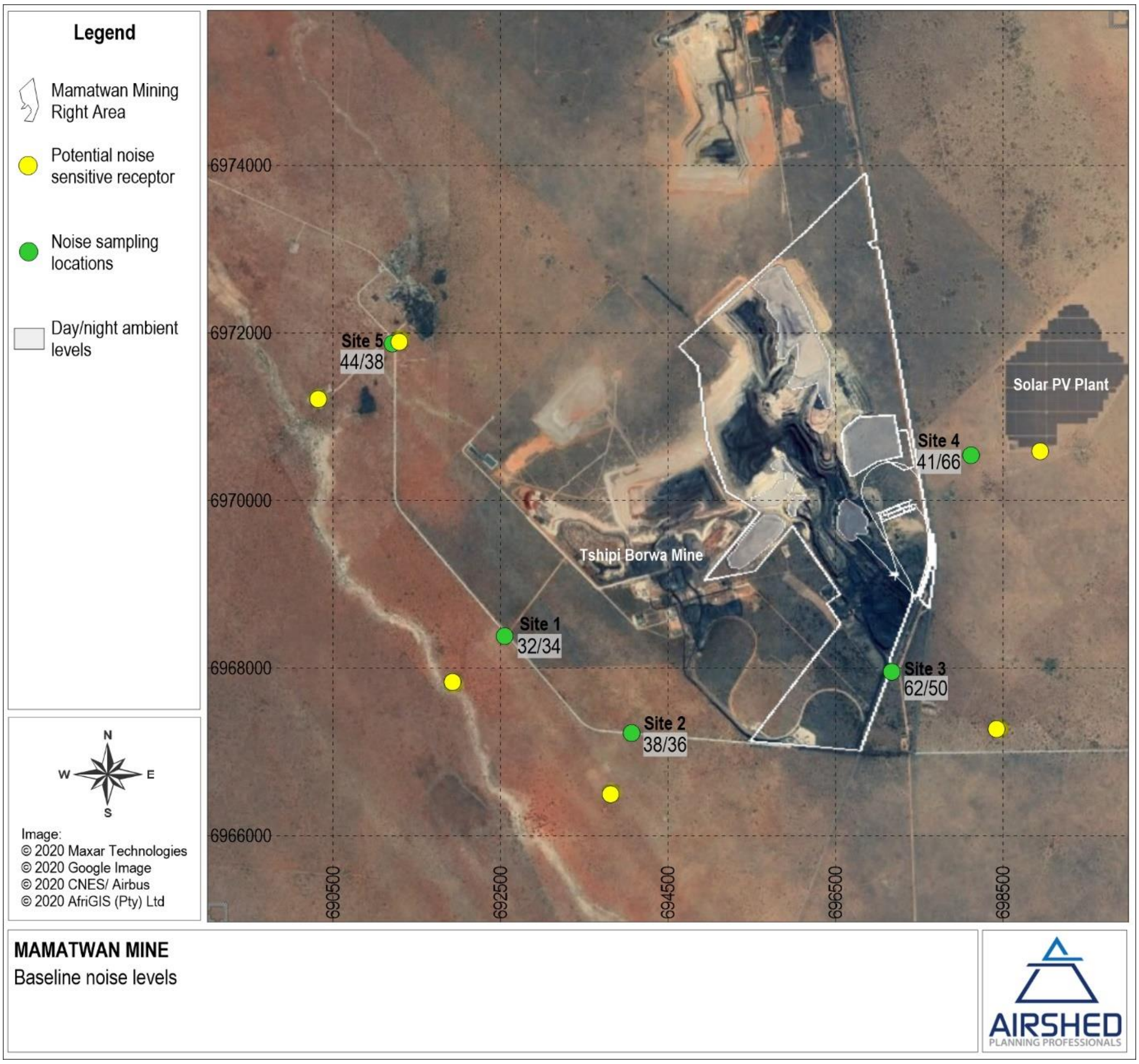


Figure 11: Baseline noise levels

4 Impact Assessment

The noise sources and scenarios included for this assessment is summarised Table 6.

Table 7: Noise sources and scenarios included for the current assessment

	Description	Noise sources	Comments
Proposed Layout Changes			
1	Establishment of a top-cut stockpile and associated crushing and screening plant: Additional storage space is required to stockpile top-cut material prior to processing at the sinter plant. The top-cut material will need to be subjected to crushing and screening (via a mobile crushing and screening plant) prior to the material being sent to the sinter plant. To develop this area indigenous vegetation needs to be cleared.	Crushing and screening	
2	Changes to waste rock dump height: MMT is proposing on increasing the approved 2005 EMPr height of the waste rock dumps from 50m to 80m.	Change in height will change the noise levels	Propagation modelling was undertaken to test the sensitivity of noise impact changes due to an increase in dump height by 30 m. The change in noise levels of 1 dBA extended up to a distance of 180 m from the dump source. There were no changes in noise levels offsite due to the increase in dump height. As the change in noise levels are expected to be minimal and the equipment list was not readily available for this source, it was not included in the modelling for the current assessment.
3	Upgrading the railway and railway loadout station: Transnet Freight Rail (TFR) plans to increase capacity of the Manganese rail line. In order to meet the TFR expansion requirements the loading rate of trains at the MMT needs to be increased. This can be achieved by upgrading the existing loadout station and related railway.	Stacker, reclaimer operations. Materials handling. Train.	Three proposed options were provided: - Option 1: The reduction of the loading times to 12 hours to load a train with 125 waggons. This option required the reconfiguration of the train station. All activities will be located in already disturbed areas. - Option 2: The reduction of the loading times to 8 hours to load a train with 125 waggons. This option requires upgrading the existing load out station and conveyor system and as such all activities will be located in already disturbed areas. - Option 3: The reduction of the loading time to 4 hours to load a train with 125 waggons. This option requires the establishment of a new railway loop, new loadout station, product stockpile areas, stackers and reclaimers. *Option 1 and Option 2 would result in similar noise levels to current activities.* *Option 3 would include additional noise sources such as a stacker and reclaimer as well as new loadout area, conveyor, and railway loop.*

Description		Noise sources	Comments
Proposed Activity Changes			
1	Sale of waste rock as aggregate: MMT is proposing on selling some of the waste rock that would have remained on surface in perpetuity as aggregate to third parties.	Crushing and screening	As the proposed activities have yet to be finalised, two scenarios were assessed: - No crushing and screening for the waste rock material - The use of crushing and screening for the waste nock material
2	Re-processing of DMS and Sinter Fines: DMS and Sinter fines are currently stockpiled in Adam's pit. MMT is proposing the re-processing of this material, where feasible, and will be sold to third parties.	Screening	

The noise source inventory, noise propagation modelling and results are discussed in Section 4.1 and Section 4.2 respectively.

4.1 Noise Sources and Sound Power Levels

A list of equipment (Table 7) for the project is provided Table 7. The noise sound pressure levels for all the equipment (obtained from measurements for similar operations) with the total octave band frequency spectra L_W's provided in Table 8.

Table 8: Noise source inventory for the project

Source Name	Source type	Location	Qty.	Speed (km/h)	Operating time, day and night-time hours		L_W (dB)
Crushing	Area	Top cut stockpile	1		16	8	127.6
Screening	Area	Top cut stockpile	1		16	8	117.0
Screening	Area	Adam's pit	1		16	8	117.0
Loaded train	Moving point source	Railway loadout station (Option 3)	1	12	(b)	0	29.5
Shunter	Moving point source	Railway loadout station (Option 3)	1	6	(b)	0	35.5
Loading	Point	Railway loadout station (Option 3)	1		1	0	109.7
Stacker and reclaimer	Area	Railway loadout station stockpiles (Option 3)	1		16	8	111.5
Conveyor to rail loadout stockpile	Line	Railway loadout station (Option 3)	1		16	8	109.7
Conveyor to loading of train	Line	Railway loadout station (Option 3)	1		1	0	109.7
Crushing (a)	Area	South of the western waste rock dumps	1		16	8	127.6
Screening (a)	Area	South of the western waste rock dumps	1		16	8	117.0

(a) Two options were simulated: (i) where no crushing and screening activities take place; and (ii) where crushing and screening activities take place for the resale of waste rock material

(b) The emission level was calculated assuming 1 train per day

Table 9: Octave band frequency spectra L_W's for the project equipment

Equipment details	Type	L_W octave band frequency spectra (dB)							L_W (dB)	L_{WA} (dBA)	Source
		63	125	250	500	1000	2000	4000			
CRUSHER	L_W	121.1	122.3	120.1	120	117.3	112.5	106.3	127.6	121.7	FMAC database
SCREEN	L_W	106	108.9	107.7	109	109.2	109	109	117.0	115.3	FMAC database
STACKER	L_W	108.1	103.4	102.3	103.1	99.9	97.3	89.6	111.5	104.9	Airshed database
LOADER	L_W	108	116	107	108	105	99	95	117.9	109.7	FMAC database
CONVEYOR	L_W	108	116	107	108	105	99	95	117.9	109.7	FMAC database

4.2 Noise Propagation and Simulated Noise Levels

The propagation of noise generated during the operational 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 Section 4.1, were applied in the model.

Table 9 provides a summary of simulated noise levels at NSRs. Results are also presented in isopleth form (Figure 12 to Figure 23). The simulated equivalent continuous day-time rating level ($L_{Req,d}$) of 55 dBA (IFC residential guideline level and SANS rating for urban districts) due to project operations extends ~340 m to the east of the Mamatwan mining right area for railway loadout station Option 3 (with and without crushing and screening activities on the waste rock material). The simulated equivalent continuous night-time rating level ($L_{Req,n}$) of 45 dBA (IFC residential guideline level and SANS rating for urban districts) due to project operations extends ~200 m to the east of the Mamatwan mining right area for railway loadout station Option 1 or Option 2 and ~480 m to the west and ~750 m to the east of the Mamatwan mining right area for railway loadout station Option 3 (with and without crushing and screening activities on the waste rock material). The simulated equivalent continuous day/night-time rating level ($L_{Req,dn}$) of 55 dBA (SANS rating for urban districts) due to project operations extends ~30 m to the east of the Mamatwan mining right area for railway loadout station Option 1 or Option 2 and ~300 m to the west and ~750 m to the east of the Mamatwan mining right area for railway loadout station Option 3 (with and without crushing and screening activities on the waste rock material).

The project activities, assuming railway loadout station Option 1, Option 2 or Option 3, are predicted to be within IFC residential and industrial guideline levels and SANS rating for urban and industrial districts at all potential NSRs (Table 9).

For a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level is not detectable. According to SANS 10103 (2008); 'little' to 'medium' reaction with 'sporadic' to 'widespread' complaints expected from the community for increased noise levels up to 10 dBA. 'Strong' reaction with 'threats of community action' is expected from the community for increased noise levels of between 10 dBA to 15 dBA. With the approach adopted for the assessment (detailed in Section 1.6), the predicted increase in noise levels at all NSRs less than 1 dBA for all options simulated. The increase in noise levels at NSRs due to project operations should therefore not be detectable.

The 1992 Noise Control Regulations 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. The predicted increase in noise levels due to project operations at NSRs are provided in Table 9. Noise level increases of more than 7 dBA are not simulated at any of the potential NSRs within the study area.

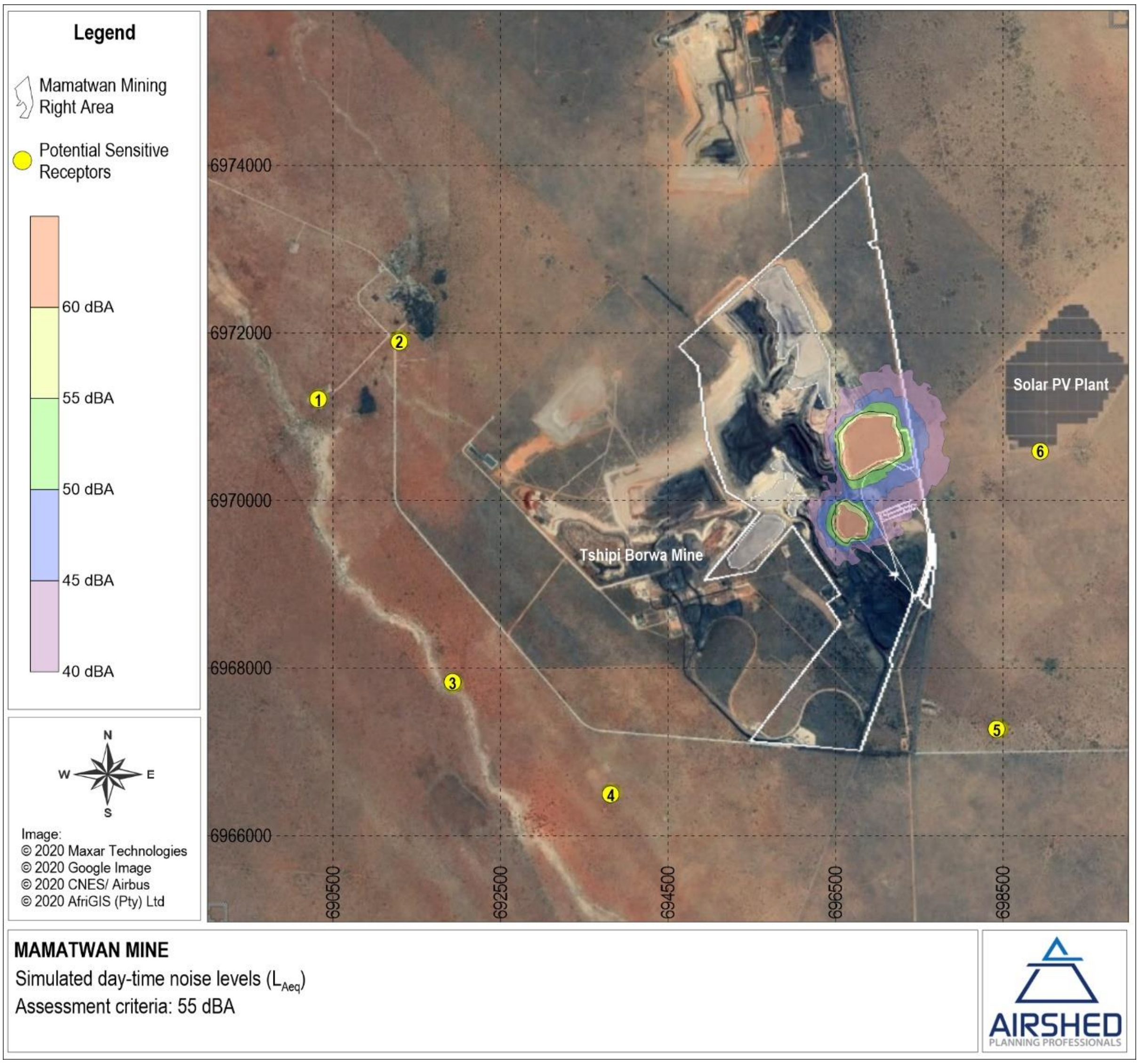


Figure 12: Simulated equivalent continuous day-time rating level ($L_{Req,d}$) for project activities (railyard Option 1 or Option 2 without crusher and screener for the waste material)

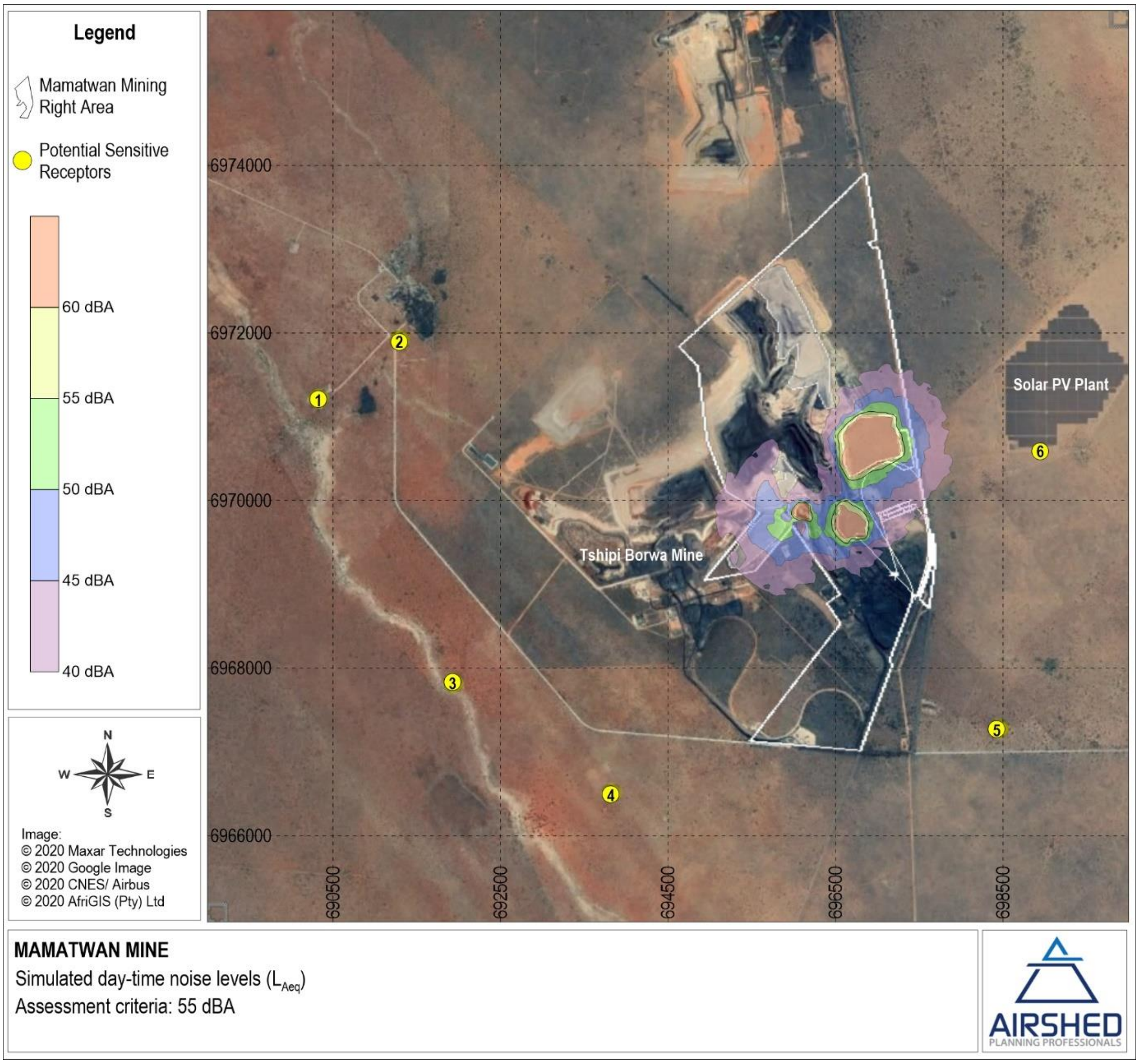


Figure 13: Simulated equivalent continuous day-time rating level ($L_{Req,d}$) for project activities (railyard Option 1 or Option 2 with crusher and screener for the waste material)

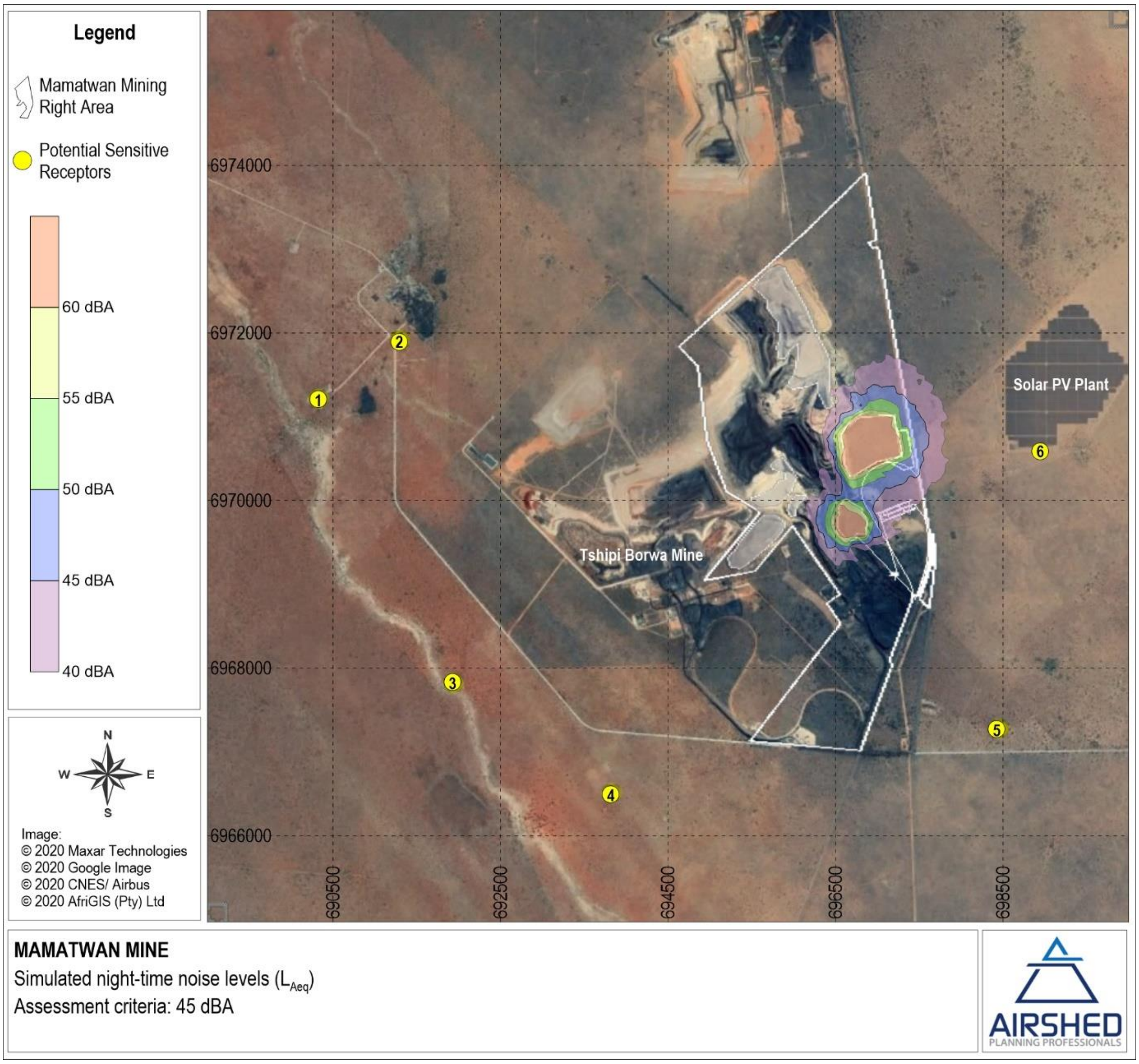


Figure 14: Simulated equivalent continuous night-time rating level ($L_{Req,n}$) for project activities (railyard Option 1 or Option 2 without crusher and screener for the waste material)

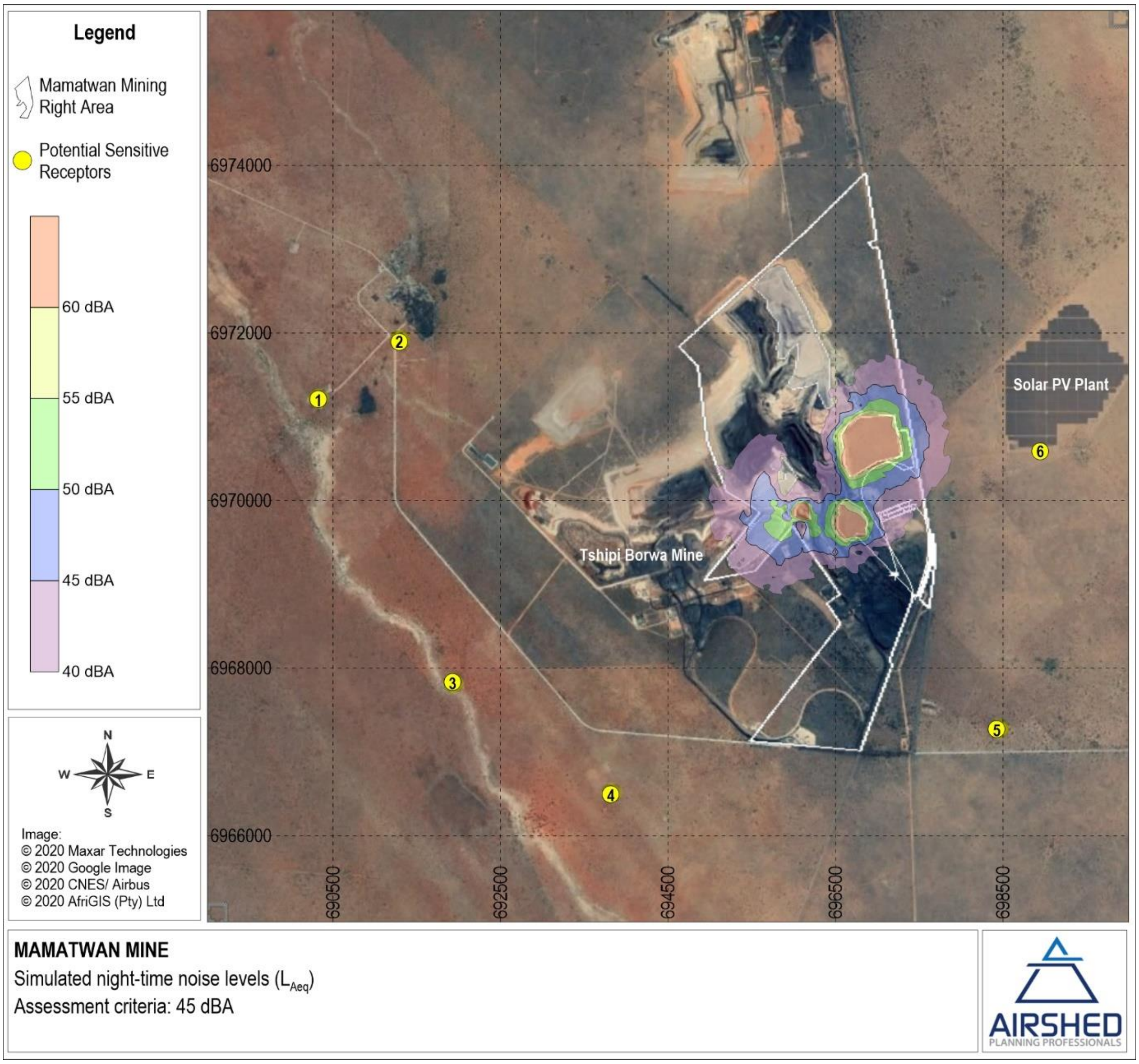


Figure 15: Simulated equivalent continuous night-time rating level ($L_{Req,n}$) for project activities (railyard Option 1 or Option 2 with crusher and screener for the waste material)

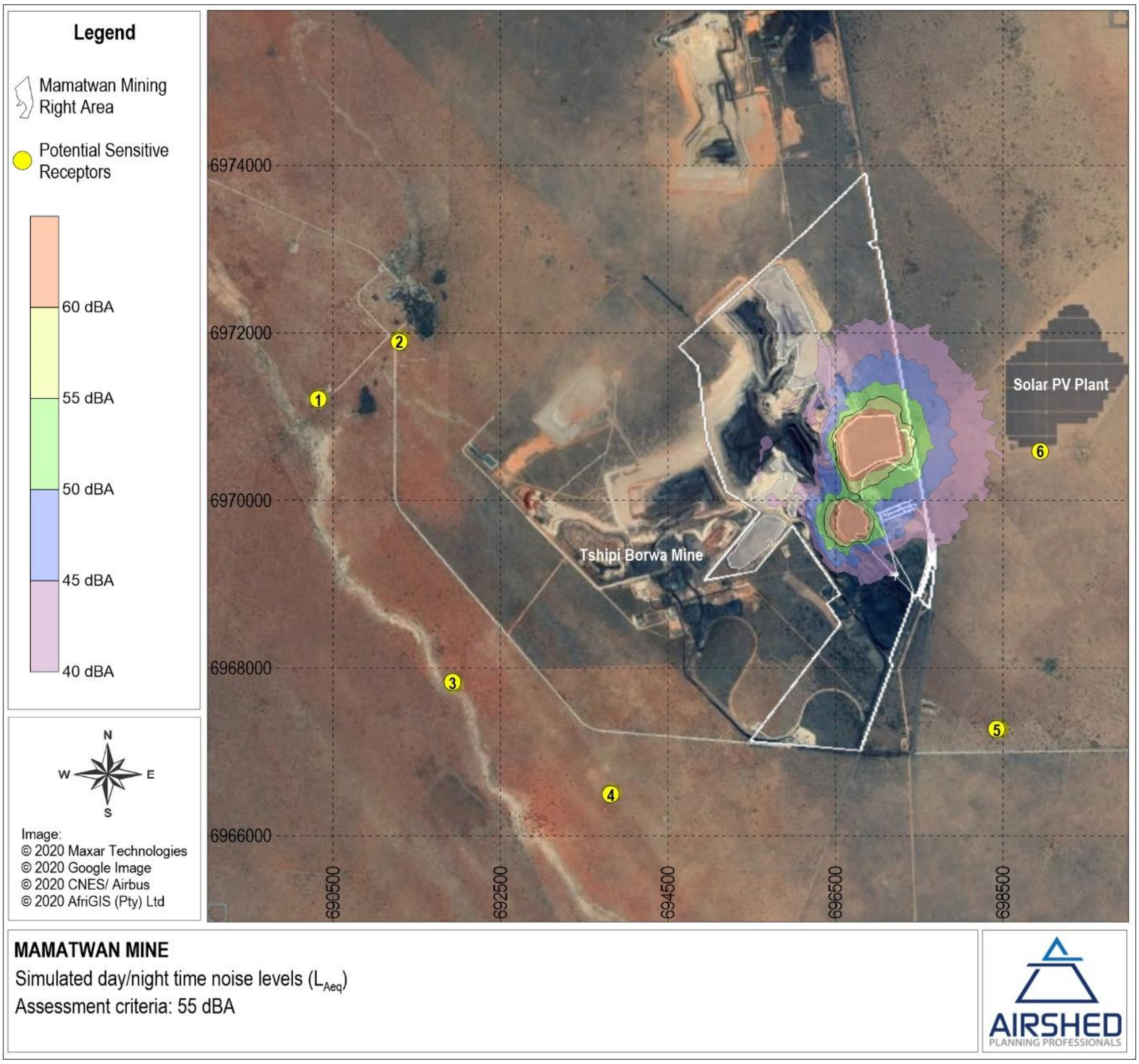


Figure 16: Simulated equivalent continuous day/night-time rating level ($L_{Req,dn}$) for project activities (railyard Option 1 or Option 2 without crusher and screener for the waste material)

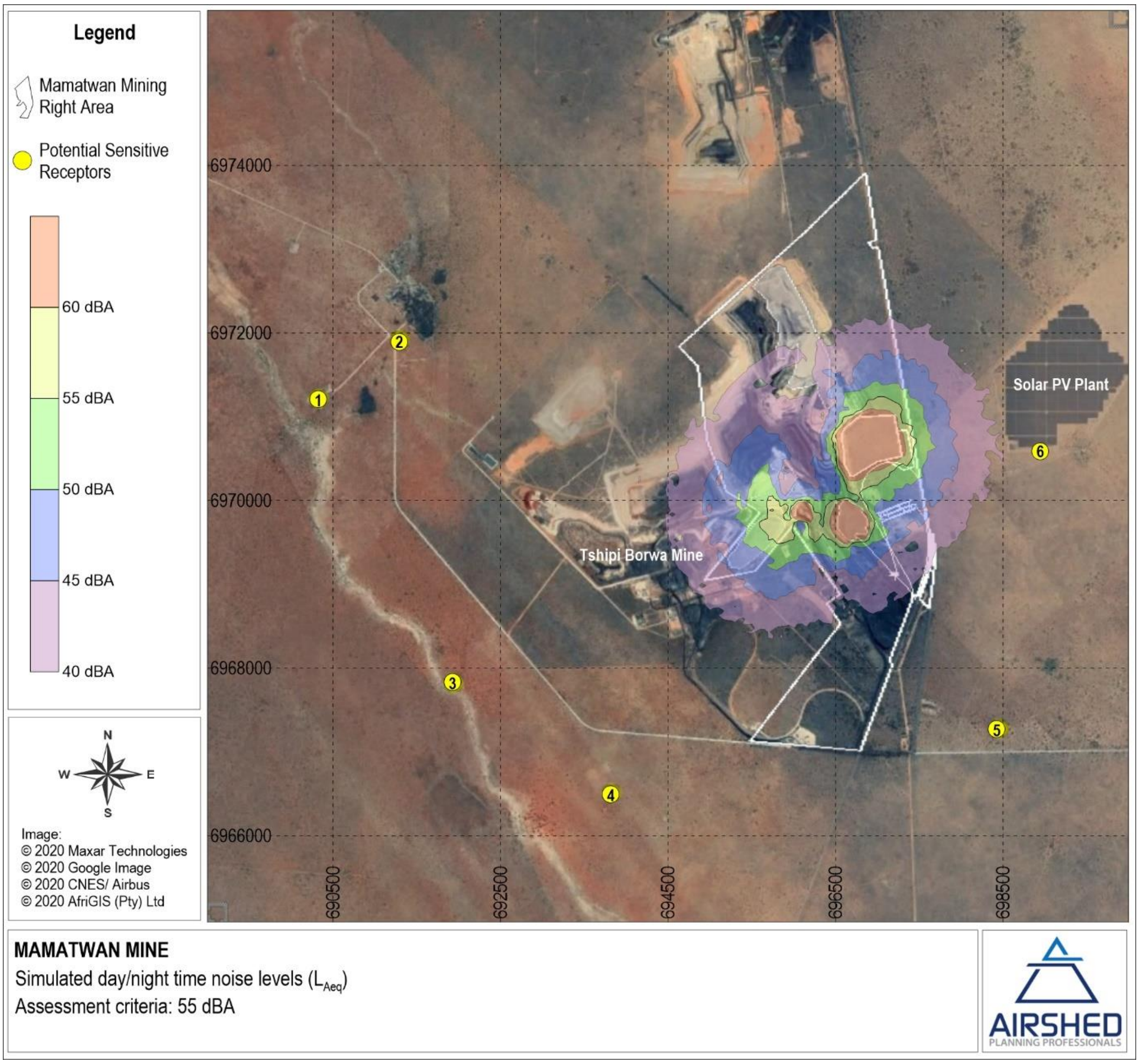


Figure 17: Simulated equivalent continuous day/night-time rating level ($L_{Req,dn}$) for project activities (railyard Option 1 or Option 2 with crusher and screener for the waste material)

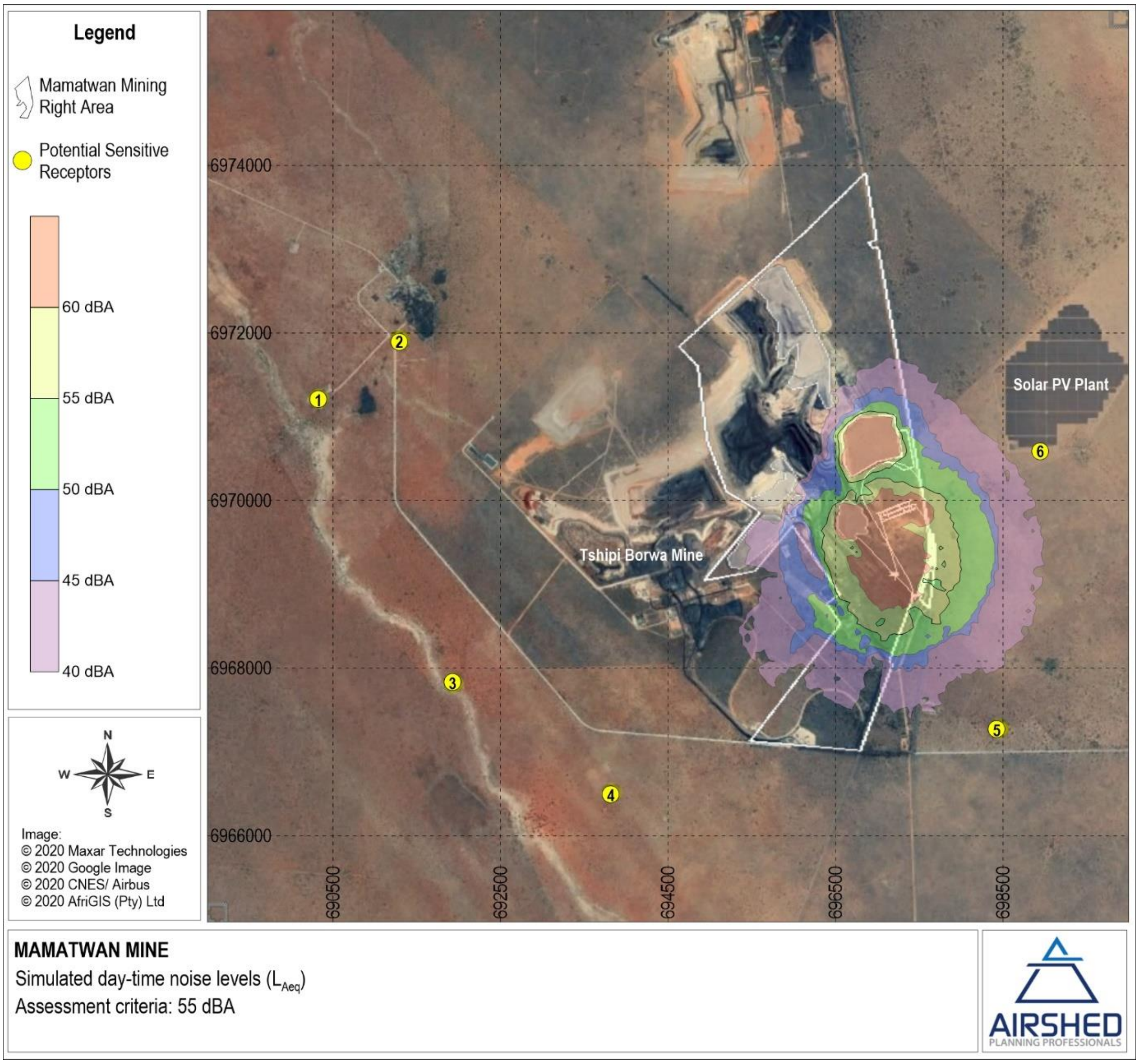


Figure 18: Simulated equivalent continuous day-time rating level ($L_{Req,d}$) for project activities (railyard Option 3 without crusher and screener for the waste material)

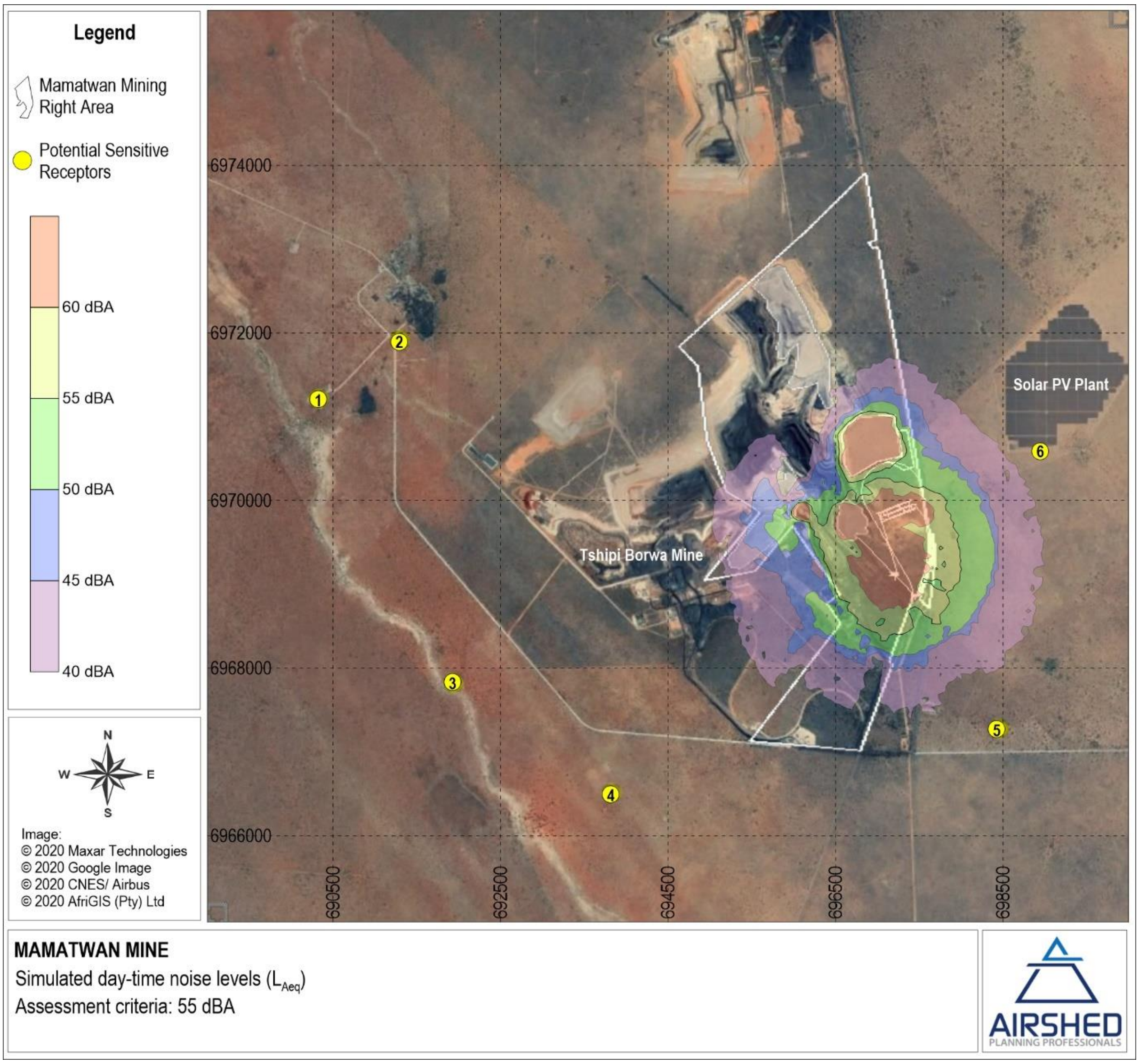


Figure 19: Simulated equivalent continuous day-time rating level ($L_{Req,d}$) for project activities (railyard Option 3 with crusher and screener for the waste material)

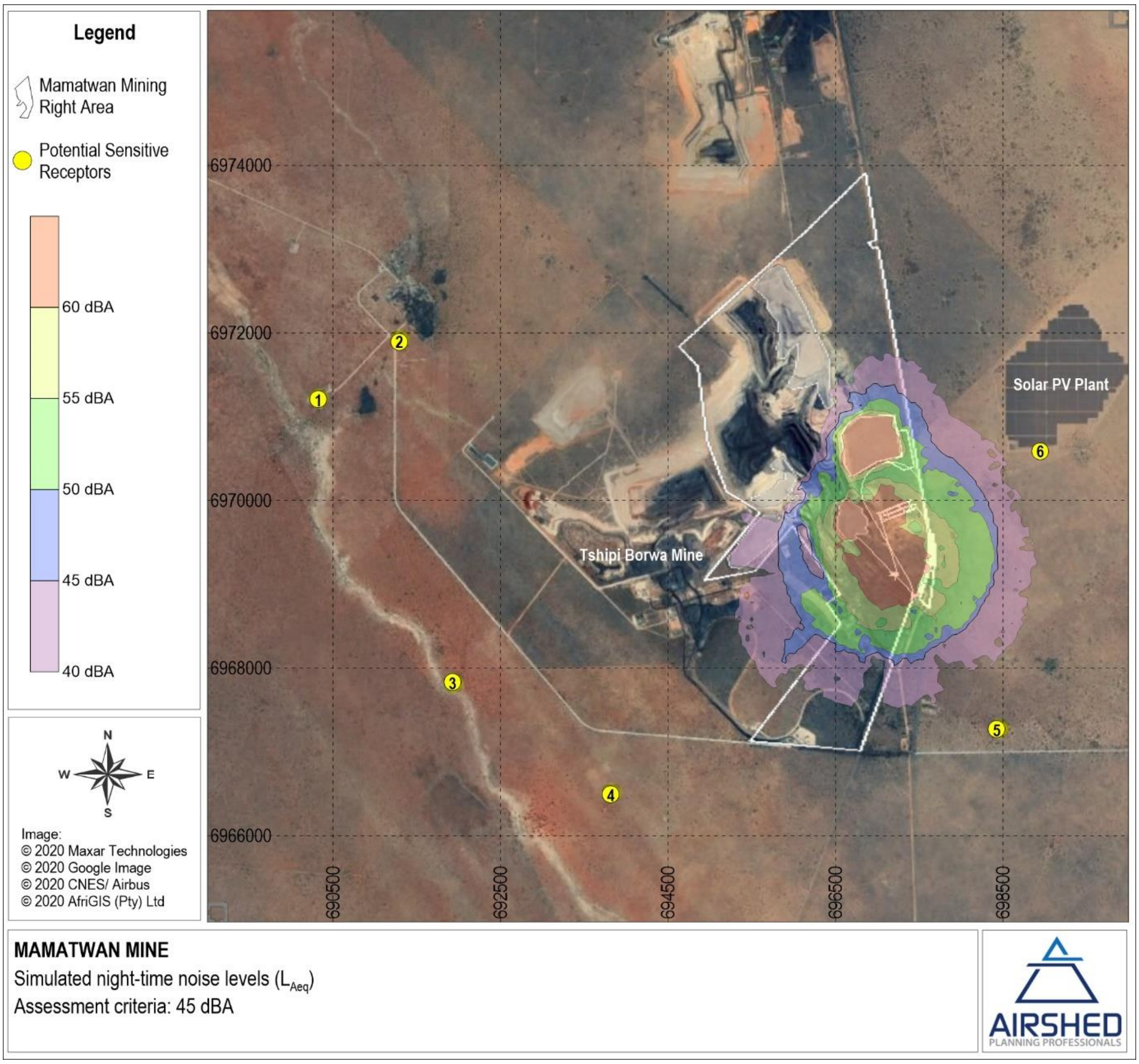


Figure 20: Simulated equivalent continuous night-time rating level ($L_{Req,n}$) for project activities (railyard Option 3 without crusher and screener for the waste material)

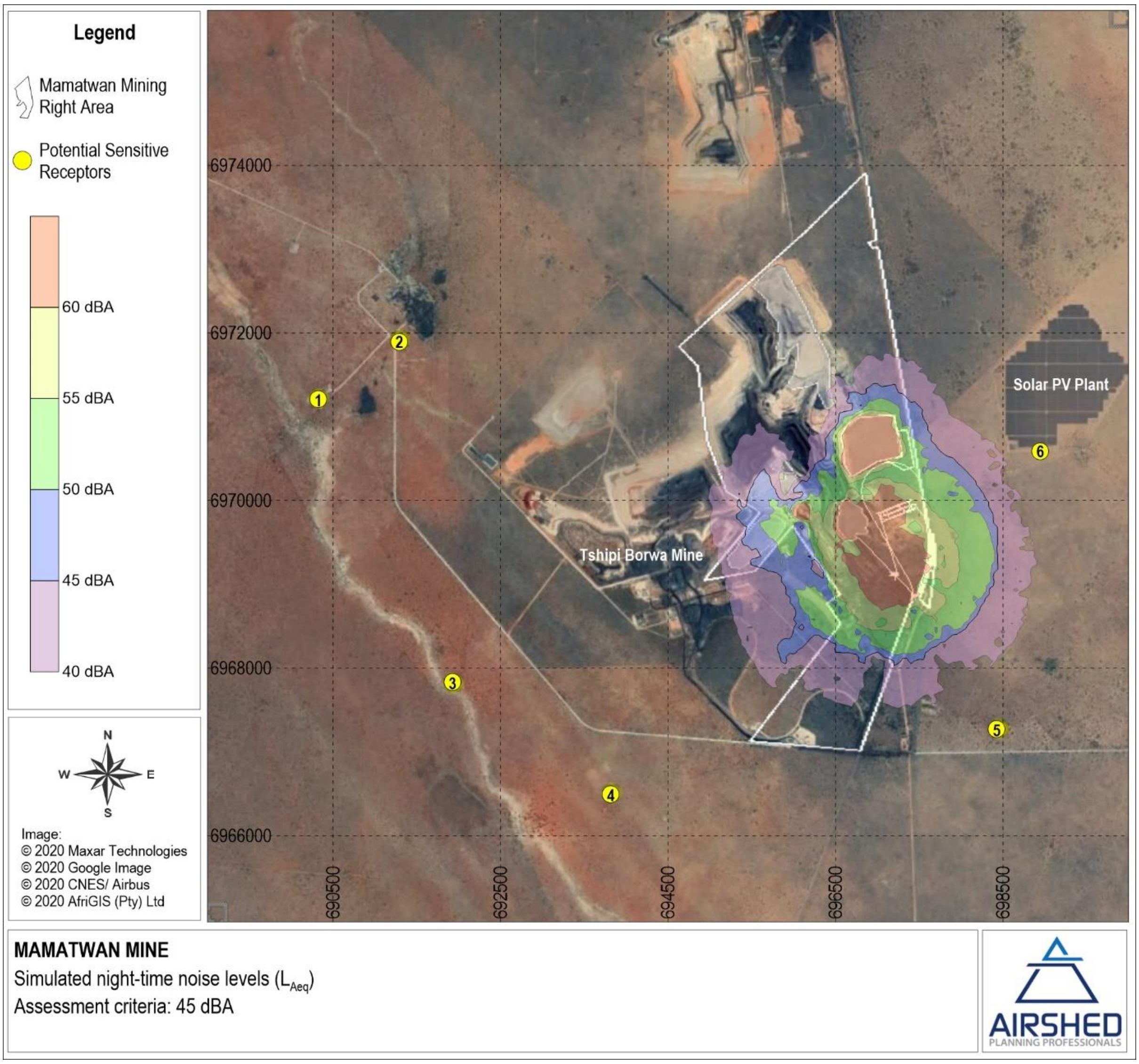


Figure 21: Simulated equivalent continuous night-time rating level ($L_{Req,n}$) for project activities (railyard Option 3 with crusher and screener for the waste material)

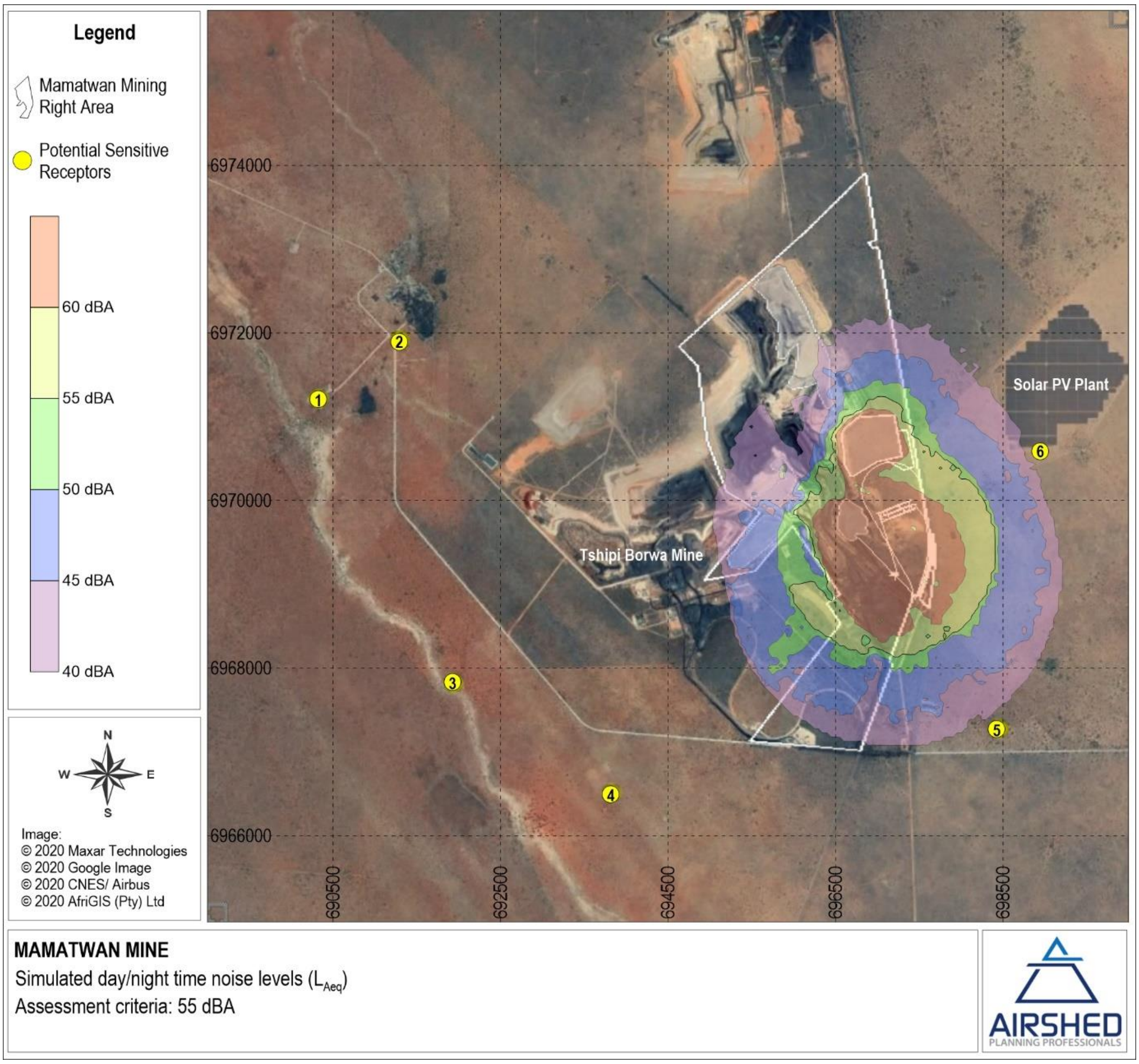


Figure 22: Simulated equivalent continuous day/night-time rating level ($L_{Req,dn}$) for project activities (railyard Option 3 without crusher and screener for the waste material)

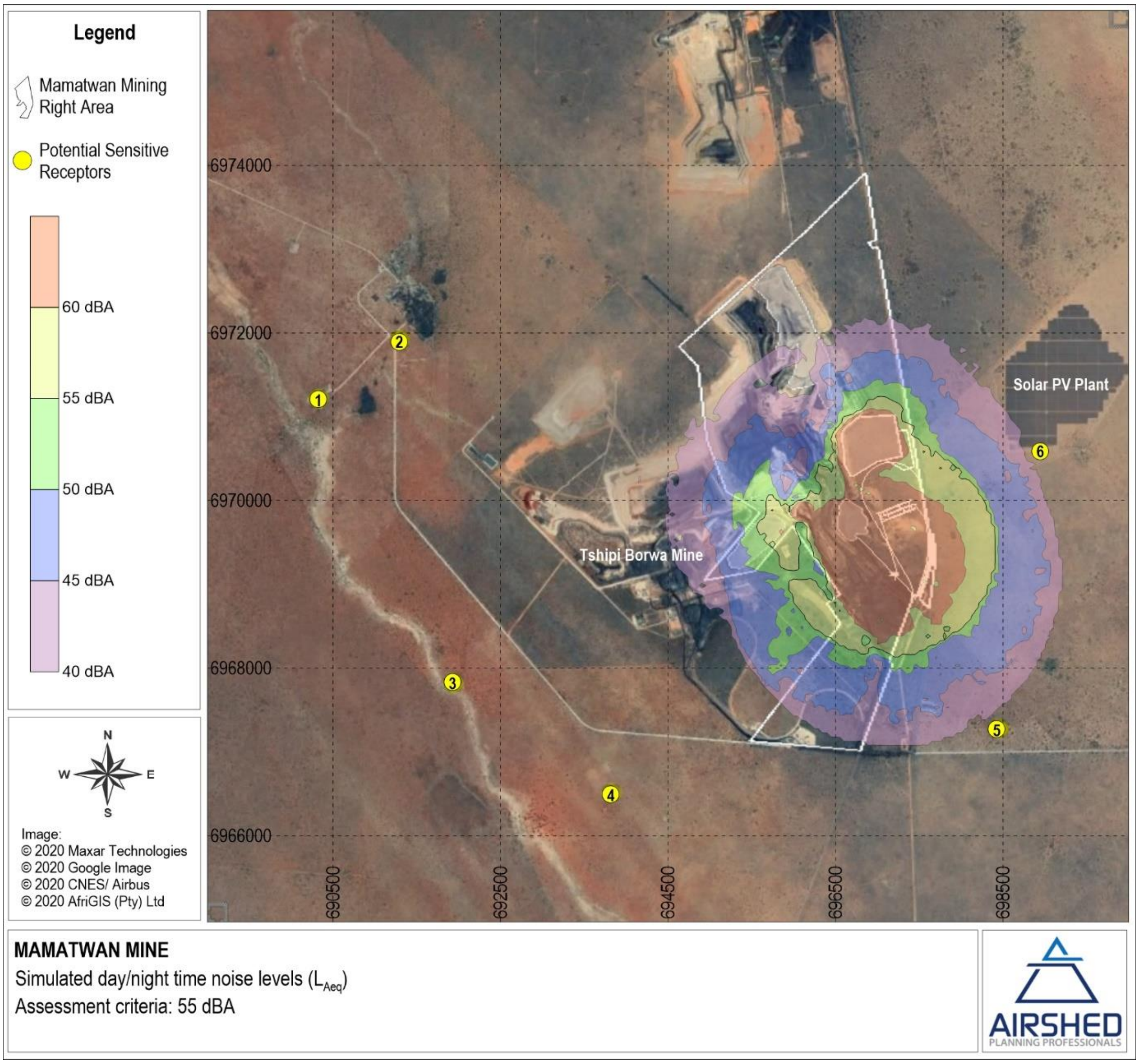


Figure 23: Simulated equivalent continuous day/night-time rating level ($L_{Req,dn}$) for project activities (railyard Option 3 with crusher and screener for the waste material)

Table 10: Summary of simulated noise levels (provided as dBA) due to the project and baseline noise measurements at NSR within the study area

Noise Sensitive Receptor	Industrial or residential receptor	Project operations		Baseline		Increase Above Baseline (e)	
		Day	Night	Day	Night	Day	Night
Railway and railway loadout station Option 1 and Option 2 (no crushing and screening activities on the waste rock material)							
1	Residential	0	0	44	38	0.0	0.0
2	Residential	0	0	44	38	0.0	0.0
3	Residential	0	0	32	34	0.0	0.0
4	Residential	0	0	38	36	0.0	0.0

Noise Sensitive Receptor	Industrial or residential receptor	Project operations		Baseline		Increase Above Baseline (e)	
		Day	Night	Day	Night	Day	Night
5	Residential	0	0	38(d)	36(d)	0.0	0.0
6	Industrial	28		41		0.2	
Railway and railway loadout station Option 1 and Option 2 (crushing and screening activities on the waste rock material)							
1	Residential	0	0	44	38	0.0	0.0
2	Residential	0	0	44	38	0.0	0.0
3	Residential	0	0	32	34	0.0	0.0
4	Residential	0	0	38	36	0.0	0.0
5	Residential	0	0	38(d)	36(d)	0.0	0.0
6	Industrial	28		41		0.2	
Railway and railway loadout station Option 3 (no crushing and screening activities on the waste rock material)							
1	Residential	0	0	44	38	0.0	0.0
2	Residential	0	0	44	38	0.0	0.0
3	Residential	0	0	32	34	0.0	0.0
4	Residential	0	0	38	36	0.0	0.0
5	Residential	0	0	38(d)	36(d)	0.0	0.0
6	Industrial	33		41		0.7	
Railway and railway loadout station Option 3 (crushing and screening activities on the waste rock material)							
1	Residential	0	0	44	38	0.0	0.0
2	Residential	0	0	44	38	0.0	0.0
3	Residential	0	0	32	34	0.0	0.0
4	Residential	0	0	38	36	0.0	0.0
5	Residential	0	0	38(d)	36(d)	0.0	0.0
6	Industrial	33		41		0.7	

(a) Exceeds day-time IFC guideline of 55 dBA for residences

(b) Exceeds night-time IFC guideline of 45 dBA for residences

(c) Exceeds day-time IFC guideline of 70 dBA for industrial

(d) Assuming baseline noise levels similar to measurements for NSR4

(e) Likely community response:

	0 to 1 dBA – No reaction, increase not detectable
	1 to 3 dBA – Increase just detectable to persons with average hearing acuity, annoyance unlikely.
	3 to 5 dBA – There will be 'little' reaction with 'sporadic complaints'.
	5 to 10 dBA – There will be 'little' to 'medium' reaction with 'sporadic' to 'widespread' complaints.
	10 to 15 dBA – There will be a 'strong' reaction with 'threats of community action'.
	> 15 dBA – There will be a 'very strong' reaction with 'vigorous community action'.

5 Management Measures

In the quantification of noise emissions and simulation of noise levels as a result of the project, it was found that environmental noise evaluation criteria for residential, educational, and institutional receptors will be exceeded at the closest off-site noise sensitive receptor to the east of the Mamatwan Mine during the day.

5.1 Controlling Noise at the Source

5.1.1 General Management Measures

Management measures to be implemented include the following:

- Train staff on noise control plan during health & safety briefings.
- Avoid clustering of equipment near receptors.
- Ensure periods of respite are provided in the case of unavoidable maximum noise level events.
- Ensure high level of maintenance on all equipment. Any change in the noise emission characteristics of equipment should serve as trigger for withdrawing it for maintenance.
- Where possible, other non-routine noisy activities such as construction, decommissioning, start-up and maintenance, should be limited to day-time hours.
- A **noise complaints register must be kept**.

5.1.2 Specifications and Equipment Design

As the site or activity is in close proximity to NSRs, equipment and methods to be employed should be reviewed to ensure the quietest available technology is used. Equipment with lower sound power levels must be selected in such instances and vendors/contractors should be required to guarantee optimised equipment design noise levels.

5.1.3 Enclosures

As far as is practically possible, source of significant noise should be enclosed. The extent of enclosure will depend on the nature of the machine and their ventilation requirements.

It should be noted that the effectiveness of partial enclosures and screens can be reduced if used incorrectly, e.g. noise should be directed into a partial enclosure and not out of it, there should not be any reflecting surfaces such as parked vehicles opposite the open end of a noise enclosure.

5.1.4 Use and Siting of Equipment and Noise Sources

Equipment should be sited as far away from NSRs as possible. Also:

- Machines used intermittently should be shut down between work periods and not left running unnecessarily. This will reduce noise and conserve energy.

- Equipment from which noise generated is known to be particularly directional, should be orientated so that the noise is directed away from NSRs.

5.1.5 Maintenance

Regular and effective maintenance of equipment and plants are essential to noise control. Increases in equipment noise are often indicative of eminent mechanical failure. Also, sound reducing equipment/materials can lose effectiveness before failure and can be identified by visual inspection.

Noise generated by vibrating machinery and equipment with vibrating parts can be reduced through the use of vibration isolation mountings or proper balancing. Noise generated by friction in conveyor rollers, trolley etc. can be reduced by sufficient lubrication.

5.2 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 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** SLM that meets all appropriate 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 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 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 Impact Significance Rating

The 2014 EIA Regulations, as amended in 2017, require that impacts be assessed in terms of the nature, significance, consequence, extent, duration and probability of the impacts including the degree to which these impacts can be reversed, may cause irreplaceable loss of resources, and can be avoided, managed or mitigated. The significance ranking methodology used in this report is provided in Appendix F.

The significance ranking for the construction, operation and closure phases is provided in Table 10 and provides a low (prior to mitigation) to very low (with mitigation) significance ranking.

Table 11: Significance rating for noise impacts due to project activities

Activity	Aspect	Impact	Mitigation	Criteria	Rating prior to mitigation		Rating post mitigation	
Construction Phase								
Land clearing, levelling, infrastructure works	Noise Impacts	**NEGATIVE IMPACT:** The construction activities at the site will result in increased noise levels.	• Use temporary noise barriers and use 'low noise' equipment (including alternative reversing alarms), where possible. • Train staff on noise control plan during health and safety briefings. • Investigate use of alternatives to audible reversing alarms (such as broadband noise emitting models) or configure to maximise forward movements of mobile plant. • Avoid clustering of mobile equipment near receptors. • Ensure periods of respite are provided in the case of unavoidable maximum noise level events. • Ensure high level of maintenance on all diesel-powered equipment. This should 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 trigger for withdrawing it for maintenance. • Maintain road surface regularly to avoid corrugations, potholes etc. • Activities should be limited to day-time hours.	Intensity	L	**Low**	L	**Very Low**
				Duration	L		L	
				Extent	M		L	
				Consequence	L		L	
Operation Phase								
Project activities including railway loadout station Option 1 or Option 2 with no crushing and screening plant for the waste rock material	Noise Impacts	**NEGATIVE IMPACT:** Project activities will result in increased noise levels.	• Use enclosures for noisy equipment, where possible. • Train staff on noise control plan during health and safety briefings. • Equipment with lower sound power levels must be selected in such instances and vendors/contractors should be required to guarantee optimised equipment design noise levels. • Site equipment further away from receptors where possible. • Ensure periods of respite are provided in the case of unavoidable maximum noise level events. • Ensure high level of maintenance on all equipment. Any change in the noise emission characteristics of equipment should serve as trigger for withdrawing it for maintenance.	Intensity	VL	**Low**	VL	**Very Low**
				Duration	H		H	
				Extent	M		VL	
				Consequence	L		L	
Project activities including railway loadout station Option 1 or Option 2 with crushing	Noise Impacts	**NEGATIVE IMPACT:** Project activities will result in	• Use enclosures for noisy equipment, where possible. • Train staff on noise control plan during health and safety briefings. • Equipment with lower sound power levels must be selected in such instances and vendors/contractors should be required to guarantee optimised equipment design noise levels.	Intensity	VL	**Low**	VL	**Very Low**
				Duration	H		H	

Activity	Aspect	Impact	Mitigation	Criteria	Rating prior to mitigation		Rating post mitigation	
and screening plant for the waste rock material		increased noise levels.	• Site equipment further away from receptors where possible. • Ensure periods of respite are provided in the case of unavoidable maximum noise level events. • Ensure high level of maintenance on all equipment. Any change in the noise emission characteristics of equipment should serve as trigger for withdrawing it for maintenance.	Extent	M		VL	
				Consequence	L		L	
Project activities including railway loadout station Option 3 with no crushing and screening plant for the waste rock material	Noise Impacts	**<u>NEGATIVE IMPACT:</u>** Project activities will result in increased noise levels.	• Use enclosures for noisy equipment, where possible. • Train staff on noise control plan during health and safety briefings. • Equipment with lower sound power levels must be selected in such instances and vendors/contractors should be required to guarantee optimised equipment design noise levels. • Site equipment further away from receptors where possible. • Ensure periods of respite are provided in the case of unavoidable maximum noise level events. • Ensure high level of maintenance on all equipment. Any change in the noise emission characteristics of equipment should serve as trigger for withdrawing it for maintenance.	Intensity	VL	**Low**	VL	**Very Low**
				Duration	H		H	
				Extent	M		VL	
				Consequence	L		L	
Project activities including railway loadout station Option 3 with crushing and screening plant for the waste rock material	Noise Impacts	**<u>NEGATIVE IMPACT:</u>** Project activities will result in increased noise levels.	• Use enclosures for noisy equipment, where possible. • Train staff on noise control plan during health and safety briefings. • Equipment with lower sound power levels must be selected in such instances and vendors/contractors should be required to guarantee optimised equipment design noise levels. • Site equipment further away from receptors where possible. • Ensure periods of respite are provided in the case of unavoidable maximum noise level events. • Ensure high level of maintenance on all equipment. Any change in the noise emission characteristics of equipment should serve as trigger for withdrawing it for maintenance.	Intensity	VL	**Low**	VL	**Very Low**
				Duration	H		H	
				Extent	M		VL	
				Consequence	L		L	
Closure Phase								
Demolition and/ or removal of structure, rehabilitation of dumps, etc.	Noise Impacts	**<u>NEGATIVE IMPACT:</u>** Demolition, movement of and handling of material will result in	Use temporary noise barriers and use 'low noise' equipment (including alternative reversing alarms), where possible; Train staff on noise control plan during health & safety briefings Investigate use of alternatives to audible reversing alarms (such as broadband noise emitting models) or configure to maximise forward movements of mobile plant; Avoid clustering of mobile equipment near receptors; Ensure periods of respite are provided in the case of unavoidable maximum	Intensity	M	**Low**	L	**Very Low**
				Duration	L		L	

Activity	Aspect	Impact	Mitigation	Criteria	Rating prior to mitigation		Rating post mitigation	
		increased noise levels.	noise level events; Ensure high level of maintenance on all diesel-powered equipment. This should 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 trigger for withdrawing it for maintenance. Maintain road surface regularly to avoid corrugations, potholes etc. Activities should be limited to day-time hours.	Extent	M		L	
				Consequence	L		L	

7 Conclusion

Based on the findings of the assessment and provided the recommended management and mitigation measures are in place, it is the specialist opinion that the project may be authorised.

8 References

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Appendix A – Specialist Curriculum Vitae

FULL CURRICULUM VITAE

Name of Firm	Airshed Planning Professionals (Pty) Ltd
Name of Staff	René von Gruenewaldt (*nee* Thomas)
Profession	Air Quality Scientist
Date of Birth	13 May 1978
Years with Firm	More than 15 years
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

René von Gruenewaldt (Air Quality Scientist): René joined Airshed Planning Professionals (Pty) Ltd (previously known as Environmental Management Services cc) in 2002. She has, as a Specialist, attained over fifteen (15) years of experience in the Earth and Natural Sciences sector in the field of Air Quality and six (6) years of experience in the field of 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 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. Her experience with emission models includes Tanks 4.0 (for the quantification of tank emissions), WATER9 (for the quantification of waste water 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.

Having worked on projects throughout Africa (i.e. South Africa, Mozambique, Malawi, Kenya, Angola, Democratic Republic of Congo, Namibia, Madagascar and Egypt) René 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

Mining and Ore Handling

René 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. René 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 and the Tsoeneng Landfill (Lesotho). 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

René 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).

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

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)
ARCINFO	GIMS, Course: Introduction to ARCINFO 7 (2001)

COUNTRIES OF WORK EXPERIENCE

South Africa, Mozambique, Malawi, Liberia, Kenya, Angola, Democratic Republic of Congo, 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 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	Good	Good

CERTIFICATION

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

______________________	06/08/2019
Signature of staff member	Date (Day / Month / Year)

Full name of staff member: René Georgeinna von Gruenewaldt

Appendix B – Declaration of Independence

DECLARATION OF INDEPENDENCE - PRACTITIONER

Name of Practitioner: René 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:
Atmospheric Impact Report in terms of section 30 of the Act.
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 Midrand on this 29th of July 2020

SIGNATURE
Principal Noise Scientist
CAPACITY OF SIGNATORY

Appendix C – Field Log Sheets and Site Photographs

SITE NUMBER: Mamnt001 (sample 5) (Site 5)			**SLM DATA RECORD:** mamnt001		
Longitude/Easting:		**Latitude/Northing:**		**Elevation:**	
Short Location Description & Notes:					

SETUP	Start Date & Time:	End Date & Time:	Sensitivity Before:	Sensitivity After:

METEOROLOGY	Wind Speed (m/s)	Wind Direction (°)	Temperature (°C)	Humidity (%)	Clouds (%)	Remarks:
Start	1.9	W	~~18~~ 22	20.9	0	-Dogs @ 45dB, Gustywinds
Middle						· Birds @ 53dB
End						

NOISE CLIMATE	☒ Birds	☐ Insects	☒ Dogs	☐ Music	☐ Community	☐ Air Traffic	☐ Road Traffic	☐ Constr.	☐ Other
Description: Trees and shrubs, gravel road, open land, uncultivate									

EVENTS

Time	Description	Time	Description	Time	Description	Time	Description
10:36:58	Car passing	21:42	Car passing				
-38:08	"	-22:46					
38:30	Man talking						
-38:39							
42:10	Car passing						
-43:33							
44:27	Birds						
11:09:36	Car passing						
-10:37							
11:04	Car passing						
-11:50							

Page __ of __

SITE NUMBER: Sample 1 (site 1)		SLM DATA RECORD: Mamat002
Longitude/Easting:	Latitude/Northing:	Elevation:
Short Location Description & Notes:		

SETUP	Start Date & Time:	End Date & Time:	Sensitivity Before:	Sensitivity After:

METEOROLOGY	Wind Speed (m/s)	Wind Direction (°)	Temperature (°C)	Humidity (%)	Clouds (%)	Remarks:
Start	1.1 - 2.3	N.W	23.2	19.7	0	- Could hear mine operation faraway (Tshipi) @ 1 33dB - Gusty winds throughout @ 38dB - 40dB
Middle						
End						

NOISE CLIMATE	☒ Birds	☐ Insects	☐ Dogs	☐ Music	☐ Community	☐ Air Traffic	☐ Road Traffic	☐ Constr.	☐ Other
Description: Trees lot, gravel road, open land									

EVENTS

Time	Description	Time	Description	Time	Description	Time	Description
12:06:06	Mine operation						
19:29	Gusty winds						
06:50	"						

Page __ of __

SITE NUMBER: Sample 2 (Site 2)		SLM DATA RECORD: mamat 003
Longitude/Easting:	Latitude/Northing:	Elevation:
Short Location Description & Notes:		

SETUP	Start Date & Time:	End Date & Time:	Sensitivity Before:	Sensitivity After:

METEOROLOGY	Wind Speed (m/s)	Wind Direction (°)	Temperature (°C)	Humidity (%)	Clouds (%)	Remarks:
Start	1.2 - 2.9	W	~~28~~ 27	24.2	0	Gusty winds
Middle						
End						

NOISE CLIMATE	☐ Birds	☐ Insects	☐ Dogs	☐ Music	☐ Community	☐ Air Traffic	☐ Road Traffic	☐ Constr.	☐ Other
Description: gravel road, small shrubs & trees									

EVENTS							
Time	Description	Time	Description	Time	Description	Time	Description
13:15:50	Gustwinds						
27:11	"						

Page __ of __

SITE NUMBER: Sample4 (Site 4)		SLM DATA RECORD: mamat004
Longitude/Easting:	Latitude/Northing:	Elevation:
Short Location Description & Notes:		

SETUP	Start Date & Time:	End Date & Time:	Sensitivity Before:	Sensitivity After:

METEOROLOGY	Wind Speed (m/s)	Wind Direction (°)	Temperature (°C)	Humidity (%)	Clouds (%)	Remarks:
Start	1.2 - 3.1	N.W	26.9	18.1	0	- Gusty winds
Middle						-
End						

NOISE CLIMATE	☒ Birds	☐ Insects	☐ Dogs	☐ Music	☐ Community	☐ Air Traffic	☒ Road Traffic	☐ Constr.	☐ Other
Description: gravel road, small trees & shrubs									

EVENTS

Time	Description	Time	Description	Time	Description	Time	Description
14:58:53	Gusty winds						
-00:01	"						
05:04	car passing &						
-06:04	hooting on main						
	road						
07:02	Birds						
07:15	"						
4							
15:48:57	Truck hooting						

Page __ of __

SITE NUMBER: Sample 3 (Site 3)		SLM DATA RECORD: Mamat005
Longitude/Easting:	Latitude/Northing:	Elevation:
Short Location Description & Notes:		

SETUP	Start Date & Time:	End Date & Time:	Sensitivity Before:	Sensitivity After:

METEOROLOGY	Wind Speed (m/s)	Wind Direction (°)	Temperature (°C)	Humidity (%)	Clouds (%)	Remarks: - loading - Trains hooking @ 60-85dB - Mine operations @ 56dB 50dB
Start	1.8	N.W	24.7	15.6	0	
Middle						
End						

NOISE CLIMATE	☐ Birds	☐ Insects	☐ Dogs	☐ Music	☐ Community	☐ Air Traffic	☐ Road Traffic	☐ Constr.	☐ Other

Description: trees & shrubs, dusty road, open land

EVENTS

Time	Description	Time	Description	Time	Description	Time	Description
16:40:57	Train hooking						
44:43	"						
45:29	"						
17:04:04	Mine & trains						
10:02	Trains hooking						
10:55	Trains						
-15:17	passing						

Page __ of __

Night

SITE NUMBER: Sample 5 (Site 5)		SLM DATA RECORD: M9mnt006
Longitude/Easting:	Latitude/Northing:	Elevation:
Short Location Description & Notes:		

SETUP	Start Date & Time:	End Date & Time:	Sensitivity Before:	Sensitivity After:

METEOROLOGY	Wind Speed (m/s)	Wind Direction (°)	Temperature (°C)	Humidity (%)	Clouds (%)	Remarks:
Start	0.1-0.5	S.	9.5	~~42~~ 11.6	0	Could hear mine operations @ ± 38dB 43dB
Middle						
End						

NOISE CLIMATE	☐ Birds	☒ Insects	☒ Dogs	☐ Music	☐ Community	☐ Air Traffic	☐ Road Traffic	☐ Constr.	☐ Other
Description:									

EVENTS

Time	Description	Time	Description	Time	Description	Time	Description
22:00:15	Dogs barking						
22:00:24	"						
00:33	"						
01:11	Mine operation						
02:39							
03:19	Mine operations						
-04:33							
05:20	"						
-07:38							
10:04	"						
-11:34							

Page __ of __

Night

SITE NUMBER: Sample 1 (Site 1)		SLM DATA RECORD: Mamat 007
Longitude/Easting:	Latitude/Northing:	Elevation:
Short Location Description & Notes:		

SETUP	Start Date & Time:	End Date & Time:	Sensitivity Before:	Sensitivity After:

METEOROLOGY	Wind Speed (m/s)	Wind Direction (°)	Temperature (°C)	Humidity (%)	Clouds (%)	Remarks:
Start	0.1-0.5	5	9	12.1	0	-Mine operations @±35dB
Middle						
End						

NOISE CLIMATE	☐ Birds	☒ Insects	☐ Dogs	☐ Music	☐ Community	☐ Air Traffic	☐ Road Traffic	☐ Constr.	☐ Other
Description:									

EVENTS

Time	Description	Time	Description	Time	Description	Time	Description
22:24:23	insects	37:53	mine				
-25:07		-39:04	operation				
26:53	Insects						
-27:37							
28:17	Hooter from						
28:46	Hooter mine						
31:31	Hooter mine						
	operation						

Page __ of __

Night

SITE NUMBER: Sample 2 (Site 2)		SLM DATA RECORD: Mamat 008
Longitude/Easting:	Latitude/Northing:	Elevation:
Short Location Description & Notes:		

SETUP	Start Date & Time:	End Date & Time:	Sensitivity Before:	Sensitivity After:

METEOROLOGY	Wind Speed (m/s)	Wind Direction (°)	Temperature (°C)	Humidity (%)	Clouds (%)	Remarks:
Start	01-0.6	SW	8.9	11,2	0	-could hear mine operations @ ± 38dB
Middle						
End						

NOISE CLIMATE	☐ Birds	☒ Insects	☐ Dogs	☐ Music	☐ Community	☐ Air Traffic	☐ Road Traffic	☐ Constr.	☐ Other
Description:									

EVENTS

Time	Description	Time	Description	Time	Description	Time	Description
22:49:03	Mine operations						
53:15	Mine operations						
53:46	Hooter						
54:06	"						
55:05 -56:34	mine ops						

Page __ of __

Night

SITE NUMBER: Sample 3 (site 3)		SLM DATA RECORD: mamat 009
Longitude/Easting:	Latitude/Northing:	Elevation:
Short Location Description & Notes:		

SETUP	Start Date & Time:	End Date & Time:	Sensitivity Before:	Sensitivity After:

METEOROLOGY	Wind Speed (m/s)	Wind Direction (°)	Temperature (°C)	Humidity (%)	Clouds (%)	Remarks:
Start	0.1-0.3	S	9.1	12.2	0	Mine operations @ ± 66dB throughout (range)
Middle						
End						

NOISE CLIMATE	☐ Birds	☐ Insects	☐ Dogs	☐ Music	☐ Community	☐ Air Traffic	☐ Road Traffic	☒ Constr.	☐ Other
Description:									

EVENTS

Time	Description	Time	Description	Time	Description	Time	Description
23:12:59	Truck	24:48	car hooter				
-13:14	passing	26:14	car passing				
~~16~~							
16:21	Train hoote						
17:04	Truck						
-17:41	passing						
20:28	Hooter						
21:34	car						
-22:52	passing						

Page __ of __

Night

SITE NUMBER: sample 4 (Site 4)		SLM DATA RECORD: mamat010
Longitude/Easting:	Latitude/Northing:	Elevation:
Short Location Description & Notes:		

SETUP	Start Date & Time:	End Date & Time:	Sensitivity Before:	Sensitivity After:

METEOROLOGY	Wind Speed (m/s)	Wind Direction (°)	Temperature (°C)	Humidity (%)	Clouds (%)	Remarks:
Start	0 - 0,2	5	9.0	12.1	0	Mine ops @ ± 46dB (fauna?)
Middle						
End						

NOISE CLIMATE	☐ Birds	☐ Insects	☐ Dogs	☐ Music	☐ Community	☐ Air Traffic	☒ Road Traffic	☐ Constr.	☐ Other
Description:									

EVENTS

Time	Description	Time	Description	Time	Description	Time	Description
23:36:09 - 36:46	car passing	48:03	Hooter from mine				
37:59 - 38:19	mine ops						
39:13 - 39:23	hooter from mine						
44:31 - 45:34	Truck passing						
47:17 - 48:01	truck passing main road						

Page __ of __

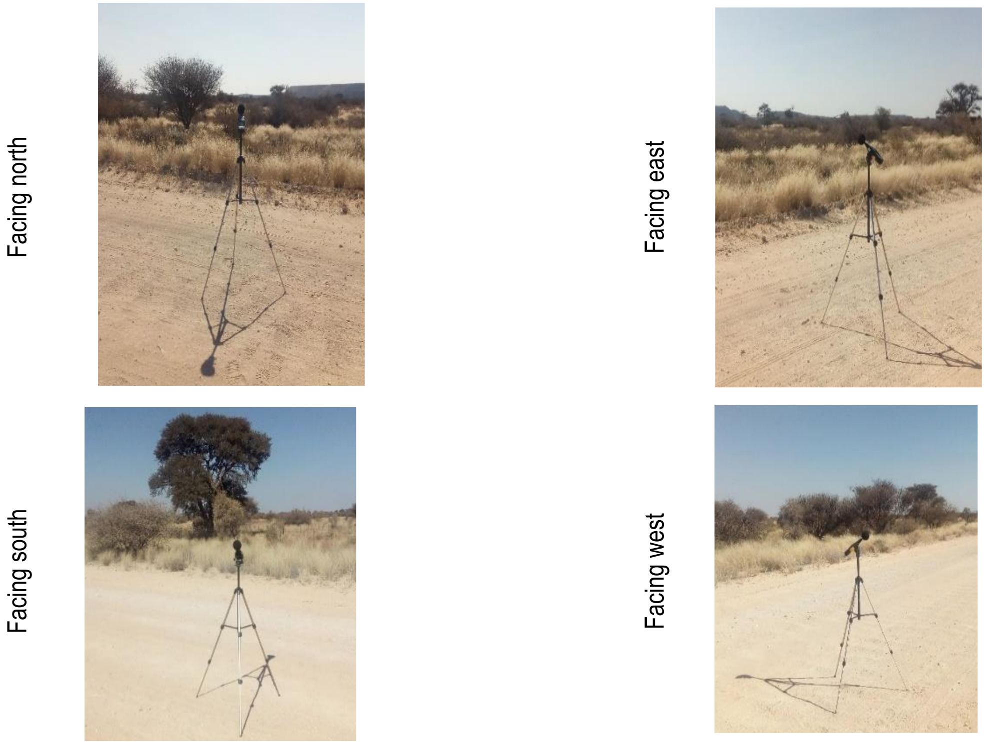


Figure 24: Photographs of environmental noise survey Site 1

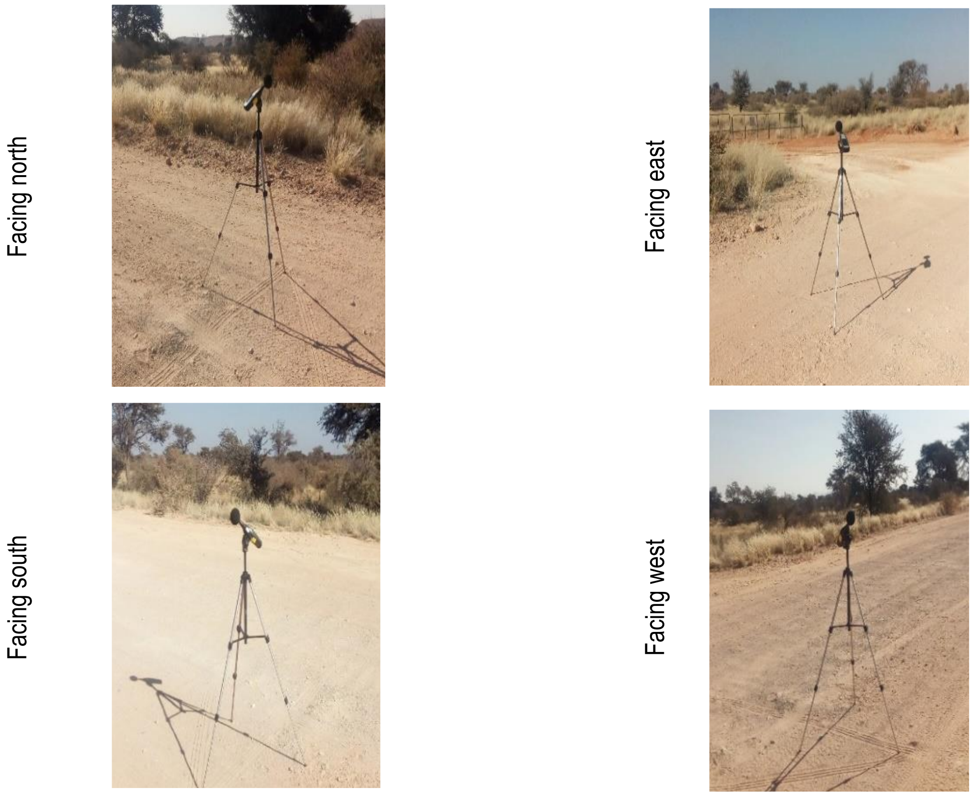


Figure 25: Photographs of environmental noise survey Site 2

Facing north

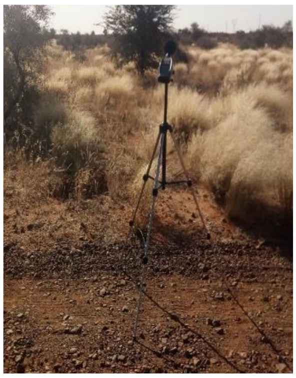
Facing east

Facing south

Facing west

Figure 26: Photographs of environmental noise survey Site 3

Facing north



Facing east

Facing south

Facing west

Figure 27: Photographs of environmental noise survey Site 4

Facing north

Facing east

Facing south

Facing west

Figure 28: Photographs of environmental noise survey Site 5

Appendix D – Calibration Certificates

nmisa
National Metrology Institute of South Africa

Certificate of Conformance

Private Bag X34, Lynnwood Ridge, Pretoria, 0040
CSIR Campus, Meiring Naude Road, Brummeria, 0184
Calibration office: +27 12 841 4623
Reception: +27 12 841 4152
Fax: +27 12 841 4458
E-mail enquiries: info@nmisa.org

Calibration of:	SOUND CALIBRATOR
Manufacturer:	SVANTEK
Model number:	SV33
Serial number:	57649
Calibrated for:	AIRSHED PLANNING PROFESSIONALS (PTY) LTD 480 Smuts Drive Halfway Gardens Midrand
Calibration procedure:	AV\AS-0008
Period of calibration:	20 September 2018

1 PROCEDURE

The sound calibrator was calibrated according to IEC 60942: 2003 specification.

The results of the measurements are traceable to the national measurement standards.

The following equipment was used:

Brüel & Kjær 2673 preamplifier	(AS-59)
MadgeTech PRHTemp2000	(AS-106)
Brüel & Kjær 3630 Calibration platform	(AS-109)
Brüel & Kjær 4228 Pistonphone	(AS-WSTD-13)
Brüel & Kjær 4192 Pressure Microphone	(AS-WSTD-15)

Calibrated by **R Nel** **Metrologist (Technical Signatory)**	Checked by **AE Karsten** **Metrologist**	For Chief Executive Officer
Date of Issue **20 September 2018**	**Page 1 of 2**	Certificate number **AV\AS-4782**

Your measure of excellence

2 RESULTS

2.1 The following parameters of the sound calibrator were calibrated and conformed to IEC 60942: 2003 specification, class 1:

Frequency (IEC 60942 clause B.3.5) 1 000 Hz	U = 0,10 Hz
Sound Pressure Level (IEC 60942 clause B.3.4) 114 dB	U = 0,15 dB
Total Distortion (IEC 60942 clause B.3.6)	U = 0,13 %

3 REMARKS

3.1 The reported uncertainties of measurement were calculated and expressed in accordance with the BIPM, IEC, ISO, IUPAP, OIML document entitled "A Guide to the Expression of Uncertainty in Measurement" (International Organisation for Standardisation, Geneva, Switzerland, 1993).

3.2 The reported expanded uncertainty of measurement, U, is stated as the standard uncertainty of measurement multiplied by a coverage factor of $k = 2$, which for a normal distribution approximates a level of confidence of 95,45 %.

3.3 Certain of the NMISA certificates are consistent with the capabilities that are included in appendix C of the MRA (Mutual Recognition Arrangement) drawn up by the CIPM. Under the MRA, all participating institutes recognise the validity of each other's calibration and measurement certificates for the quantities and ranges and measurement uncertainties specified in Appendix C. For details see http://www.bipm.org.

3.4 The calibrations were carried out at an ambient temperature of 23 °C ± 2 °C and a relative humidity of 50 %RH ± 20 %RH.

3.5 The above statement of conformance is based on the measurement value(s) obtained, extended by the estimated uncertainty of measurement, being within the appropriate specification limit(s).

------------------ *end of certificate* ------------------

Calibrated by **R Nel** **Metrologist (Technical Signatory)**	Checked by **AE Karsten** **Metrologist**	For Chief Executive Officer
Date of Issue **20 September 2018**	**Page 2 of 2**	Certificate number **AV\AS-4782**

Brüel & Kjær

Prepolarized Free-field 1/2" Microphone Type 4950

Calibration Chart

Serial No: 3177677

Open-circuit Sensitivity*, S_0: ***-26.9*** dB re 1V/Pa

Equivalent to: ***45.3*** mV/Pa

Uncertainty, 95 % confidence level 0.2 dB

Capacitance: *12.8* pF

Valid At:

Temperature:	23	°C
Ambient Static Pressure:	101.3	kPa
Relative Humidity:	50	%
Frequency:	251.2	Hz
Polarization Voltage, external:	0	V

Sensitivity Traceable To:

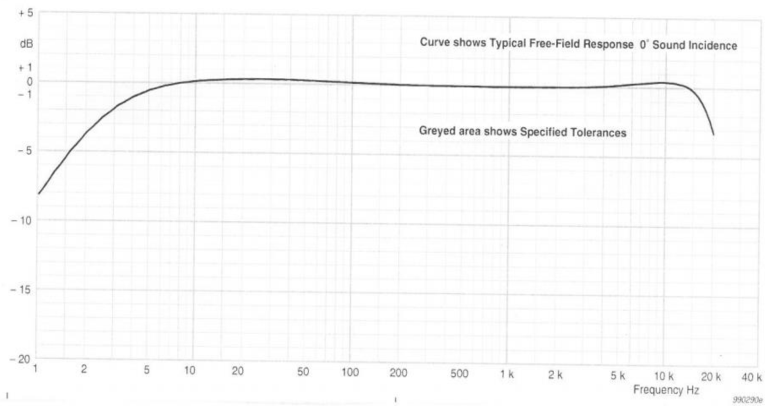
DPLA: Danish Primary Laboratory of Acoustics

NIST: National Institute of Standards and Technology, USA

Environmental Calibration Conditions:

101.2 kPa 24 °C 55 % RH

Procedure: 704875 **Date:** 24. Jul. 2018 **Signature:** [signature]



Appendix E – Time-series, Statistical, and Frequency Spectrum Results

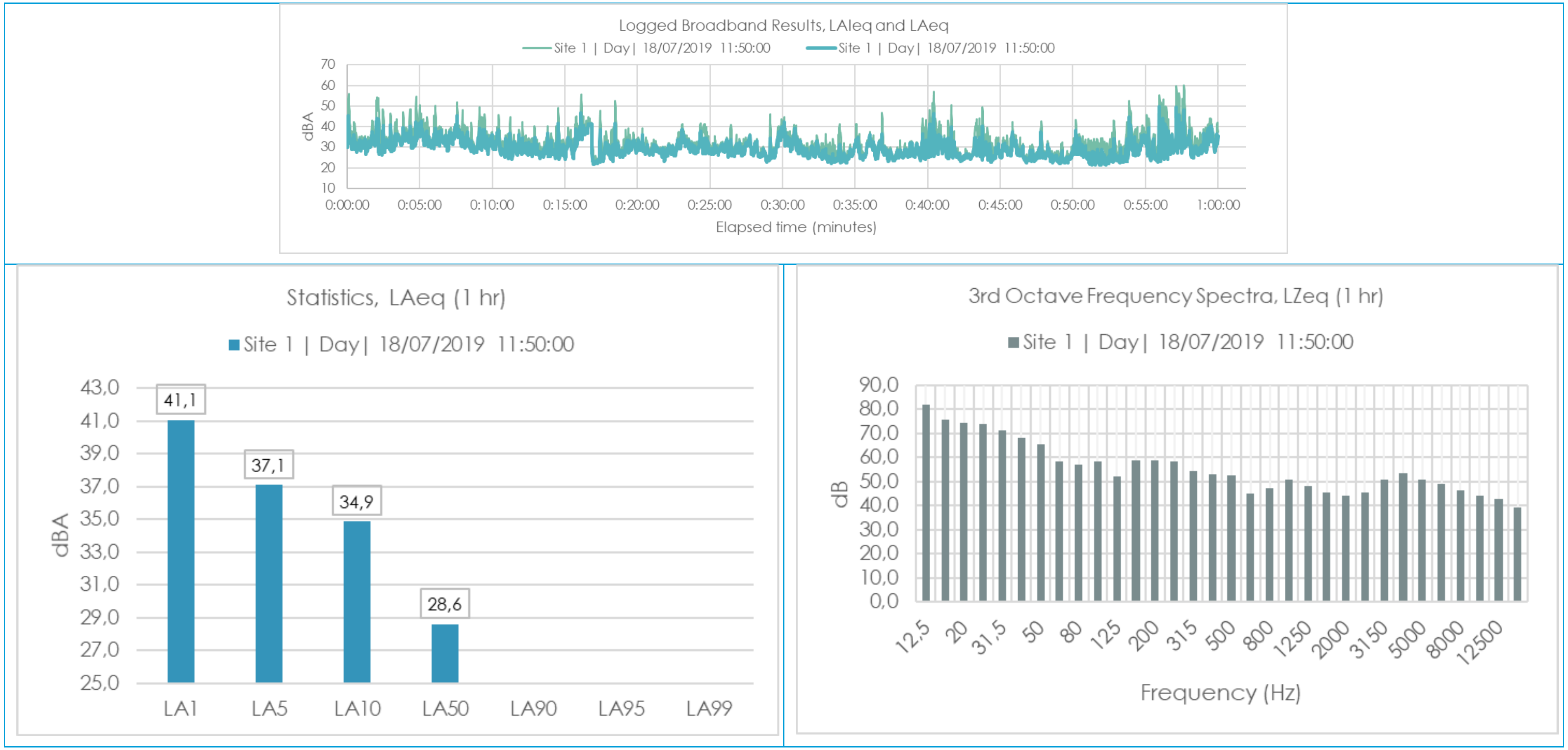


Figure 29:Day broadband time series, Logged statistics results and Logged frequency spectra-Site 1

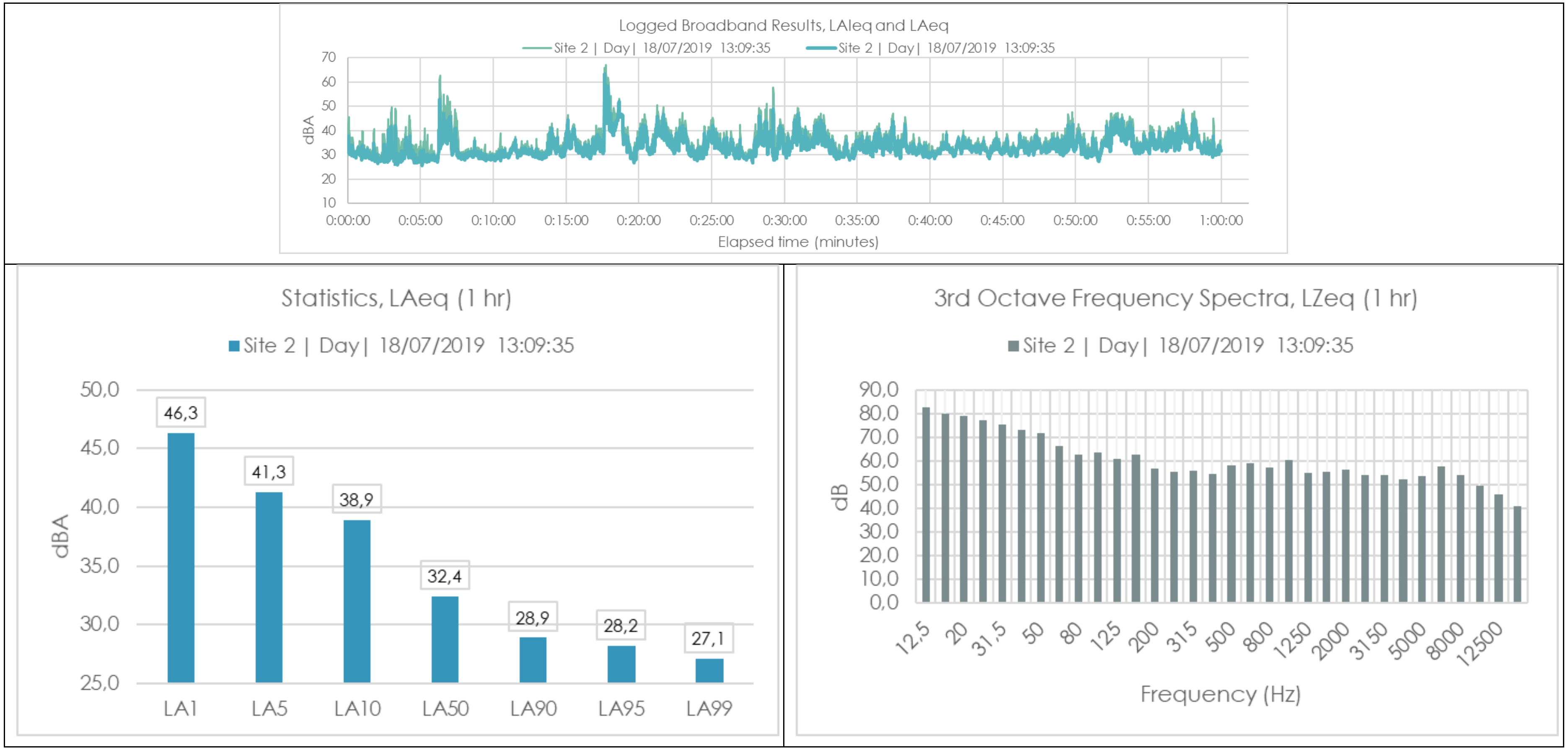


Figure 30:Day broadband time series, Logged statistics results and Logged frequency spectra-Site 2

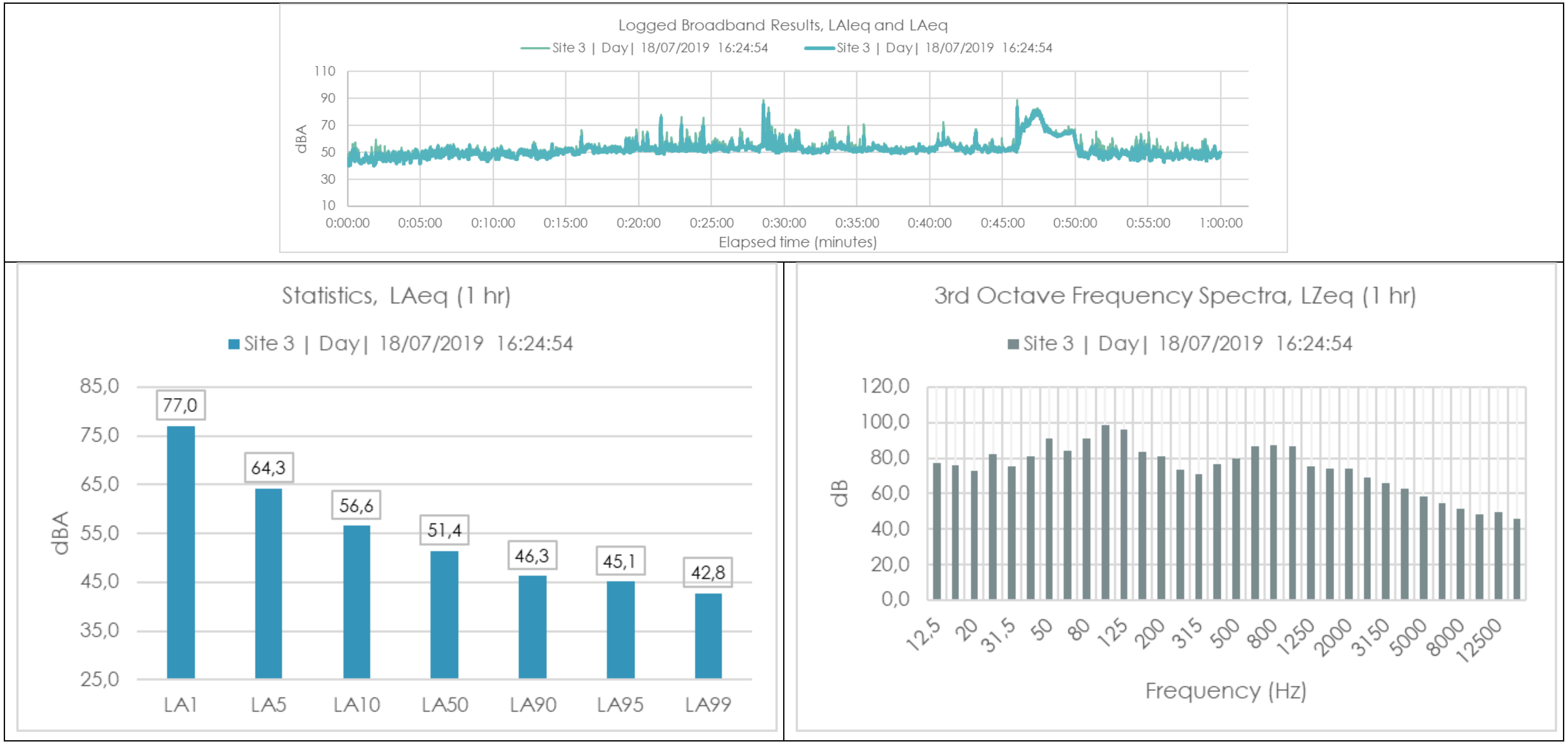


Figure 31:Day broadband time series, Logged statistics results and Logged frequency spectra-Site 3

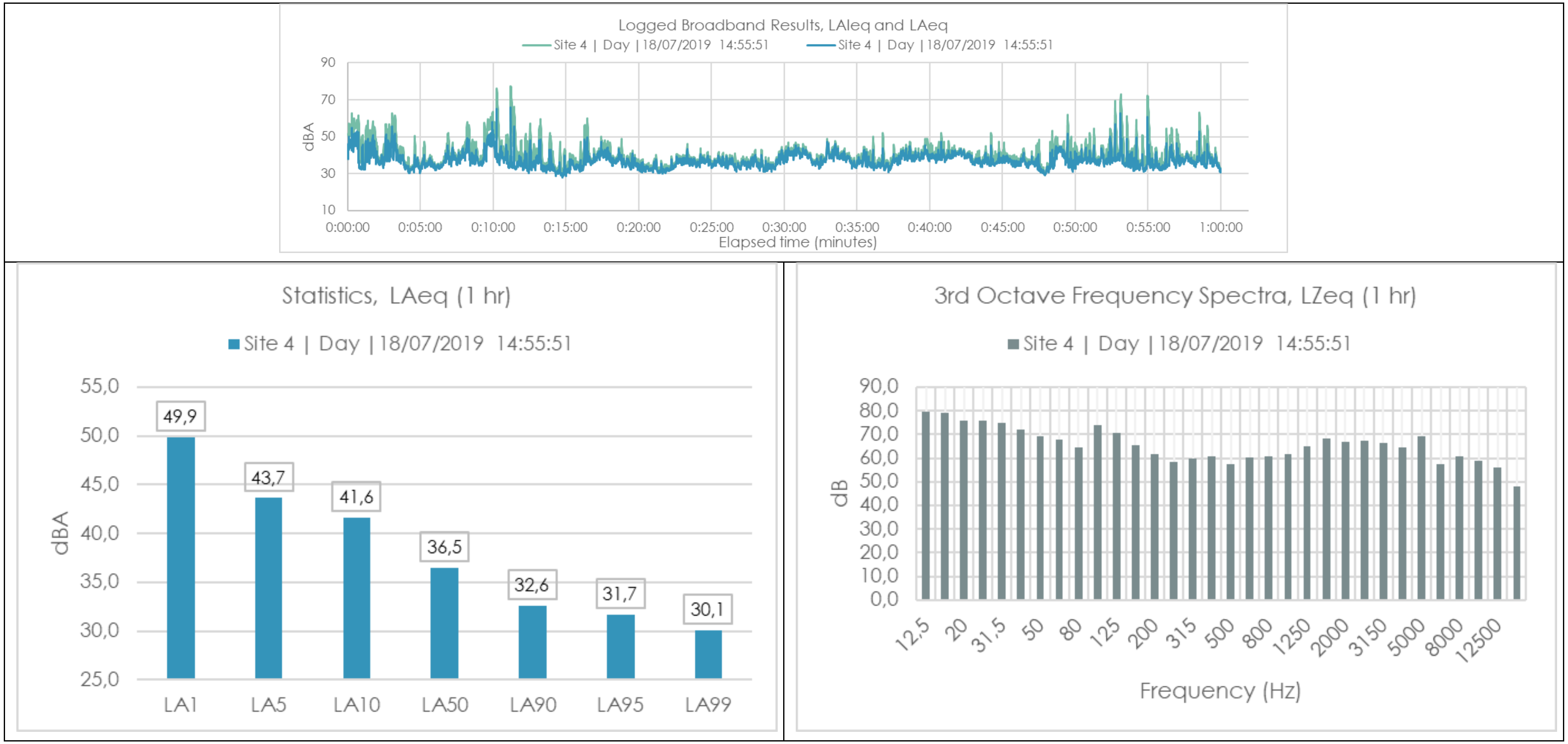


Figure 32: Day broadband time series, Logged statistics results and Logged frequency spectra-Site 4

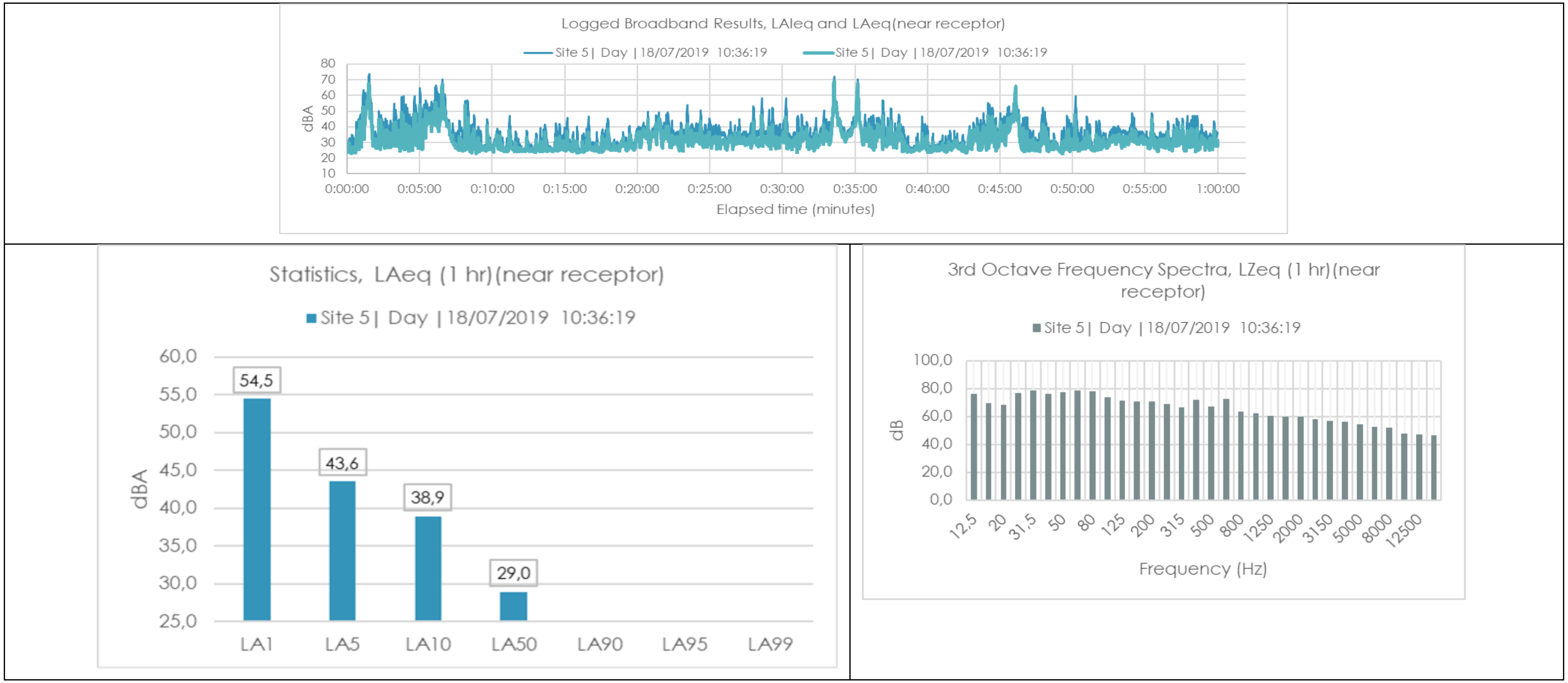


Figure 33:Day broadband time series, Logged statistics results and Logged frequency spectra-Site 5

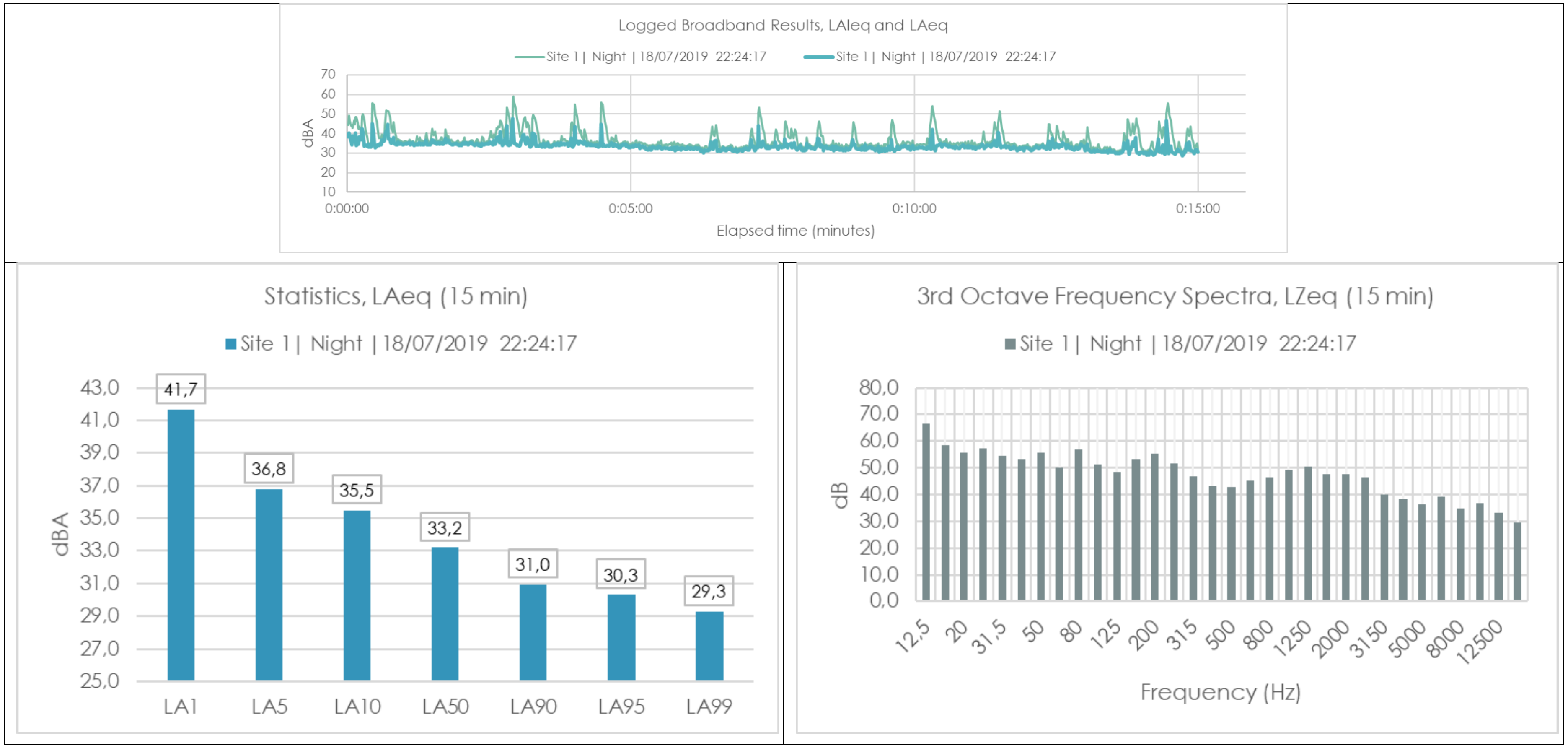


Figure 34: Night broadband time series, Logged statistics results and Logged frequency spectra-Site 1

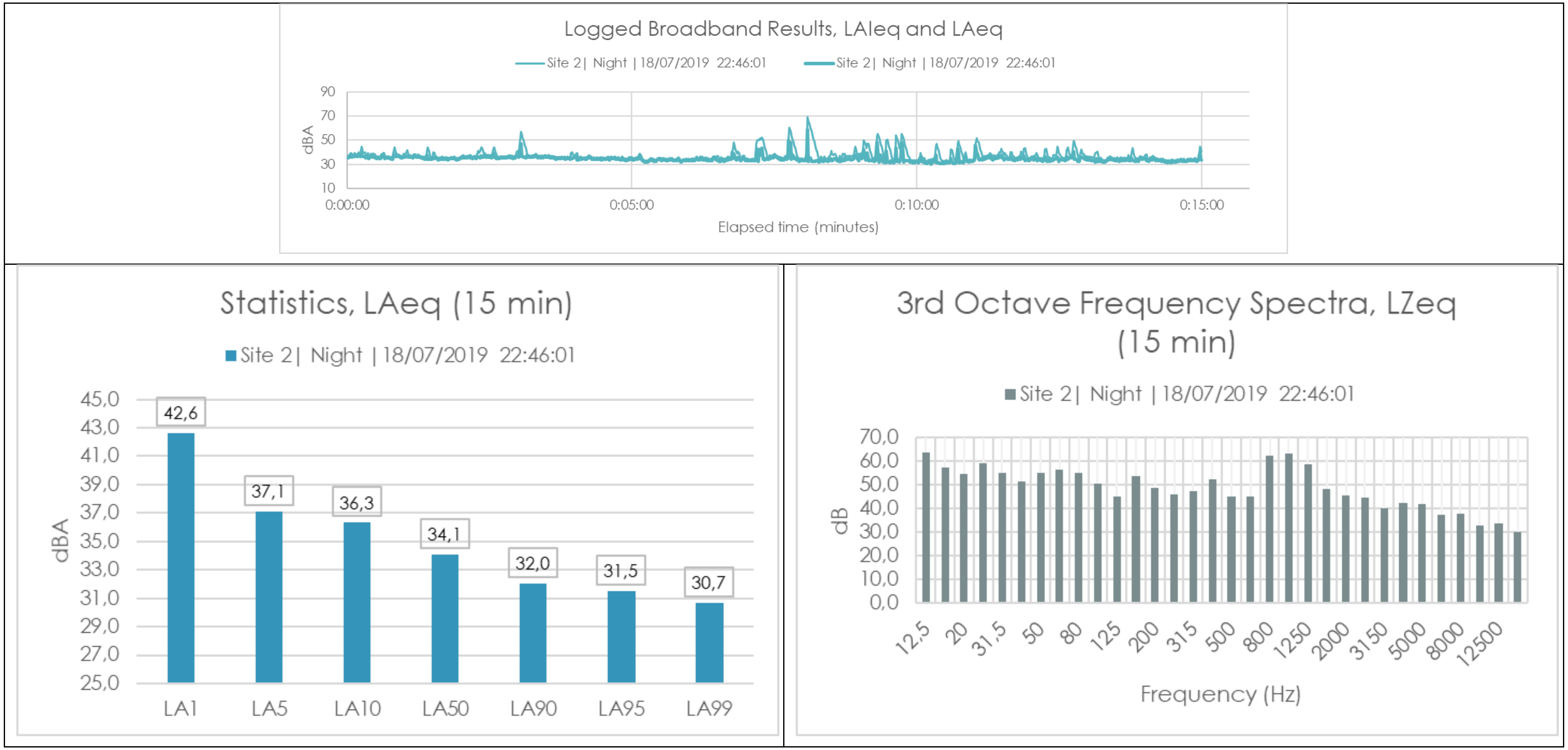
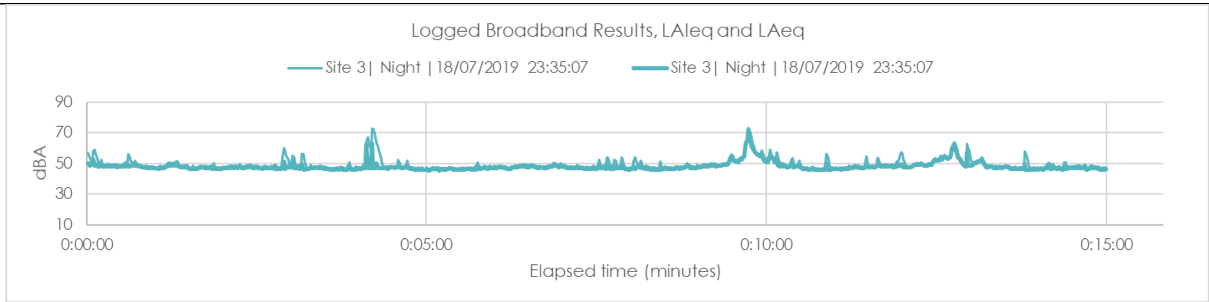
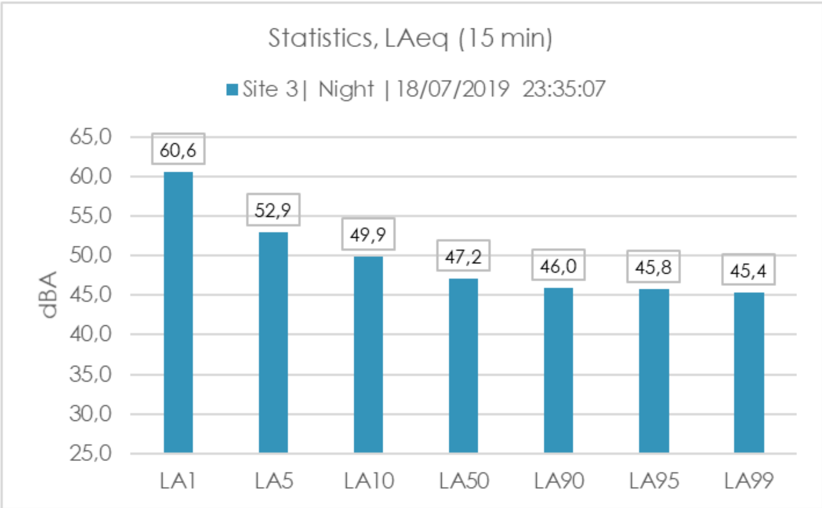


Figure 35: Night broadband time series, Logged statistics results and Logged frequency spectra-Site 2





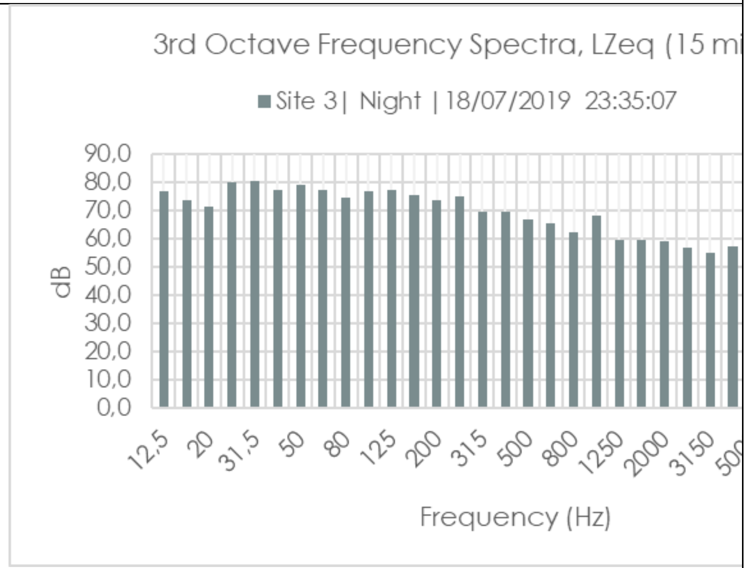


Figure 36: Night broadband time series, Logged statistics results and Logged frequency spectra-Site 3

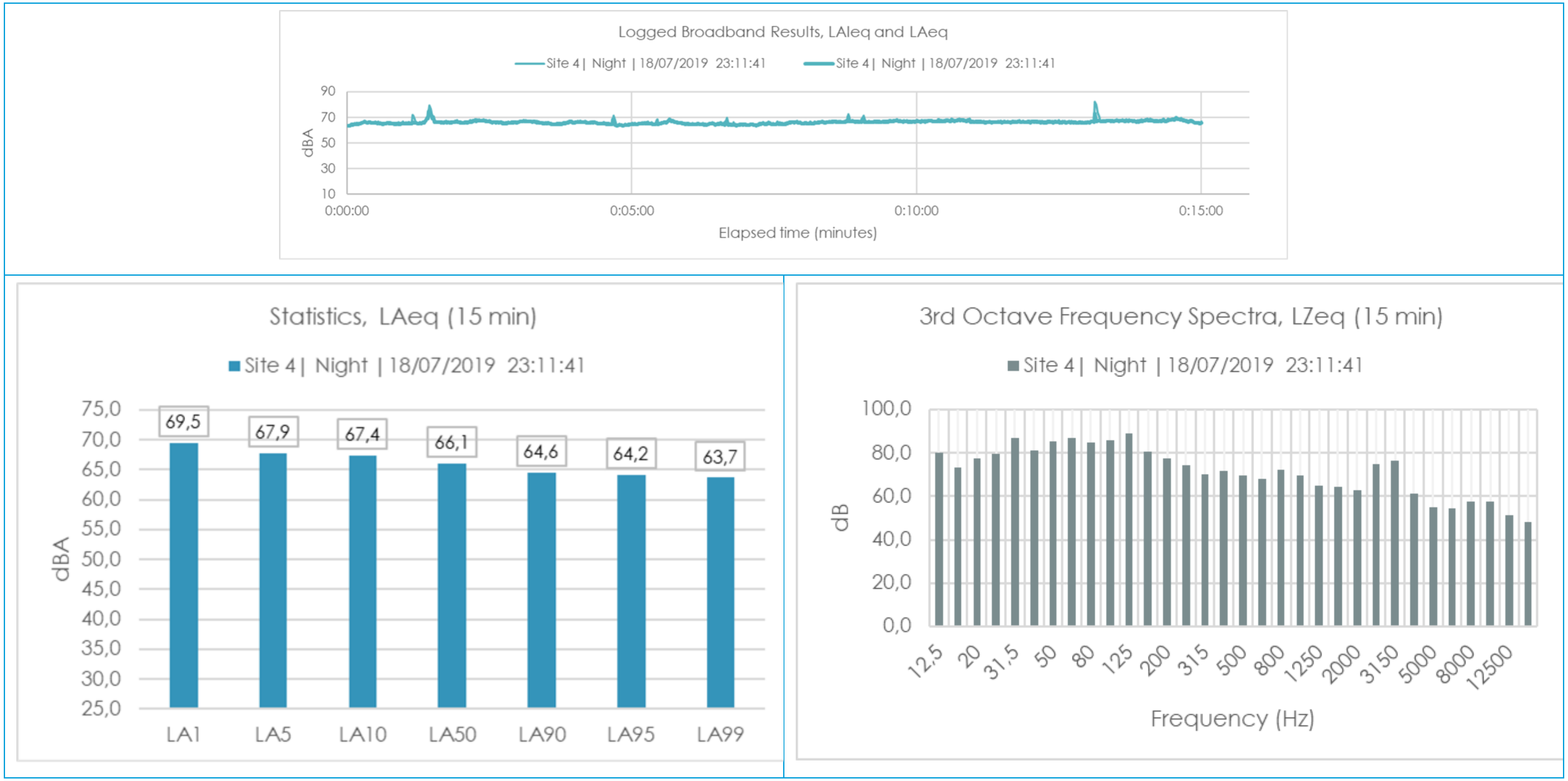


Figure 37: Night broadband time series, Logged statistics results and Logged frequency spectra-Site 4

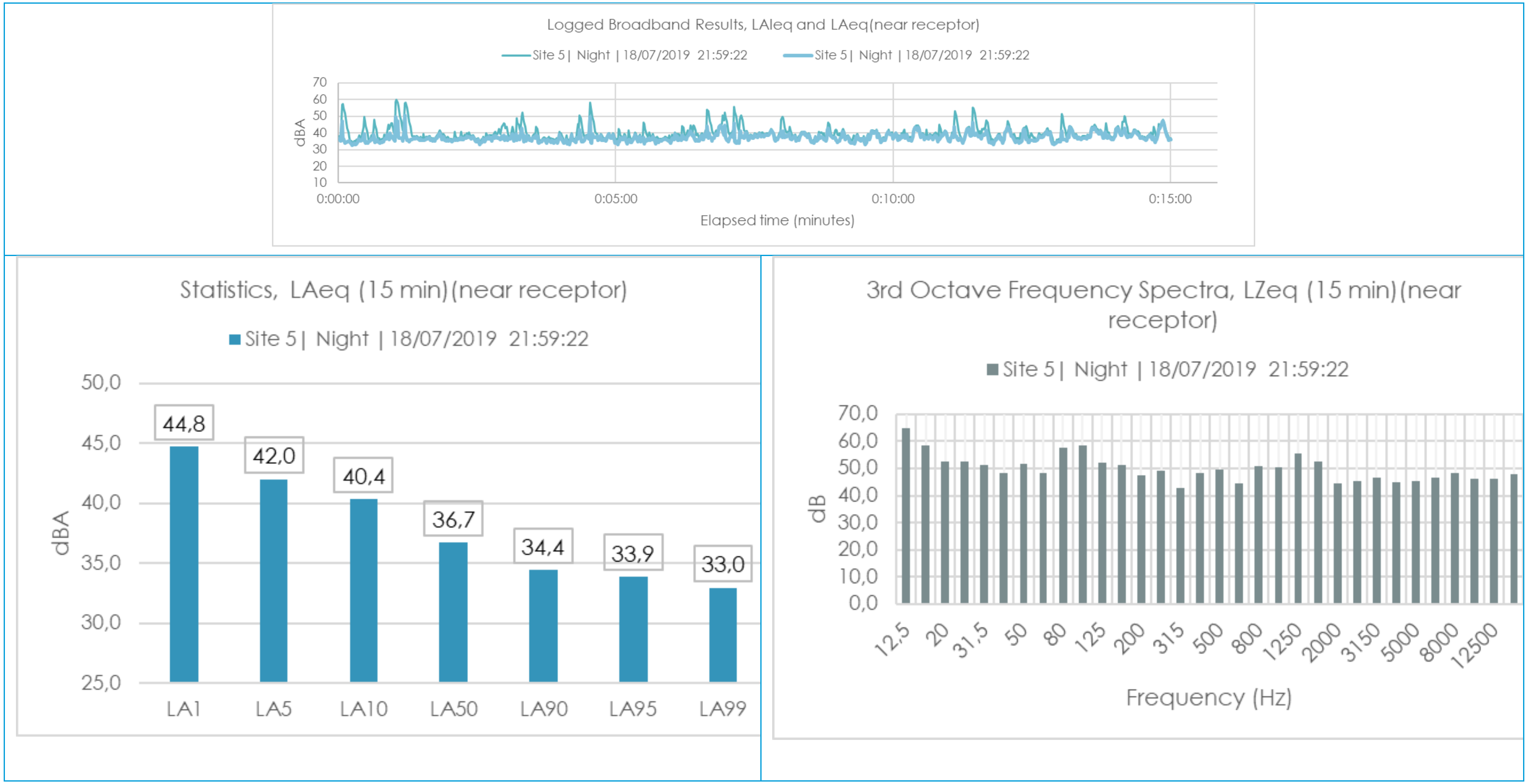


Figure 38: Night broadband time series, Logged statistics results and Logged frequency spectra-Site 5

Appendix F – Impact Assessment Methodology

PART A: DEFINITIONS AND CRITERIA*		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of intensity, spatial extent and duration**
Criteria for ranking of the INTENSITY of environmental impacts	**VH**	Severe change, disturbance or degradation. Associated with severe consequences. May result in severe illness, injury or death. Targets, limits and thresholds of concern continually exceeded. Substantial intervention will be required. Vigorous/widespread community mobilization against project can be expected. May result in legal action if impact occurs.
	H	Prominent change, disturbance or degradation. Associated with real and substantial consequences. May result in illness or injury. Targets, limits and thresholds of concern regularly exceeded. Will definitely require intervention. Threats of community action. Regular complaints can be expected when the impact takes place.
	M	Moderate change, disturbance or discomfort. Associated with real but not substantial consequences. Targets, limits and thresholds of concern may occasionally be exceeded. Likely to require some intervention. Occasional complaints can be expected.
	L	Minor (Slight) change, disturbance or nuisance. Associated with minor consequences or deterioration. Targets, limits and thresholds of concern rarely exceeded. Require only minor interventions or clean-up actions. Sporadic complaints could be expected.
	VL	Negligible change, disturbance or nuisance. Associated with very minor consequences or deterioration. Targets, limits and thresholds of concern never exceeded. No interventions or clean-up actions required. No complaints anticipated.
	VL+	Negligible change or improvement. Almost no benefits. Change not measurable/will remain in the current range.
	L+	Minor change or improvement. Minor benefits. Change not measurable/will remain in the current range. Few people will experience benefits.
	M+	Moderate change or improvement. Real but not substantial benefits. Will be within or marginally better than the current conditions. Small number of people will experience benefits.
	H+	Prominent change or improvement. Real and substantial benefits. Will be better than current conditions. Many people will experience benefits. General community support.
	VH+	Substantial, large-scale change or improvement. Considerable and widespread benefit. Will be much better than the current conditions. Favourable publicity and/or widespread support expected.
Criteria for ranking the DURATION of impacts	**VL**	Very short, always less than a year. Quickly reversible
	L	Short-term, occurs for more than 1 but less than 5 years. Reversible over time.
	M	Medium-term, 5 to 10 years.
	H	Long term, between 10 and 20 years. (Likely to cease at the end of the operational life of the activity)
	VH	Very long, permanent, +20 years (Irreversible. Beyond closure)
Criteria for ranking the EXTENT of impacts	**VL**	A part of the site/property.
	L	Whole site.
	M	Beyond the site boundary, affecting immediate neighbours
	H	Local area, extending far beyond site boundary.
	VH	Regional/National

PART D: INTERPRETATION OF SIGNIFICANCE	
Significance	**Decision guideline**
Very High	Potential fatal flaw unless mitigated to lower significance.
High	It must have an influence on the decision. Substantial mitigation will be required.
Medium	It should have an influence on the decision. Mitigation will be required.
Low	Unlikely that it will have a real influence on the decision. Limited mitigation is likely required.
Very Low	It will not have an influence on the decision. Does not require any mitigation
Insignificant	Inconsequential, not requiring any consideration.

***VH = very high, H = high, M= medium, L= low and VL= very low and + denotes a positive impact.**

PART B: DETERMINING CONSEQUENCE							
INTENSITY = VL							
DURATION	Very long	VH	Low	Low	Medium	Medium	High
	Long term	H	Low	Low	Low	Medium	Medium
	Medium term	M	Very Low	Low	Low	Low	Medium
	Short term	L	Very low	Very Low	Low	Low	Low
	Very short	VL	Very low	Very Low	Very Low	Low	Low
INTENSITY = L							
DURATION	Very long	VH	Medium	Medium	Medium	High	High
	Long term	H	Low	Medium	Medium	Medium	High
	Medium term	M	Low	Low	Medium	Medium	Medium
	Short term	L	Low	Low	Low	Medium	Medium
	Very short	VL	Very low	Low	Low	Low	Medium
INTENSITY = M							
DURATION	Very long	VH	Medium	High	High	High	Very High
	Long term	H	Medium	Medium	Medium	High	High
	Medium term	M	Medium	Medium	Medium	High	High
	Short term	L	Low	Medium	Medium	Medium	High
	Very short	VL	Low	Low	Low	Medium	Medium
INTENSITY = H							
DURATION	Very long	VH	High	High	High	Very High	Very High
	Long term	H	Medium	High	High	High	Very High
	Medium term	M	Medium	Medium	High	High	High
	Short term	L	Medium	Medium	Medium	High	High
	Very short	VL	Low	Medium	Medium	Medium	High
INTENSITY = VH							
DURATION	Very long	VH	High	High	Very High	Very High	Very High
	Long term	H	High	High	High	Very High	Very High
	Medium term	M	Medium	High	High	High	Very High
	Short term	L	Medium	Medium	High	High	High
	Very short	VL	Low	Medium	Medium	High	High
			VL	L	M	H	VH
			A part of the site/ property	Whole site	Beyond the site, affecting neighbours	Extending far beyond site but localised	Regional/ National
					EXTENT		

PART C: DETERMINING SIGNIFICANCE							
PROBABILITY (of exposure to impacts)	Definite/ Continuous	VH	Very Low	Low	Medium	High	Very High
	Probable	H	Very Low	Low	Medium	High	Very High
	Possible/ frequent	M	Very Low	Very Low	Low	Medium	High
	Conceivable	L	Insignificant	Very Low	Low	Medium	High
	Unlikely/ improbable	VL	Insignificant	Insignificant	Very Low	Low	Medium
			VL	L	M	H	VVH
					CONSEQUENCE		