Noise Specialist Report for the Proposed Medupi Flue Gas Desulphurisation (FGD) Retrofit Project

Project done for **Zitholele Consulting**

Prepared by:
Reneé von Gruenewaldt

Technical support:
Nicolette von Reiche

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Address: 480 Smuts Drive, Halfway Gardens | Postal: P O Box 5260, Halfway House, 1685
Tel: +27 (0)11 805 1940 | Fax: +27 (0)11 805 7010
www.airshed.co.za

Report Details

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Prepared by	Reneé von Gruenewaldt *(Pr. Sci. Nat.)*, MSc (University of Pretoria)
Technical support	Nicolette von Reiche, BEng Hons (Mech.) (University of Pretoria)
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Revision Record

Version	Date	Section(s) Revised	Summary Description of Revision(s)
Rev 0	24 November 2016	Draft report	For client review
Rev 0.1	5 December 2016	Whole report	Grammatical changes
Rev 0.2	18 January 2018	Section 4	Incorporation of changes to authorisation and licencing approach in 2017
Rev 0.3	7 February 2018	Executive summary and Section 1	Incorporation of comments from client

NEMA Regulation (2014), Appendix 6

NEMA Regulations (2014) - Appendix 6	Relevant section in report
Details of the specialist who prepared the report.	Report Details (page i)
The expertise of that person to compile a specialist report including curriculum vitae.	Section 7: Annex A – Specialist's Curriculum Vitae
A declaration that the person is independent in a form as may be specified by the competent authority.	Report Details (page i)
An indication of the scope of, and the purpose for which, the report was prepared.	Section 1.1: Purpose Section 1.2: Scope of Work
The date and season of the site investigation and the relevance of the season to the outcome of the assessment.	Section 3.3: Sampled Baseline and Representative Pre-Development Noise Levels Note: Seasonal changes immaterial to study outcome
A description of the methodology adopted in preparing the report or carrying out the specialised process.	Section 1.5: Approach and Methodology
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure.	Section 3: Description of the Receiving Environment
An identification of any areas to be avoided, including buffers.	Not applicable
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.	Not applicable
A description of any assumptions made and any uncertainties or gaps in knowledge.	Section 1.6: Limitations and Assumptions
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment.	Section 4: Impact Assessment Site alternatives were not considered
Any mitigation measures for inclusion in the EMPr.	Section 5: Management, Mitigation and Recommendations
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Any monitoring requirements for inclusion in the EMPr or environmental authorisation.	Section 5.3: Monitoring
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised.	Section 5: Management, Mitigation and Recommendations
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 5: Management, Mitigation and Recommendations
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.	No comments received
Any other information requested by the competent authority.	Not applicable

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.
EMP	Environmental Management Plan
FGD	Flue Gas Desulphurisation
IFC	International Finance Corporation
ISO	International Standards Organisation
kW	Power in kilo Watt
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_{Aleq} (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)
L_{PA}	A-weighted sound pressure level (in dBA)
L_{PZ}	Un-weighted sound pressure level (in dB)
L_W	Sound Power Level (in dB)
MW	Power in mega Watt
NEMAQA	National Environment Management Air Quality Act
NSR	Noise sensitive receptor
SABS	South African Bureau of Standards
SANS	South African National Standards
SLM	Sound Level Meter
SoW	Scope of Work
WHO	World Health Organisation

Executive Summary

Airshed Planning Professionals (Pty) Limited was appointed by Zitholele Consulting to undertake a noise impact assessment for a proposed Medupi Flue Gas Desulphurisation (FGD) Retrofit Project (hereafter referred to as the project).

Confirmed scope of work includes assessment of the following activities and infrastructure:

1. Construction and operation of a rail yard/siding to transport Limestone from a source defined point via the existing rail network to the Medupi Power Station and proposed rail yard / siding. The rail yard infrastructure will include storage of fuel (diesel) in above ground tanks and 15m deep excavation for tippler building infrastructure;
2. Construction and operation of limestone storage area, preparation area, handling and transport via truck and conveyor to the FGD system located near the generation units of the Medupi Power Station;
3. The construction and operation of the wet FGD system that will reduce the SO2 content in the flue gas emitted;
4. Construction and operation of associated infrastructure required for operation of the FGD system and required services to ensure optimal functioning of the wet FGD system. The associated FGD infrastructure include a facility for storage of fuel (diesel), installation of storm water infrastructure and conservancy tanks for sewage;
5. The handling, treatment and conveyance of gypsum and effluent from the gypsum dewatering plant.
6. Pipeline for the transportation of waste water from the gypsum dewatering plant and its treatment at the waste water treatment plant (WWTP) that will be located close to the FGD infrastructure within the Medupi Power Station;
7. Construction and operation of the WWTP;
8. Management, handling, transport and storage of salts and sludge generated through the waste water treatment process at a temporary waste storage facility.
9. The transportation of salts and sludge via trucks from the temporary waste storage facility to a final Waste Disposal Facility to be contracted by Eskom for the first 5 years of operation of the FGD system.
10. Disposal of gypsum together with ash on the existing licenced ash disposal facility (ADF), with resulting increase in height of the ADF from 60m to 72m.

The main objective of this study was to establish baseline/pre-development noise levels in the study area and to quantify the extent to which ambient noise levels will change as a result of the project. The baseline and impact study then informed the noise management and mitigation measures recommended for adoption as part of the project's Environmental Management Plan (EMP).

To achieve this objective, the following tasks were included in the scope of work (SoW):

1. A review of 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 noise sensitive receptors (NSRs) from available maps;
    b. A study of environmental noise attenuation potential by referring to available weather records and land use data sources; and
    c. Determining representative baseline noise levels through the analysis of sampled environmental noise levels obtained from a survey conducted in September 2015.
4. An impact assessment, including:
    a. The establishment of a source inventory for the project;
    b. Noise propagation simulations to determine environmental noise levels; and,
    c. The screening of simulated noise levels against environmental noise criteria.
5. The identification and recommendation of suitable mitigation measures and monitoring requirements; and,
6. A specialist noise impact assessment report.

In the assessment of sampled and simulated noise levels reference was made to the International Finance Corporation (IFC) guidelines for residential, institutional and educational receptors (55 dBA during the day and 45 dBA during the night) since these (a) are applicable to nearby NSRs and (b) in-line with South African National Standards (SANS) 10103 guidelines for urban districts. The IFC's 3 dBA increase criterion is used to determine the potential for noise impact.

The baseline acoustic environment was described in terms of the location of NSRs in relation to proposed activities, the ability of the environment to attenuate noise over long distances and existing or pre-development noise levels. The following was found:

- Several individual residential dwellings are located within a few kilometres from the Medupi Power Station. There are also residential areas to the north and northeast of the Matimba Power Station.
- Baseline noise levels are affected by road traffic, mining activities, birds and insects. Noise levels in the vicinity of the Medupi Power Station are currently comparable to levels typically found in suburban districts. Representative day- and night-time as well as 24-hour baseline noise levels of 48.3 dBA, 43.7 dBA and 50.9 dBA respectively were calculated from survey results.

Sound power levels for main equipment were determined from equipment specifications. The source inventory, local meteorological conditions and information on local land use were used to populate the noise propagation model (CadnaA, ISO 9613). The propagation of noise was calculated over an area of 10 km east-west by 10 km north-south. The area was divided into a grid matrix with a 10 m resolution and NSRs were included as discrete receptors. The following was found:

- Noise impacts during the operational phase will be more notable at night.
- The operational phase will result in noise levels that do not exceed the selected impact criteria at the nearest NSR. 'Little' to no reaction from individuals within this impacted area may be expected.

It is important to note the following conservative assumption when interpreting results summarised above. Shielding effects due to infrastructure and land topography were also not taken into account providing a conservative aspect in the simulated noise levels.

It was concluded that, given the conservative nature of the assessment, the implementation of the basic good practice management measures recommended in this report will ensure low noise impact levels. From a noise perspective, the project may proceed.

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1 INTRODUCTION

Airshed Planning Professionals (Pty) Limited was appointed by Zitholele Consulting to undertake a noise impact assessment for a proposed Medupi Flue Gas Desulphurisation (FGD) Retrofit Project (hereafter referred to as the project).

1.1 Purpose

The main purpose of the noise study is to determine the potential impact on the acoustic climate and noise sensitive receptors (NSRs) given activities proposed as part of the project.

1.2 Scope of Work

Confirmed Scope of Work (SoW) includes assessment of the following activities and infrastructure:

1. Construction and operation of a rail yard/siding to transport Limestone from a source defined point via the existing rail network to the Medupi Power Station and proposed rail yard / siding. The rail yard infrastructure will include storage of fuel (diesel) in above ground tanks and 15m deep excavation for tippler building infrastructure;
2. Construction and operation of limestone storage area, preparation area, handling and transport via truck and conveyor to the FGD system located near the generation units of the Medupi Power Station;
3. The construction and operation of the wet FGD system that will reduce the SO_2 content in the flue gas emitted;
4. Construction and operation of associated infrastructure required for operation of the FGD system and required services to ensure optimal functioning of the wet FGD system. The associated FGD infrastructure include a facility for storage of fuel (diesel), installation of storm water infrastructure and conservancy tanks for sewage;
5. The handling, treatment and conveyance of gypsum and effluent from the gypsum dewatering plant.
6. Pipeline for the transportation of waste water from the gypsum dewatering plant and its treatment at the waste water treatment plant (WWTP) that will be located close to the FGD infrastructure within the Medupi Power Station;
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10. Disposal of gypsum together with ash on the existing licenced ash disposal facility (ADF), with resulting increase in height of the ADF from 60m to 72m.

The following tasks were included in the SoW:

1. A review of 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 and land use data sources; and
   c. Determining representative baseline noise levels through the analysis of sampled environmental noise levels obtained from a survey conducted in September 2015.
4. An impact assessment, including:
   a. The establishment of a source inventory for the project;
   b. Noise propagation simulations to determine environmental noise levels; and,
   c. The screening of simulated noise levels against environmental noise criteria.

5. The identification and recommendation of suitable mitigation measures and monitoring requirements; and,
6. A specialist noise impact assessment report.

1.3 Description of Activities from a Noise Perspective and Selection of Assessment Scenarios

Noise will be generated during the project's construction, operational and decommissioning/closure phases. Construction and decommissioning/closure phase activities, however, will be for limited time frames and was not assessed in detail for the current study.

1.3.1 Construction Phase

During the construction phase several facilities need to be established. These include; contractor's laydown areas, workshops, stores for the storing and handling of construction materials, a parking area for cars and equipment, etc. These facilities will likely be removed at the end of the construction phase.

It is anticipated the construction phase activities would result in noise from mobile construction equipment, metal and masonry/concrete works, ancillary equipment such as welders, compressors and generators as well as traffic for the delivery of materials and construction staff transport.

1.3.2 Operational Phase

The proposed project will comprise of operations at the Power Station including boilers, turbines, ball mills, pumps, fans, conveyors, stackers, and road activity. The detail of the sources is provided in Section 4.1.

1.3.3 Decommissioning and Closure Phase

The removal of infrastructure will take place during the decommission phase. Diesel mobile equipment and demolition activities will generate noise.

1.4 Background to Environmental Noise and the Assessment Thereof

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

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

Noise is reported in decibels (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 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 1). "dBA" is the descriptor that is used to indicate 10 times a logarithmic ratio of quantities, that have the same units (in this case sound pressure) that has been A-weighted.

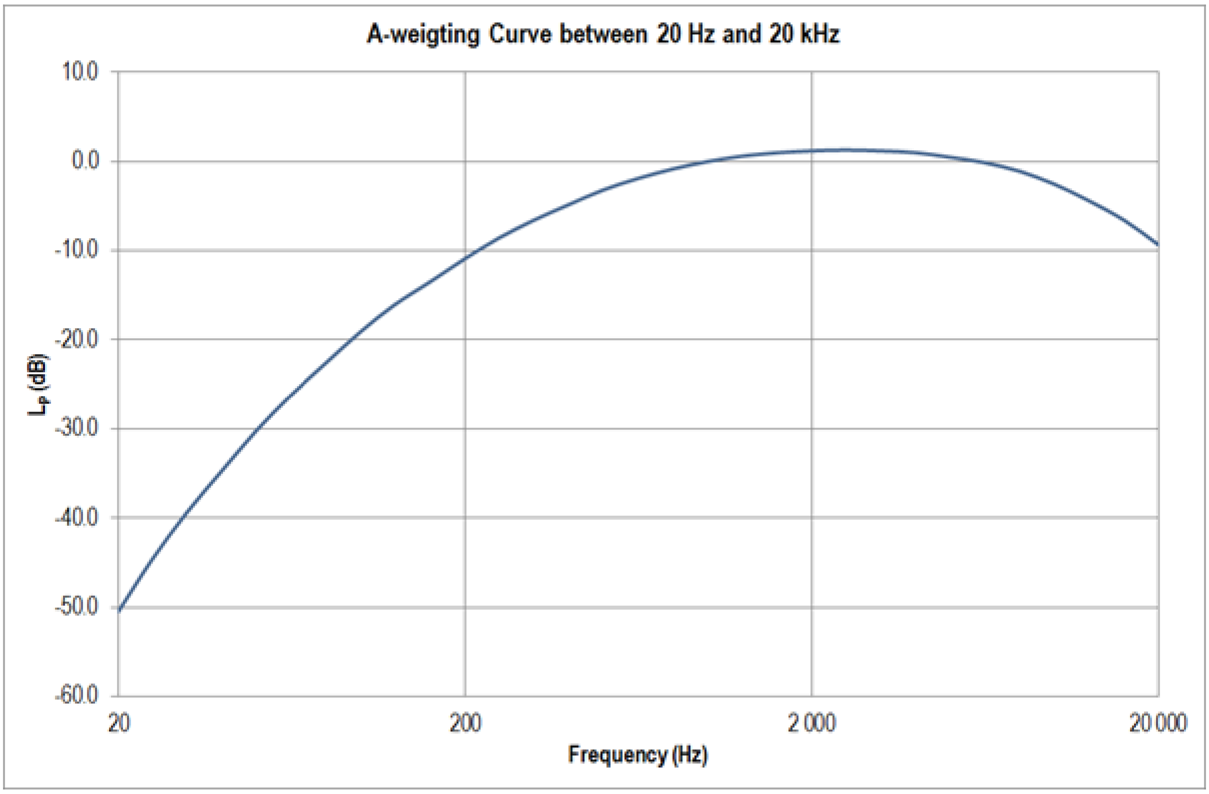


Figure 1: A-weighting curve

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 just simply be added together. To obtain the combined sound pressure level of a combination of sources such as those at an industrial plant, individual sound pressure levels must be converted to their linear values and added using:

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

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

1.4.4 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 generally made to the following indices:

- **L_{Aeq} (T)** – The A-weighted equivalent sound pressure level, where T indicates the time over which the noise is averaged (calculated or measured). The International Finance Corporation (IFC) provides guidance with respect to L_{Aeq} (1 hour), the A-weighted equivalent sound pressure level, averaged over 1 hour.
- **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 the South African Bureau of Standards' (SABS) South African National Standard (SANS) 10103 of 2008 for 'The measurement and rating of environmental noise with respect to annoyance and to speech communication' prescribes the sampling of L_{AIeq} (T).
- **$L_{Req,d}$** – The L_{Aeq} rated for impulsive sound (**L_{AIeq}**) 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 (**L_{AIeq}**) 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 (L_{AIeq}) 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 10 dB 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_{AFmax}** – The maximum A-weighted noise level measured with the fast time weighting. It's the highest level of noise that occurred during a sampling period.
- **L_{AFmin}** – The minimum A-weighted noise level measured with the fast time weighting. It's the lowest level of noise that occurred during a sampling period.

1.5 Approach and Methodology

The assessment included a study of the legal requirements pertaining to 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 Review of Assessment Criteria

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 environmental noise limits have yet to be set. It is believed that when published, national criteria will make extensive reference to South African National Standard (SANS) 10103 of 2008 '*The measurement and rating of environmental noise with respect to annoyance and to speech communication*'. These guidelines, which are in line with those published by the International Finance Corporation (IFC) and World Health Organisation (WHO), were considered in the assessment.

1.5.2 Study of the Receiving Environment

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

The ability of the environment to attenuate noise as it travels through the air was studied by considering local meteorology and land use. The atmospheric attenuation potential was described based on MM5 meteorological data for the period 2011 to 2013. Land cover data was obtained from Google Earth satellite.

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. Data from a baseline noise survey conducted by Airshed as part of the scope of work was studied to determine representative baseline noise levels for use in the assessment of cumulative impacts.

1.5.3 Source Inventory

The source noise inventory was informed by:

- Equipment specific L_W predictive equations for industrial equipment as published by Crocker (1998);

- Generic area wide L_W's for industrial areas as published by the European Commission (EC WG-AEN, 2003); and
- Sound power levels measured by acoustic consultants.

1.5.4 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 outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level under meteorological conditions favourable to propagation from sources of known sound emission.

These conditions are for downwind propagation or, equivalently, propagation under a well-developed moderate ground based temperature inversion, which commonly occurs at night.

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

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

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*
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 at noise at the proposed plant were quantified as 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/mining 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 10 km east-west by 10 km north-south with the proposed project located centrally. The area was divided into a grid matrix with a 10 m resolution and NSRs were included as discrete receptors. The model calculates L_P's at each grid and discrete receptor point at a height of 1.5 m above ground level.

1.5.5 Presentation of Results

Noise impacts were calculated in terms of:

- Equivalent continuous day, night and day-night rating levels ($L_{Req,d}$, $L_{Req,n}$ and $L_{R,dn}$) in comparison with guidelines. These levels were assessed for the project activities;
- The effective increase ambient day, night and day-night noise levels over estimated baseline $L_{Req,d}$, $L_{Req,n}$ and $L_{R,dn}$ as a result of the project.

Results are presented in isopleth form. An isopleth is a line on a map connecting points at which a given variable (in this case 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, reference was made to guidelines published in SANS 10103.

1.5.6 Recommendations of Management and Mitigation

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

1.6 Limitations and Assumptions

The main assumptions and limitations for the current assessment are as follows:

- The quantification of sources of noise was restricted to activities associated with the project scope.
- Shielding effect of infrastructure was not considered in simulations. This approach will provide a conservative estimate of the estimated sound pressure levels from the project.
- Terrain was not accounted for in this assessment, providing a conservative estimate of noise levels as no natural shielding is taken into account.
- Source strength calculations were based on theoretical estimates not taking into account acoustic shielding or mitigation as a conservative estimate.
- The background used for the estimation of cumulative change in noise levels was selected from measured data points within the study area.

2 LEGAL REQUIREMENTS AND NOISE LEVEL GUIDELINES

2.1 SANS 10103 (2008)

SANS 10103 (2008) successfully addresses the manner in which environmental noise measurements are to be taken and assessed in South Africa, and is fully aligned with the WHO guidelines for Community Noise (WHO, 1999). The values given in Table 1 are typical rating levels that should not be exceeded outdoors in the different districts specified. Outdoor ambient noise exceeding these levels will be considered to be annoying to local noise sensitive receptors.

Table 1: Typical rating levels for outdoor noise, SANS 10103 (2008)

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}[1] 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.

[1] $L_{Aeq,T}$ is the A-weighted equivalent sound pressure level, where T indicates the time over which the noise is averaged (calculated or measured).

2.2 IFC Guidelines on Environmental Noise

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

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

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

Table 2: 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

2.3 Criteria Applied in this Assessment

Reference is made to the IFC guidelines for residential, institutional and educational receptors (55 dBA during the day and 45 dBA during the night) since these are -

(a) applicable to nearby NSRs; and
(b) in-line with SANS 10103 guidelines for urban districts.

For that reason, the SANS 10103 24-hour limit of 55 dBA for urban districts is also used. The IFC's 3 dBA increase criterion is used to determine the potential for noise impact together with the SANS 10103 guideline for community response of 'little' reaction with 'sporadic complaints' (0 dB < $\Delta \leq$ 10 dB).

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
- Sampled baseline or pre-development noise levels.

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 industrial activities. Those within the vicinity of the Medupi Power Station are presented in Figure 2 and include individual residential dwellings and residential settlements to the north and northeast of the Matimba Power Station.

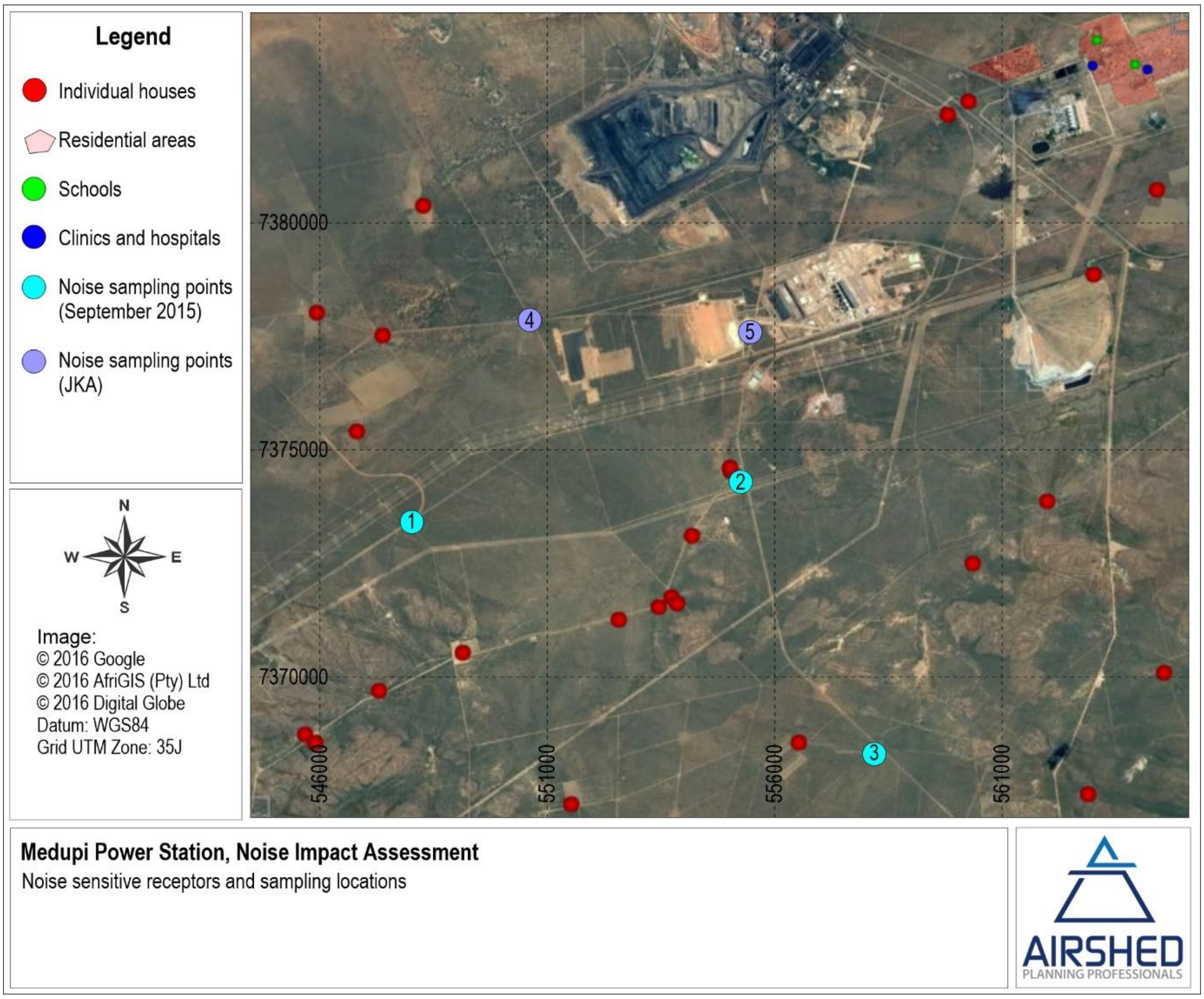


Figure 2: Location of NSRs

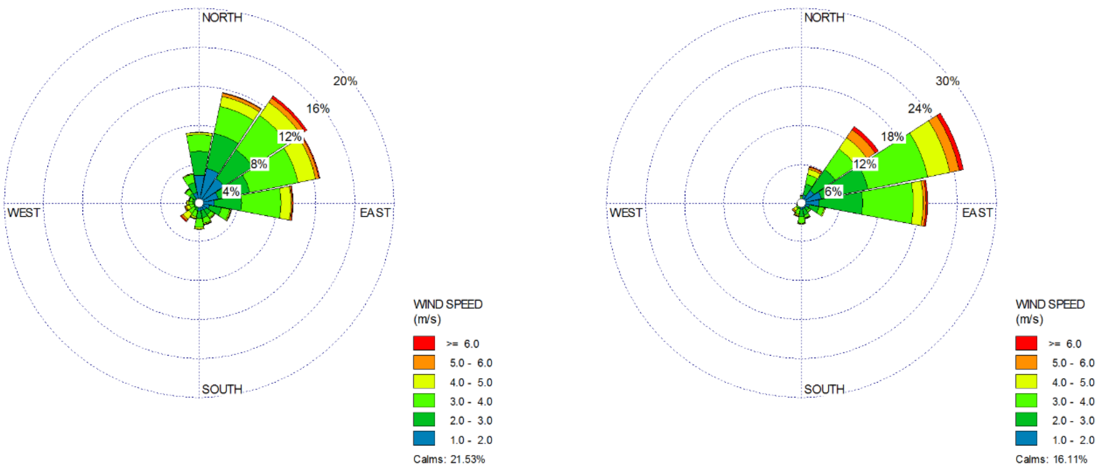
3.2 Environmental Noise Propagation and Attenuation Potential

3.2.1 Atmospheric Absorption and Meteorology

Atmospheric absorption and meteorological conditions have already been mentioned with regards to its 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. Reference is made to MM5 modelled data for the period 2011 to 2013.

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

The diurnal wind field is presented in Figure 3. Wind roses represent wind frequencies for the 16 cardinal wind directions. Frequencies are indicated by the length of the shaft when compared to the circles drawn to represent a frequency of occurrence. Wind speed classes are assigned to illustrate the frequencies with high and low winds occurring for each wind vector. The frequencies of calms, defined as periods for which wind speeds are below 1 m/s, are also indicated.



(a) Day-time wind field (06:00 to 22:00) **(b) Night-time wind field (22:00 to 06:00)**

Figure 3: Wind roses for day- and night-time conditions at the Medupi Power Station site (MM5 data)

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. An average temperature of 15°C and a humidity of 62% were applied in simulations.

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 the sound waves 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). With exception of the boiler building, shielding effect of other infrastructure was not taken into account for this assessment. Terrain and thus natural shielding effect was conservatively not included in this study.

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, the ground cover was taken to be acoustically mixed.

3.3 Sampled Baseline and Representative Pre-Development Noise Levels

Airshed conducted a baseline noise survey on 3 September 2015 at three locations (Figure 2). Pictures of these locations and surround areas are presented in Figure 4. The survey consisted of 60 minute samples during the day and 30 minute samples during the night (results summarised in Table 3 with measured levels provided in Figure 5 to Figure 10).

For noise measurements conducted in September, the equivalent day/night noise levels at location 1 and 2 correspond to typical noise levels prevalent in suburban districts. The equivalent day/night noise levels at location 3 correspond to typical noise levels prevalent in a central business district. This is as a result of fast travelling heavy vehicles on the road in the vicinity of the sampler.

Noise measurements for the area were also conducted by Jorgens Keet Associates (JKA) (as documented in Noise Impact Assessment for the ash disposal facility at Matimba Power Station (Jorgens Keet Associates, 2014)). In the vicinity of the potential Medupi waste disposal facility sites, two noise measurements from this study have been extracted and provided in Table 4 (see Figure 2). It should be noted that these measurements were taken in April 2005 (prior to the construction of the Medupi Power Station) and may not be representative of the current noise levels at the study area. It is unlikely however that the current noise levels at these sites will be lower than the JKA 2005 measurements.

For the JKA noise measurements conducted in April 2005, the equivalent day/night noise levels at location 4 correspond to typical noise levels prevalent in suburban to urban districts. The equivalent day/night noise levels at location 5 correspond to typical noise levels prevalent in rural to suburban districts.

For estimating the increase in ambient noise levels as a result of the project, the following representative background noise levels (based on Site 1, 2, 4 and 5) were calculated from survey results.

- $L_{Req,d}$ – 48.3 dBA;
- $L_{Req,n}$ – 43.7 dBA; and
- $L_{R,dn}$ – 50.9 dBA.

Table 3: Summary of the noise survey conducted by Airshed on 3 September 2015

Site	1		2		3	
Time of Day	Day	Night	Day	Night	Day	Night
Description	Cloudy, warm conditions with gusting moderate wind. Measurements mostly affected by heavy and light vehicle traffic on the adjacent main road. Birds also contributed to measured noise levels.	Cool, partly cloudy conditions with gusting moderate wind. Audible sources included constant humming of mining equipment and power station.	Cloudy, warm conditions with moderate wind. Birds, insects, vehicle traffic and continuous humming from the Medupi Power Station contributed to measured noise levels.	Cool, overcast conditions with moderate winds. Noise generated by cattle grazing and moving in the vicinity and vehicle traffic from nearby road.	Partly cloudy, warm conditions with gusting moderate winds. Measurements mostly affected by heavy and light vehicle traffic on the adjacent main road and occasional air traffic.	Cold, partly cloudy conditions with low wind. Low humming from the power station, bats, jackals, and insects contributed to measured noise levels.
Project Name	150903-001	150903-005	150903-002	150903-006	150903-003	150904-001
Start Time	03/09/2015 8:54	03/09/2015 22:19	03/09/2015 10:29	03/09/2015 23:30	03/09/2015 11:52	04/09/2015 0:33
Elapsed Time	01:00:03	00:30:11	01:00:00	00:30:08	01:00:00	00:30:14
L_{AIeq} (dBA)[(a)]	45.26	43.47	49.45	40.06	62.57	34.35
L_{Aeq} (dBA)[(b)]	42.68	41.98	45.95	38.17	58.55	33.39
L_{A90} (dBA)[(c)]	29.07	34.93	35.33	35.39	28.62	30.12
$L_{Req,T}$ (dBA)[(d)]	45.26	43.47	49.45	40.06	62.57	34.35
$L_{R,dn}$ (dBA)[(e)]	49.8		49.7		60.8	
C_t[(f)]	5	0	0	0	5	0
$L_{Req,T}$ (dBA)[(g)]	50.26	43.47	49.45	40.06	67.57	34.35
$L_{R,dn}$ (dBA)[(h)]	51.6		49.7		65.8	

Notes:

(a) 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)

(b) The A-weighted equivalent sound pressure level, where T indicates the time over which the noise is averaged (calculated or measured) (in dBA)

(c) 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)

(d) Equivalent continuous rating (in dBA)

(e) 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 10 dB in order to account for the additional disturbance caused by noise during the night

(f) Correction factor for tonal character determined in accordance with SANS 10103 (2008)

(g) Equivalent continuous rating (in dBA) with tonal character penalty

(h) 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 tonal character penalty has been taken into account and the $L_{Req,n}$ has been weighted with 10 dB in order to account for the additional disturbance caused by noise during the night

Location Site1
Eskom property; leased to farmer. Opposite entrance to Eskom game farm

Location Site2
~3 km south of the existing ADF

Location Site 3
Approximately ~10 km south east of the existing ADF

Figure 4: Pictures of baseline noise measurement locations undertaken for the project

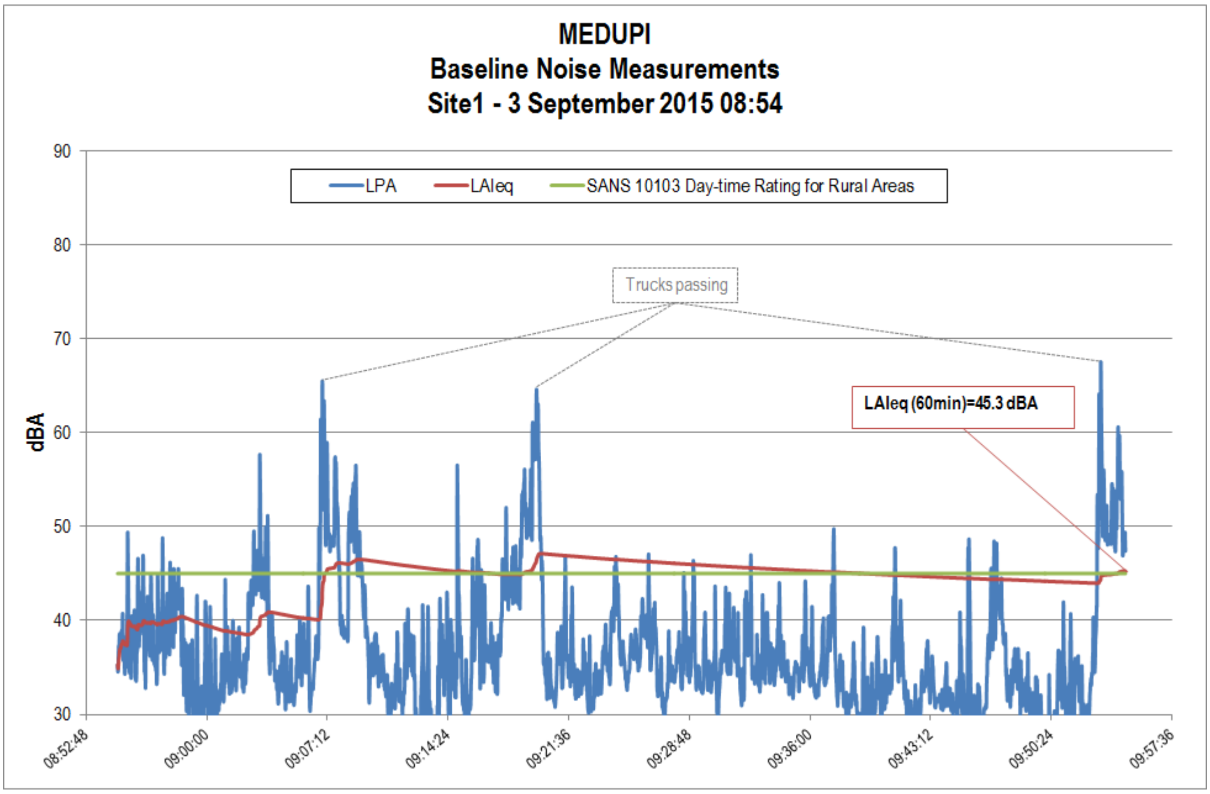


Figure 5: Baseline day-time noise measurement at noise sampling site 1

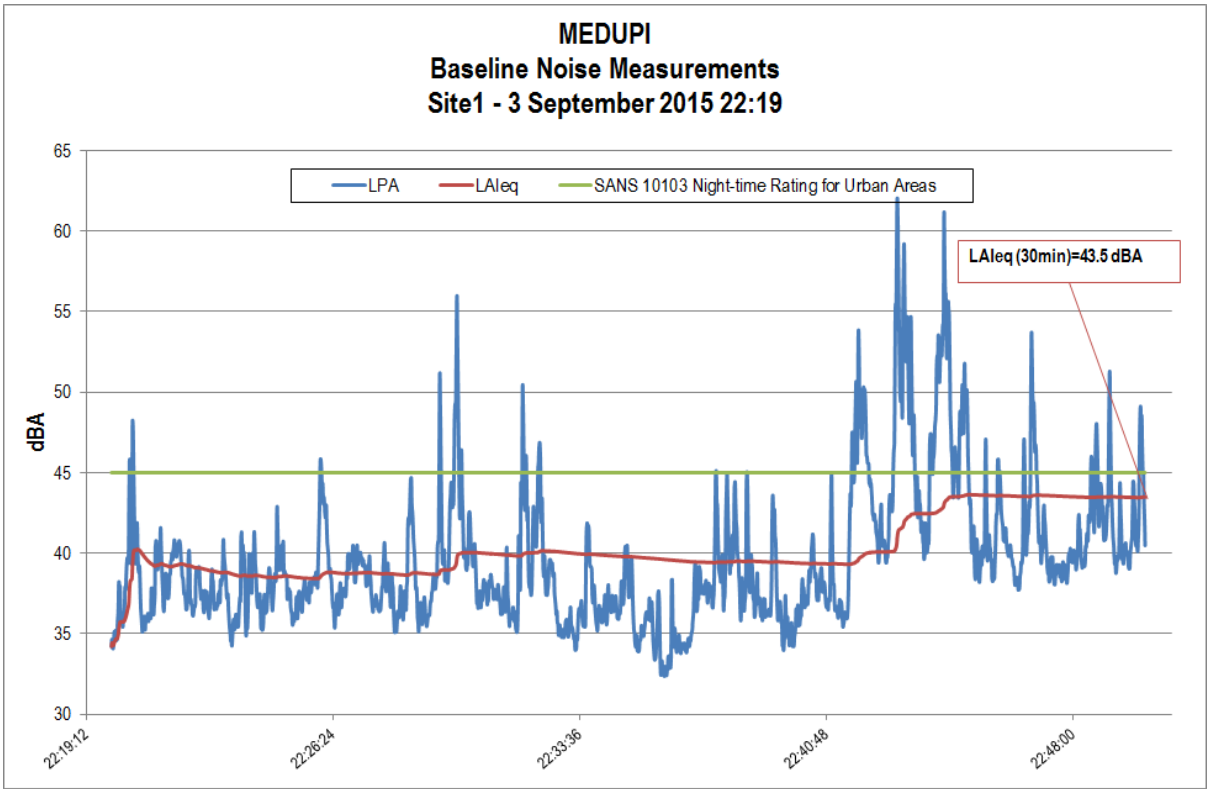


Figure 6: Baseline night-time noise measurement at noise sampling site 1

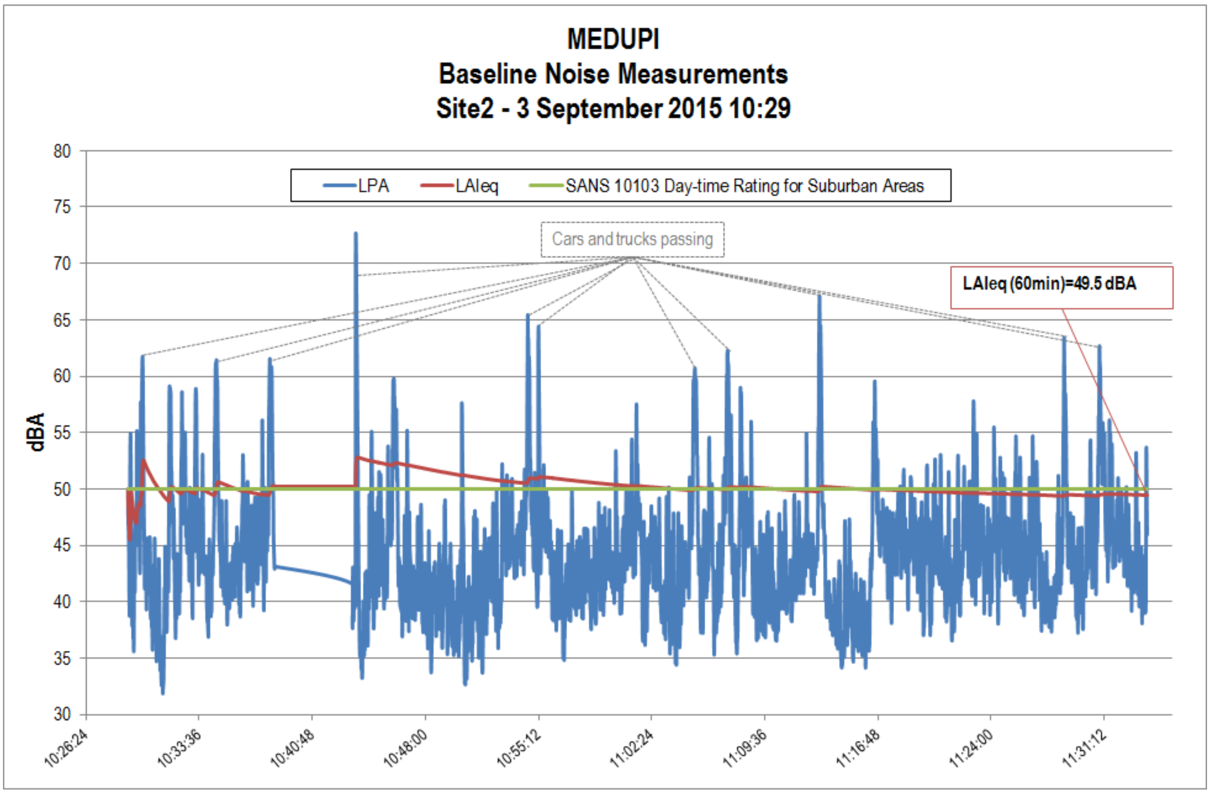


Figure 7: Baseline day-time noise measurement at noise sampling site 2

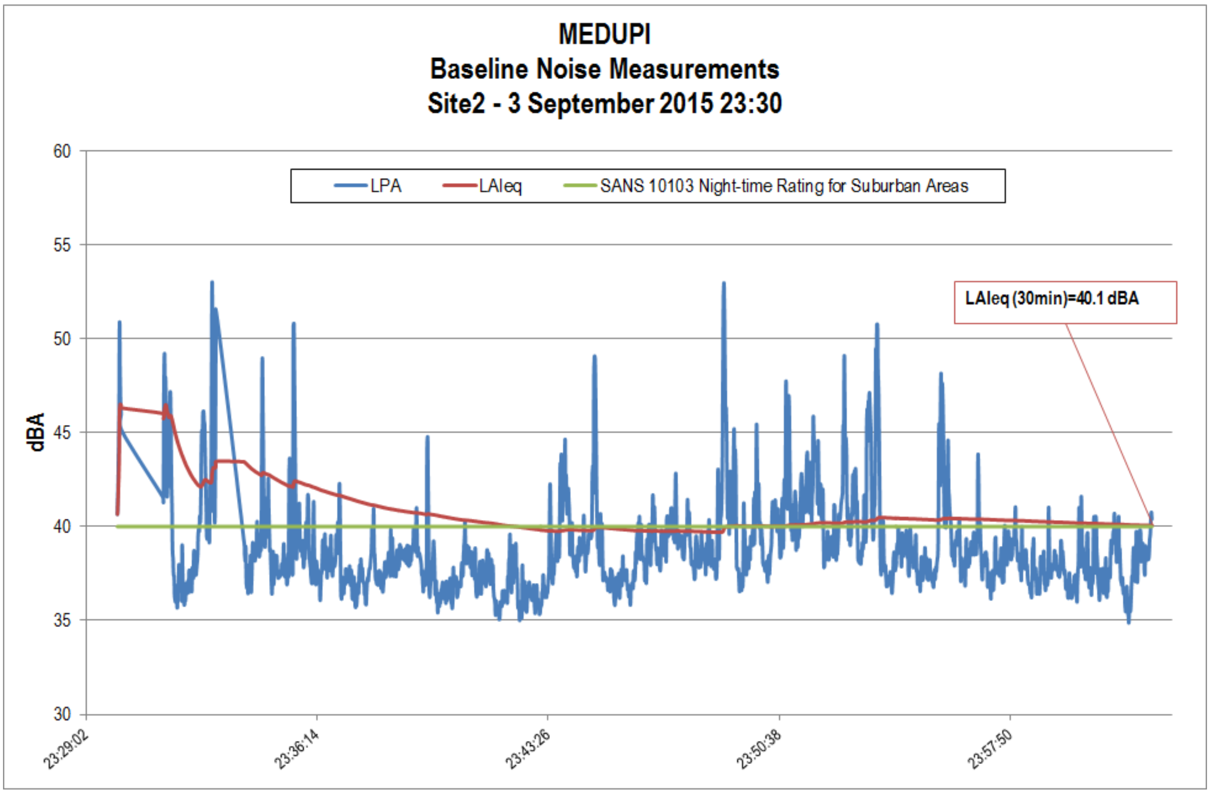


Figure 8: Baseline night-time noise measurement at noise sampling site 2

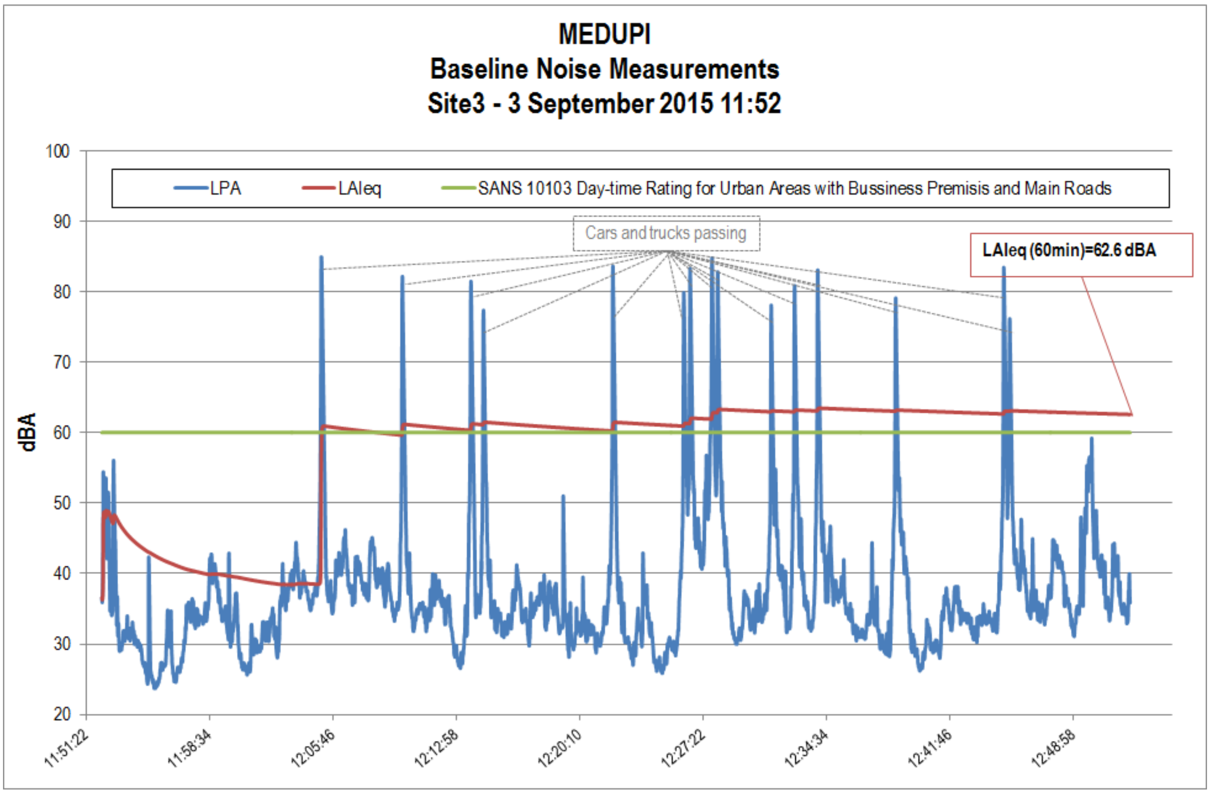


Figure 9: Baseline day-time noise measurement at noise sampling site 3

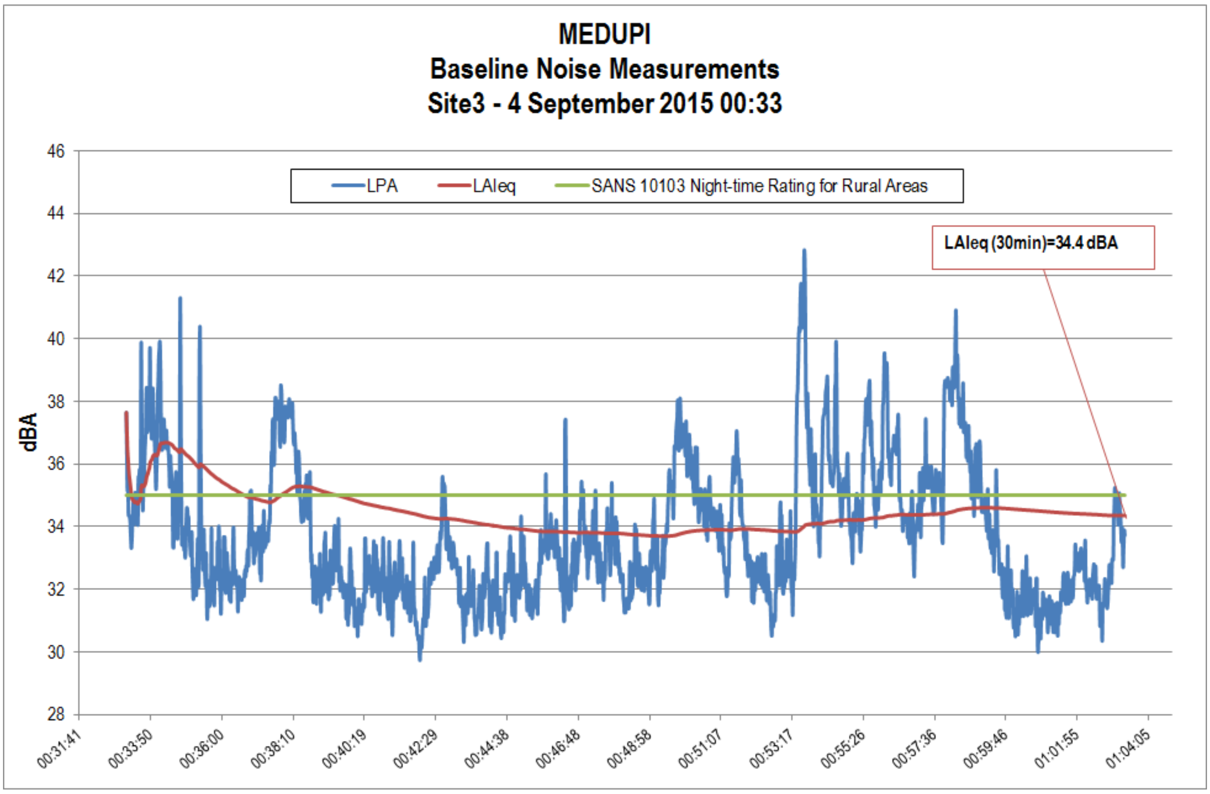


Figure 10: Baseline night-time noise measurement at noise sampling site 3

Table 4: Equivalent continuous ratings for measured noise levels in the existing Medupi waste disposal facility area undertaken by JKA during April 2005 (Jorgens Keet Associates, 2014)

Location	$L_{Req,d}$ (dBA)	$L_{Req,n}$ (dBA)	$L_{R,dn}$ (dBA)
4	46.2	47.2	53.1
5	45.1	39.6	47.2

4 Impact Assessment

The noise source inventory, noise propagation modelling and results for the operational phase of the project are discussed in Section 4.

4.1 Noise Sources and Sound Power Levels

Sound power levels (LW's or noise "emissions") from activities associated with the project were estimated based on technical source data from information gathered during the document review, sound power level predictions for industrial machinery as published in the 'Handbook of Acoustics' (Crocker, 1998), sound power level measurements as undertaken by acoustic consultants F Malherbe and B van Zyl and the 'Good Practice Guide for Strategic Noise Mapping and the Production of Associated Data on Noise Exposure' (EC WG-AEN, 2003).

The following noise sources were included in simulations; main steam boilers, steam turbine-generator units, ball mills, ash stacker, coal and ash conveyors, conveyor transfer stations, general industrial noise (i.e. small pumps, conveyors, motors, coal handling etc.) and access road to transport the salts and sludge offsite. LW's for these sources are summarised in Table 5. It should be noted that 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. Other less notable sources of noise such as pumps, fans, electrical motors, etc. were included as an area wide industrial source emitting 65 dBA/m².

Table 5: Operational phase source noise inventory for the project

Source Type	Description and information used in calculations	Qty	L_{Wi} (in dB) at octave band centre frequencies (in Hz)									L_{WA} (dBA)	Source
			31.5	63	125	250	500	1000	2000	4000	8000		
Main Steam Boilers	800 MW	8	123.5	122.5	117.5	111.5	110.5	108.5	106.5	106.5	106.5	114.9	LW Equation,Handbook of Acoustics,Crocker (2008)
Steam-Turbine Generator Units	800 MW	8	115.6	121.6	119.6	114.6	110.6	106.6	103.6	95.6	89.6	113.1	LW Equation,Handbook of Acoustics,Crocker (2008)
Ball Mills		3		106.9	108.2	109.3	106.8	106.2	101.1	97.2		110.1	F Malherbe Acoustic Consulting
Ash Stacker		1		108.1	103.4	102.3	103.1	99.9	97.3	89.6		104.9	Airshed Database, Kendal Ash Stacker Measurements
Highway Truck	300 kW assuming speed of 60 km/h	82/day	119.8	108.8	113.8	116.8	111.8	109.8	106.8	100.8	94.8	115.1	LW Equation,Handbook of Acoustics,Crocker (2008)
Heavy Industry		1	18.6	31.8	41.9	49.4	54.8	58	59.2	59	56.9	65	EC WG-AEN (2006)
Standard Conveyor	5 m/s	9		83.4	86.5	84.5	88.7	82.9	76.5	67.3		88.2	Francois Malherbe Acoustic Consulting & B van Zyl
Conveyor Transfer Station		10		102.7	102.6	107.6	104.6	102.4	99.2	94.4		107.3	Francois Malherbe Acoustic Consulting
Handling at railway yard and siding		6		80	90	98.8	97.6	100.7	101.4	95.4		105.8	Francois Malherbe Acoustic Consulting

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. Meteorological and site specific acoustic parameters as discussed in Section 3.2.1 along with source data discussed in 4.1, were applied in the model.

Results are presented in isopleth form (Figure 11 to Figure 16). An isopleth is a line on a map connecting points at which a given variable (in this case 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.

For the assessment, an access road was assumed for the transport of the sludge and salts from the site for illustrative purposes. The simulated equivalent continuous day-time rating level (LReq,d) of 55 dBA (noise guideline level) extends ~70m from the road. The simulated equivalent continuous night-time rating level (LReq,n) of 45 dBA (noise guideline level) extends ~100m from the road. These distances can be assumed for any road that will be utilised for the transport of the sludge and salts from the site.

Operational phase related noise due to the project is not predicted to exceed the selected noise guidelines at NSR surrounding the Medupi Power Station with an increase above the baseline of less than 3 dBA at all of the identified NSR. 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' reaction with 'sporadic complaints' may be expected from the community for increased noise levels up to 10 dBA. With the conservative approach adopted for the assessment (detailed in Section 1.6) the predicted increase in noise levels is not expected to be higher than 1 dBA at any of the identified NSR. *'Little' reaction is therefore expected from the community due to the project with changes in the general ambient noise levels barely being detectable (for a person with average hearing acuity).*

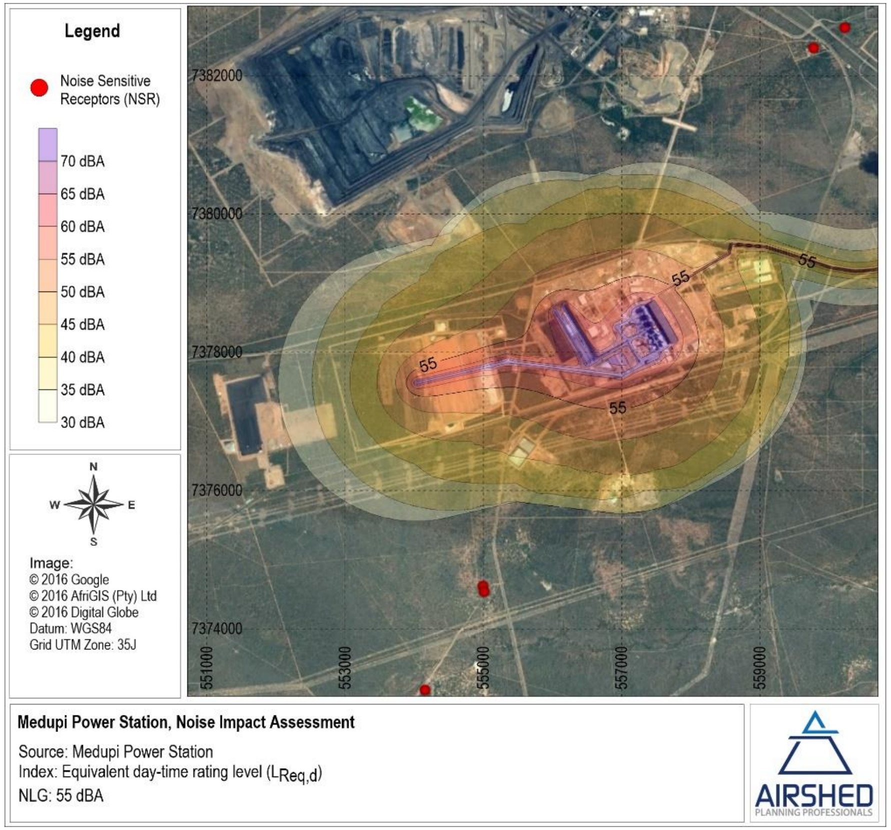


Figure 11: Simulated equivalent continuous day-time rating level ($L_{Req,d}$) for project activities

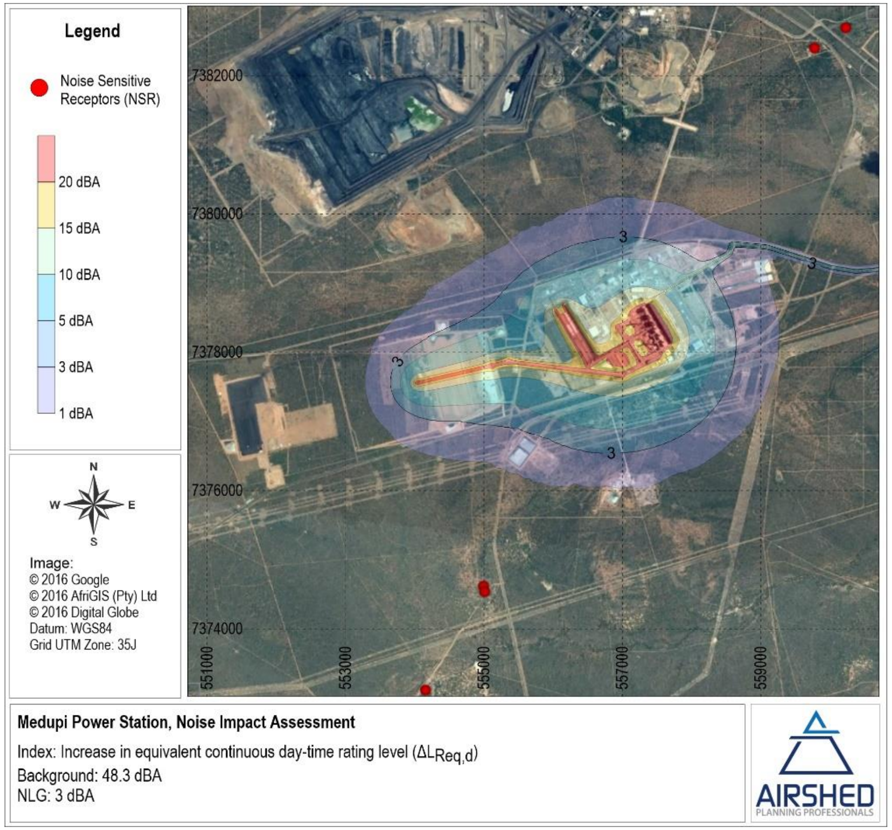


Figure 12: Simulated increase in equivalent continuous day-time rating level ($\Delta L_{Req,d}$) above the baseline

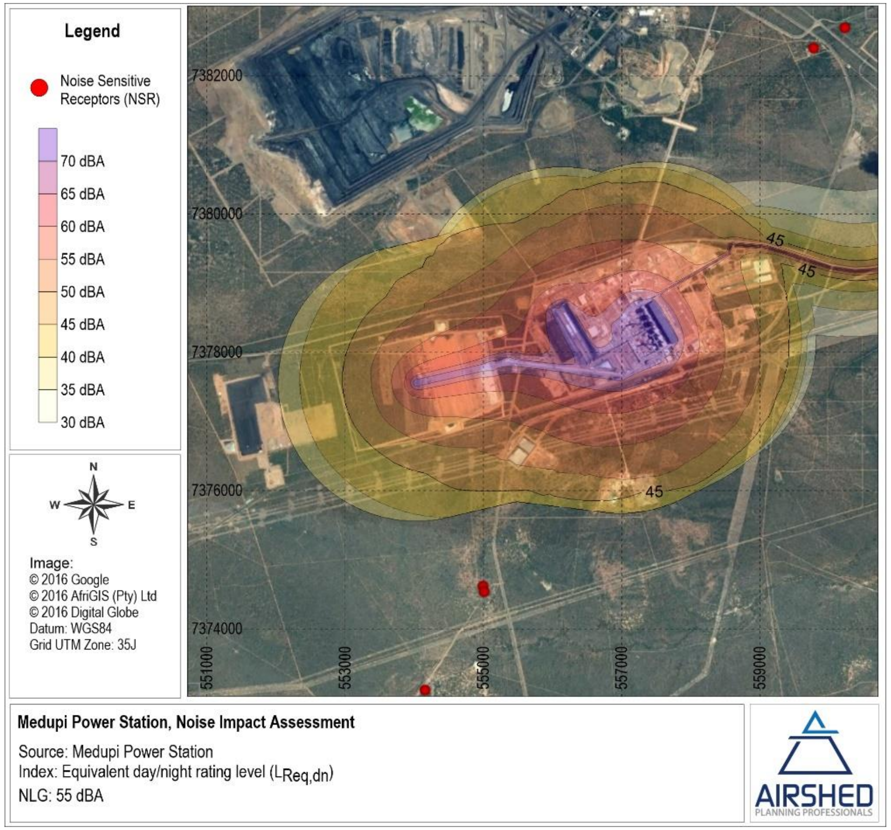


Figure 13: Simulated equivalent continuous night-time rating level ($L_{Req,n}$) for project activities

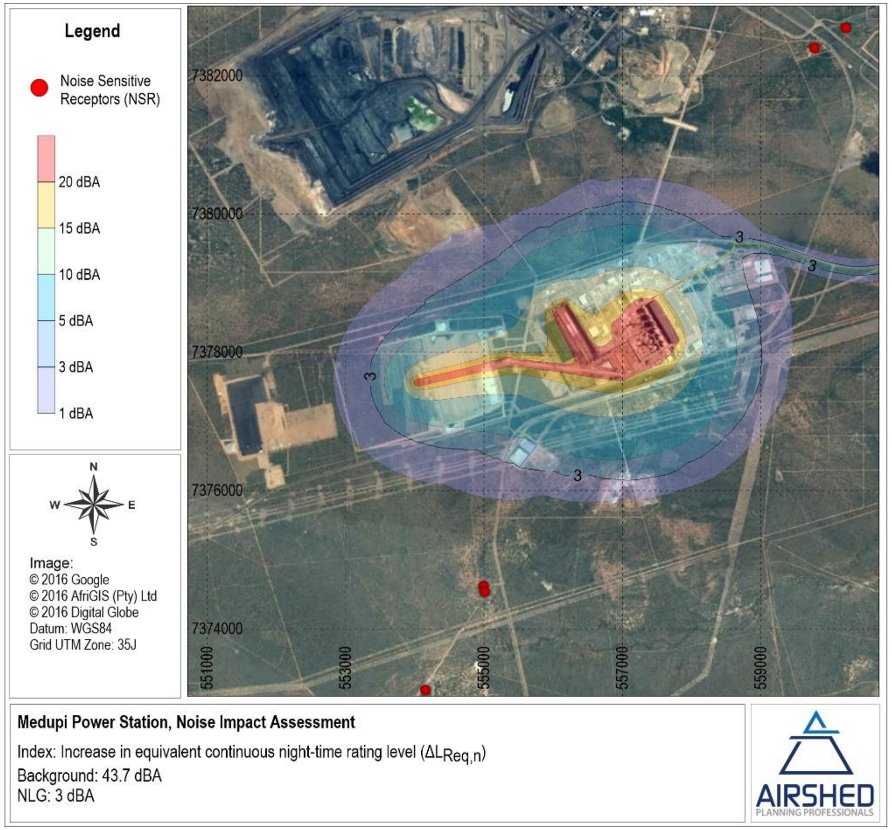


Figure 14: Simulated increase in equivalent continuous night-time rating level ($\Delta L_{Req,n}$) above the baseline

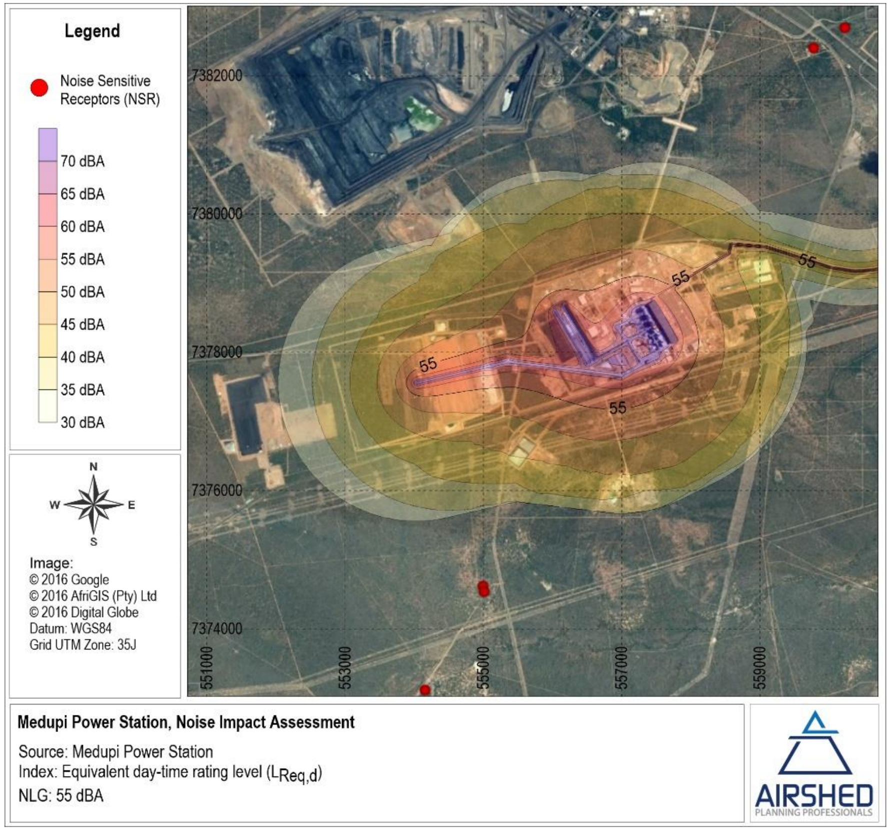


Figure 15: Simulated equivalent continuous day/night rating level ($L_{Req,dn}$) for project activities

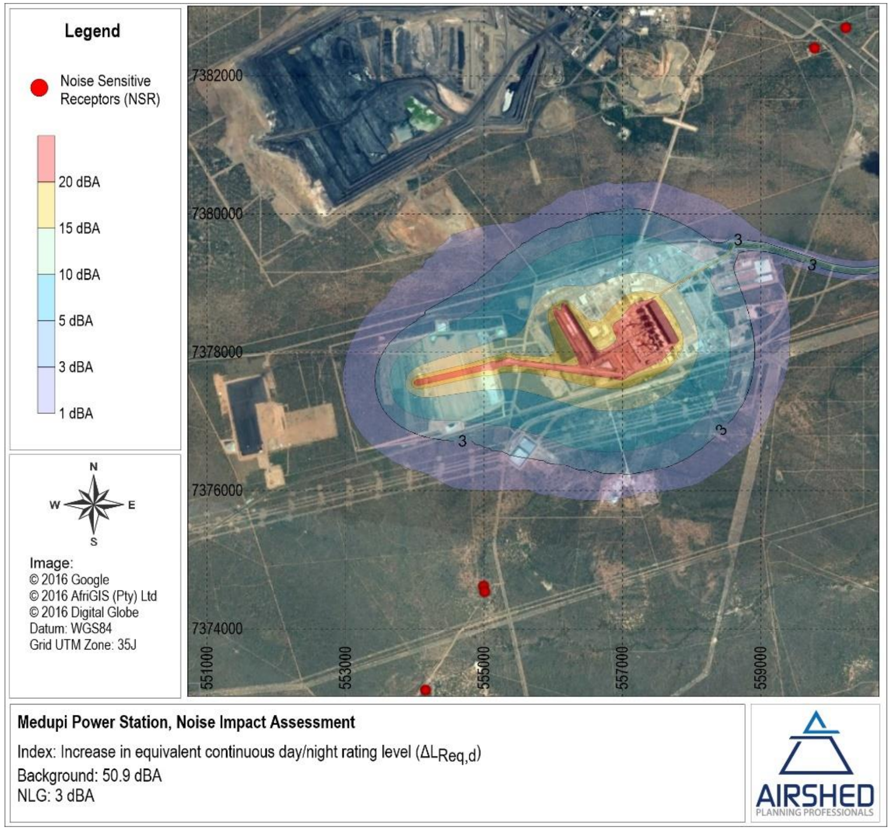


Figure 16: Simulated increase in equivalent continuous day/night rating level ($\Delta L_{Req,dn}$) above the baseline

4.3 Impact Significance Rating

The impact significance rating for the project is presented in Table 6.

Table 6: Impact rating matrix for the proposed project operations

Activity	Nature of Impact	Impact type	Extent	Duration	Potential Intensity	Likelihood	Rating	Mitigation	Interpretation
PRE-CONSTRUCTION PHASE									
Noise Levels	Indirect Impact: Increase in noise levels	Existing	2	1	1	0.5	2 - LOW	With noise mitigation, noise levels from the project will be low.	Noise levels in the area are representative of suburban districts.
		Cumulative	2	1	1	0.5	2 - LOW		Noise levels due to pre-construction will be similar to baseline levels.
		Residual	2	1	1	0.5	2 - LOW		Not applicable as no activities will have taken place.
CONSTRUCTION PHASE									
Noise Levels	Indirect Impact: Increase in noise levels	Existing	2	1	1	0.5	2 - LOW	With noise mitigation, noise levels from the project will be low.	Noise levels in the area are representative of suburban districts.
		Cumulative	2	1	2	0.5	3 - MOD		Noise levels due to construction will be local and can be notable.
		Residual	2	1	1	0.5	2 - LOW		With mitigation, the residual noise impact will be reduced (similar to existing levels).
OPERATIONAL PHASE									
Noise Levels	Indirect Impact: Increase in noise levels	Existing	2	1	1	0.5	2 - LOW	With noise mitigation, noise levels from the project will be low.	Noise levels in the area are representative of suburban districts.
		Cumulative	2	1	1	0.5	2 - LOW		Change in noise levels due to operation is slight at NSRs.
		Residual	2	1	1	0.5	2 - LOW		With mitigation, the residual noise impact will be reduced (similar to existing levels).
DECOMMISSIONING PHASE									
Noise Levels	Indirect Impact: Increase in noise levels	Existing	2	1	1	0.5	2 - LOW	With noise mitigation, noise levels from the project will be low.	Noise levels in the area are representative of suburban districts.
		Cumulative	2	1	2	0.5	3 - MOD		Noise levels due to decommissioning will be local and can be notable.

Activity	Nature of Impact	Impact type	Extent	Duration	Potential Intensity	Likelihood	Rating	Mitigation	Interpretation
		Residual	2	1	1	0.5	2 - LOW		With mitigation the residual noise impact will be reduced (similar to existing levels).

5 Management, Mitigation and Recommendations

In the quantification of noise emissions and simulation of noise levels as a result of the proposed project, it was calculated that ambient noise evaluation criteria for human receptors will not be exceeded at NSRs. 'Little' reaction can be expected from members of the community within this impact area.

From a noise perspective, the project may proceed. It is recommended, however, that mitigation measures be implemented to ensure minimal impacts on the surrounding environment.

5.1 Good Engineering and Operational Practices

For general activities, the following good engineering practice should be applied:

- To minimise noise generation, vendors should be required to guarantee optimised equipment design noise levels.
- A mechanism to monitor noise levels, record and respond to complaints and mitigate impacts should be developed.

5.2 Traffic

The measures described below are considered good practice in reducing traffic related noise. In general, road traffic noise is the combination of noise from individual vehicles in a traffic stream and is considered as a line source if the density of the traffic is high enough to distinguish it from a point source. The following general factors are considered the most significant with respect to road traffic noise generation:

- Traffic volumes i.e. average daily traffic.
- Average speed of traffic.
- Traffic composition i.e. percentage heavy vehicles.
- Road gradient.
- Road surface type and condition.
- Individual vehicle noise including engine noise, transmission noise, contact noise (the interaction of tyres and the road surface, body, tray and load vibration and aerodynamic noise

In managing transport noise specifically related to trucks, efforts should be directed at:

- Minimizing individual vehicle engine, transmission and body noise/vibration. This is achieved through the implementation of an equipment maintenance program.
- Minimize slopes by managing and planning road gradients to avoid the need for excessive acceleration/deceleration.
- Maintain road surface regularly to avoid corrugations, potholes etc.
- Avoid unnecessary idling times.
- Minimizing the need for trucks/equipment to reverse. This will reduce the frequency at which disturbing but necessary reverse warnings will occur. Alternatives to the traditional reverse 'beeper' alarm such as a 'self-adjusting' or 'smart' alarm should be considered. These alarms include a mechanism to detect the local noise level and automatically adjust the output of the alarm is so that it is 5 to 10 dB above the noise level in the vicinity of the moving equipment. The promotional material for some smart alarms does state that the ability to adjust the level of the alarm is of advantage to those sites 'with low ambient noise level' (Burgess & McCarty, 2009).

5.3 Monitoring

In the event that noise related complaints are received, short term (24-hour) 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 following procedure should be adopted for all noise surveys:

- Any surveys should be designed and conducted by a trained specialist.
- Sampling should be carried out using a Type 1 sound level meter (SLM) that meets all appropriate International Electrotechnical Commission (IEC) standards and is subject to annual calibration by an accredited laboratory.
- The acoustic sensitivity of the SLM should be tested with a portable acoustic calibrator before and after each sampling session.
- Samples of at least 24 hours in duration and sufficient for statistical analysis should be taken with the use of portable SLM's capable of logging data continuously over the time period. Samples representative of the day- and night-time acoustic climate should be taken.
- The following acoustic indices should be recoded and reported:
    - L_{Aeq} (T)
    - L_{AIeq} (T)
    - Statistical noise level L_{A90}
    - L_{Amin} and L_{Amax}
    - 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 climate of each site.

5.4 Conclusion

It was concluded that, given the conservative nature of the assessment, the implementation of the basic good practice management measures recommended in this report will ensure low noise impact levels. From a noise perspective, the project may proceed.

6 REFERENCES

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7 Annex A – Specialist's 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 14 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 thirteen (14) years of experience in the Earth and Natural Sciences sector in the field of Air Quality and three (3) 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 industrial source complex models (ISCST3 and SCREEN3), 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.

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 and mineral sands mines. These include: compilation of emissions databases for Landau and New Vaal coal collieries (SA), impact assessments and management plans for Schoonoord, Belfast, Goedgevonden, Mbila, Evander South, Driefontein and Hartogshoop cola collieries in SA, 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) and Kusile Rail (SA).

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 and Petro SA.

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 Kusile ash Project, Hendrina Power Station Coal Fines Project, Komati Power Station, Grootvlei and Tutuka Fabric Filter Plants, Tutuka and Lethabo Power Stations, the proposed Kusile, Medupi and Vaal South Power Stations and the cumulative assessment of the existing and return to service Eskom power stations assessment over the Highveld. René was also involved in 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 PBMR and nuclear plants at Duynefontein, Bantamsklip and Thyspunt (still on-going).

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 and the Mogale General Waste Landfill (adjacent to the Leipardsvlei Landfill). Air quality impact assessments have also been completed for the BCL incinerator (Cape Town) and the Ergo Rubber Incinerator.

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, 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

- 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.

______________________	22/04/2016
Signature of staff member	Date (Day / Month / Year)

Full name of staff member: René Georgeinna von Gruenewaldt

CURRICULUM VITAE

Name	Nicolette von Reiche (nee Krause)
Date of Birth	22 October 1982
Nationality	South African
Employer	Airshed Planning Professionals (Pty) Ltd
Position	Principal Consultant and Project Manager
Profession	Mechanical Engineer employed as a Air Quality and Environmental Noise Assessment Consultant
Years with Firm	9 Years

MEMBERSHIP OF PROFESSIONAL SOCIETIES

- South African Acoustic Institute (SAAI), 2006 to present
- National Association for Clean Air (NACA), 2006 to present
- International Institute for Acoustics and Vibration (IIAV), 2014 to present

EXPERIENCE

Nicolette has over nine years of experience in both air quality and noise impact assessment and management. She is an employee of Airshed Planning Professionals (Pty) Ltd and is involved in the compilation of emission inventories, atmospheric dispersion modelling, air pollution mitigation and management, and air pollution impact work. Airshed Planning Professionals is affiliated with Francois Malherbe Acoustic Consulting cc and in assisting with numerous projects she has gained experience in environmental noise measurement, modelling and assessment as well.

A list of projects competed in various sectors is given below:

Power Generation, Oil and Gas

eni East Africa S.p.A Rovuma Area 4 baseline for offshore gas (Mozambique), Staatsolie Power Company Suriname (Suriname), Benga Coal Fired Power Station (Mozambique), Zuma Energy Project (Nigeria), Anglo Coal Bed Methane Project, Eskom Ash Disposal Projects for Kusile Power Station, Camden Power Station and Kendal Power Station, Hwange Thermal Coal Fired Power Station Project (Zimbabwe), Eskom Ankerlig Gas Power Station.

Industrial Sector

Scantogo Cement Project (Togo), Boland Bricks, Brits Ferrochrome Smelter Project, Samancor Chrome's Ferrometals, Middelburg Ferrochrome and Tubatse Ferrochrome, BHP Billiton Metalloys Ferromanganese Projects and Mamatwan Sinter Plant Projects, Tharisa Minerals Concentrator Plant Project, Obuasi Gold Processing Plant (Ghana), Obuasi Gold Mine Pompora Treatment Plant Project (Ghana), Afrisam Saldanha Project, Scaw Metals Projects, including a Co-generation Plant and Steel Wire Rope Plant Project, Delta EMD Project, Dense Medium Separation (DMS) Powders Project, Transalloys Silica Manganese, Dundee Precious Metals Tsumeb (Namibia), Rössing Uranium Desalination Plant (Namibia), Otavi Steel Project (Namibia)

Air Quality and Environmental Noise Management

- Saldanha Industrial Development Zone (IDZ) – Part of an integrated team of specialists that developed the proposed development and management strategies for the IDZ. Air quality guidelines were developed and a method of determining emissions for potential developers. The investigation included the establishment of the current air emissions and air quality impacts (baseline) with the objective to further development in the IDZ and to allow equal opportunity for development without exceeding unacceptable air pollution levels.
- Gauteng Department of Transport air quality and noise management plan - The plan involved the identification of main traffic related sources of noise and air pollution, the identification of intervention strategies to reduce traffic related noise and emissions to air and the theoretical testing of intervention strategies through emission quantification and dispersion modelling of selected case studies.
- Erongo Strategic Environmental Impact Assessment (Namibia) and Air Quality Management Plan

Mining Sector

- **Coal mining:** Elders Colliery, Grootgeluk Colliery, Inyanda Colliery, Boschmanspoort Colliery, Benga Mine (Mozambique), Vangatfontein Colliery Dust Monitoring, T-Project Underground Coal Mine, Lusthof Colliery
- **Metalliferous mines:** Samancor Chrome's Eastern and Western Chrome Mines, Kinsenda Copper Mine (DRC), Bannerman Uranium Mine (Namibia), Sadiola Gold Mine Deep Sulphides Project (Mali), Kolomela Iron Ore Mine Noise Monitoring, Mamatwan Manganese Mine, Ntsimbintle Manganese Mine, Tharisa Minerals Chrome and Platinum Group Metals Open-pit Mine Project, Obuasi Gold Mine (Ghana), Omitiomire Copper Mine (Namibia), Perkoa Zinc Project (Burkina Faso), Tschudi Copper Mine (Namibia), Rössing Uranium Mine (Namibia), WCL Iron Ore Mines (Liberia), Fekola Gold Project (Mali), Esaase Gold Project (Ghana), Xstrata Paardekop and Amersfoort Underground Coal Mines, Mampon Gold Mine (Ghana), Husab Uranium Mine (Namibia), Mkuju River Uranium Project (Tanzania), Impala Platinum Mine, Angola Exploration Mining Resources Project (Angola), Kanyika Niobium Mine (Malawi)
- **Quarries:** Scantogo Limestone Quarry, Lion Park Quarries Dustfall Monitoring

Waste Disposal and Treatment Sector

Aloes Hazardous Waste Disposal Site, Holfontein Hazardous Waste Disposal Site, Shongweni Hazardous Waste Disposal Site, Coega General and Hazardous Waste Disposal Site, Umdloti Waste Water Treatment Works, Waltloo Medical Waste Incinerator

Transport and Logistics Sector

Saldanha Iron Ore Port Projects and Railway Line, Gautrain Environmental Noise Monitoring Project, Guinea Port and Railway Project (Guinea), Kenneth Kaunda International Airport Expansion (Zambia), Zambia Dry Port Project in Walvis Bay (Namibia)

Ambient Air Quality and Noise Sampling

- Gravimetric Particulate Matter (PM) and dustfall sampling
- Passive diffusive gaseous pollutant sampling
- Environmental noise sampling
- Source noise measurements

SOFTWARE PROFICIENCY

- Atmospheric Dispersion Models: AERMOD, ISC, CALPUFF, ADMS (United Kingdom), CALINE, GASSIM, TANKS
- Noise Propagation Modeling: Integrated Noise Model (for airport noise), CONCAWE, South African National Standards (SANS 10210) for Calculating and Predicting Road Traffic Noise
- Graphical Processing: Surfer, ArcGIS (basic proficiency)
- Other: MS Word, MS Excel, MS Outlook

EDUCATION

- BEng: (Mechanical Engineering), 2005, *University of Pretoria*
- BEng (Hons): (Mechanical Engineering) 2010, *University of Pretoria*; specializing in:
    - Advance Heat and Mass Transfer
    - Advanced Fluid Mechanics
    - Numerical Thermo-flow
    - Tribology

COURSES COMPLETED AND CONFERENCES ATTENDED

- Course: Air Quality Management. Presented by the University of Johannesburg (March 2006)
- Course: AERMET/AERMAP/AERMOD Dispersion Model. Presented by the University of Johannesburg (March 2010)
- Conference: NACA (October 2007), Attended and presented a paper
- Conference: NACA (October 2008), Attended and presented a paper
- Conference: NACA (October 2011), Attended and presented a poster
- Conference: NACA (October 2012), Attended and presented a paper
- Conference: IUAPPA (October 2013), Attended and presented a paper

COUNTRIES OF WORK EXPERIENCE

South Africa, Mozambique, Zimbabwe, Zambia, Namibia, the Democratic Republic of the Congo, Botswana, Ghana, Liberia, Togo, Mali, Burkina Faso, Tanzania, Malawi, Angola, Nigeria and Suriname

LANGUAGES

	Speak	Read	Write
English	Excellent	Excellent	Excellent
Afrikaans	Excellent	Excellent	Excellent

REFERENCES

Name	Position	Contact Number
Dr. Gerrit Kornelius	Associate of Airshed Planning Professionals	+27 (82) 925 9569 gerrit@airshed.co.za
François Malherbe	Owner of François Malherbe Acoustic Consulting	+27 (82) 469 8063 malherf@mweb.co.za
Dr. Hanlie Liebenberg Enslin	Managing Director at Airshed Planning Professionals	+27 (83) 416 1955 hanlie@airshed.co.za

CERTIFICATION

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

28/03/2015