dBAcoustics

Environmental Impact Assessment for the decommissioning of Verwoedburg 275kv substation and 2 x 275kv Verwoedburg Apollo power lines within the City of Tshwane

Environmental Impact Report
Noise Impact Assessment

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Date: 28 October 2013

DECLARATION OF INDEPENDENCE

I, **Barend J B van der Merwe** as duly authorised representative of **dBAcoustics**, hereby confirm my independence and declare that I have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which **Nsovo Environmental Consulting** was appointed as environmental assessment practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act) for the **compilation of an EIA and EMP for the decommissioning of Verwoedburg 275kv substation and 2 x 275kv Verwoedburg Apollo power lines within the City of Tshwane – Noise Impact Assessment**. I further declare that I am confident in the results of the studies undertaken and conclusions drawn as a result of it. I have disclosed, to the environmental assessment practitioner, in writing, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act. I have further provided the environmental assessment practitioner with written access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not. I am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2010 and any other specific and relevant legislation (national and provincial), policies, guidelines and best practice.

Signature: 

Full Name: Barend Jacobus Barnardt van der Merwe

Date: 28 October 2013
Title / Position: Environmental noise specialist
Qualification(s): BSc Honours in Geography
Experience (years): 12 years
Registration(s): SAAI and SAIOH

EXECUTIVE SUMMARY

The purpose of the environmental noise study was to determine the prevailing ambient levels along the boundaries of the power lines and in the vicinity of the abutting noise sensitive areas. The evaluation and assessment of the different areas will assist management to identify possible noise impacts during the decommissioning phase of the project.

The R21 and M57 roads run in the vicinity of the Apollo sub-station, Apollo power lines and the Verwoedburg sub-station. The traffic noise is widely audible and makes up the prevailing ambient noise level for the study area.

The prevailing ambient noise levels within and adjacent to the study area will vary because of the existing roads, aircraft activities and domestic type noises. The levels of noise emissions are a function of:

- The distance the receptors are from the existing noise sources;
- The operation hours of the existing noise sources;
- The intervening topography and structures that may shield the noise from the receiver;
- Meteorological conditions such as wind speed, temperature and the season.

The proposed decommissioning phase is situated in an area where there are higher prevailing noise levels because of two linear noise sources with the subsequent increased noise levels. The sensitivity analysis of the study area is illustrated in Table 8.

Table 8: Sensitivity Analysis

	Description
Low Sensitivity	Residential properties in the vicinity of roads.
Medium Sensitivity	Isolated residential areas where there are intermittent type noises such as passing traffic and distant sub-station activity noise.
High Sensitivity	Noise sensitive areas within a radius of 100m from the proposed Apollo sub-station, Verwoedburg/Apollo power line.

The topography is slightly undulated areas with scattered trees, grass land and medium ground conditions.

Results

Two aspects are important when considering potential noise impacts of a project and it is:

- The increase in the noise level because of the decommissioning phase activities, and;
- The overall noise level produced by the proposed demolition activities.

The calculated and the prevailing ambient noise levels are illustrated in the following Table.

Noise sensitive area	**Calculated noise level during the decommissioning activities at the different sites - dBA**	**Prevailing noise level at the noise sensitive areas - dBA**
A	30.0	61.9
B	30.8	45.9
C	36.5	48.4
D	41.5	58.5
E	39.7	64.7
F	36.7	43.5
G	35.5	44.0

There will be no noise intrusion at the noise sensitive areas provided that the demolition activities, in the vicinity of the noise sensitive areas, are taking place during daytime periods.

Conclusion

The residents in the vicinity of the proposed demolition activities are already exposed to the different and higher ambient noise levels created by traffic noise. The projected noise levels during the decommissioning phase are in line and lower than the prevailing ambient noise levels for each specific noise sensitive area.

The noise level at the different sites during the demolition activities can however be controlled by means of approved acoustic screening measures, state of the art equipment, proper noise management principles and compliance to the Local Noise Control Regulations, and the International Finance Corporation's Environmental Health and Safety Guidelines.

Barend van der Merwe
Environmental Acoustic Specialist

Environmental Impact Assessment for the decommissioning of Verwoedburg 275kv substation and 2 x 275kv Verwoedburg Apollo power lines within the City of Tshwane.

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ABBREVIATIONS

dBA – A-weighted sound pressure level;

dB – Decibel;

IFC – International Finance Corporation;

m – Meters;

m/s – meters per second;

N, E, S, W – North, East, West, South

L_{Basic} – Basic noise level in dBA;

NSA – Noise sensitive areas;

MP – Measuring points;

PPV – Peak particle velocity

SANS – South African National Standards;

Glossary of Acoustic Terminology

Ambient noise level	The totally encompassing sound in a given time usually being composed of sound from many sources near and far.
Amplitude	Is the objective measurement of the degree of change (positive or negative) in atmospheric pressure (the compression and rarefaction of air molecules) caused by sound-waves. The unit of measurement is the Newton per square meter (N/m^2).
A – Weighting	An electronic filter that simulates the human hearing characteristic which is less sensitive to sounds at low frequencies than at high frequencies.
Damping/Absorption	The process by which a fluid (such as air), material or structure absorbs sound by dissipating the impinging or transmitted sound energy. Also known as absorption.
Decibel (dB)	A descriptor that is used to indicate the level determined as 10 times the logarithmic ratio of two quantities with the same units.
dBA	A descriptor that is used to indicate that 10 times the logarithmic ratio of two quantities with the same units have been A-weighted.
Environmental zone	The physical component such as ground, rock and sand, which transmits vibration from the source to the person.
Equivalent noise level	A single value noise level that has the same energy content as a time varying noise level measured over a given period of time. It is therefore a time averaged noise level.
Frequency	The characteristic of a time varying signal that describes the number of cycles per second, expressed in Hertz, Hz**.**
Integrated noise level	A time and energy averaged measure of a noise signal varying as a function of time.

Level	The property of any parameter that expresses its magnitude as 10 times the logarithm of the ratio of the value of parameter to a reference value with the same units. For a noise level the reference value is 20μPa for sound pressure and 1pW for sound power.
Noise	Sound is pressure fluctuations in the air, or other supporting medium, that can be detected by the ear or by a microphone. Noise is sound which is loud or perceived to be unpleasant in a given situation and thus causes disturbance. Any unwanted sound.
Noise emission	The noise energy that is transmitted from a point, line or surface source into the environment.

1 DETAILS OF SPECIALIST AND EXPERTISE

I, Barend JB van der Merwe of 43th Street, Linden Johannesburg am an environmental noise and ground vibration specialist for the last 12 years. I have been instrumental in the pre-feasibility studies of proposed projects which may have an impact on the environment and noise sensitive areas. I am also involved with the noise and ground vibration impact assessments and the environmental management plans compilation of large projects such as wind farms, mining, roads, trains (primarily the Gautrain) and various point noise sources. As a post-graduate student in Environmental Management at the University of Johannesburg, I am currently researching the impact of noise and ground vibration on a village close to a new underground mine. I have played a major role in the identification, evaluation and control of physical factors such as noise and ground vibration in the following projects – wind farms, various platinum and coal mines and the quarterly noise evaluation of the Gautrain, the rehabilitation of the N11 near Mokopane, construction of the P166 near Mbombela, design of the Musina by-pass, noise mitigatory measures at the N17 road near Trichardt, establishment of the weigh bridge along the N3 near Pietermaritzburg, George Western by-pass. The following large environmental companies are amongst my clients : Gibb, Royal Haskoning DHV, Coffey Environmental, Golder Associates Africa(Pty)Ltd, GCS Environmental(Pty)Ltd, Knight Piesold Environmental(Pty)Ltd and SRK Engineering(Pty)Ltd.

Qualifications

1. BSc Honours in Geography and Environmental Management – University of Johannesburg;
2. National Higher Diploma in Environmental Health - Witwatersrand Technikon;
3. National Diploma in Public Health - Cape Town Technikon;
4. National Certificate in Noise Pollution - Technikon SA;
5. National Certificate in Air Pollution - Technikon SA;
6. National Certificate in Water Pollution - Technikon SA;
7. Management Development Diploma - Damelin Management School; and
8. Advanced Business Management Diploma - Rand Afrikaans University.

Experience

- Member South African Acoustics Institute.
- Noise Control Officer I.t.o. Noise Control Regulations.
- Member of the South African Institute of Occupational Health
- Moderator Wits Technikon – Environmental Pollution III.
- Various road projects for SANRAL.
- Compilation of the Integrated Pollution strategy for Ekurhuleni Town Council.
- Represent clients at Town Planning Tribunals.
- Represent clients at Housing Board tribunals.
- Determine residual noise levels in certain areas as required by clients.
- Noise attenuation at places of entertainment.

- Design and implementation of sound attenuators.
- Noise projections and contouring.
- Advisory capacity regarding noise related cases to local authorities: - Sandton, Roodepoort, Randburg, Krugersdorp, Alberton, Centurion, Vereeniging. Due to my previous experience in Local Government I provide a service to these Local government departments on the implementation of the Noise Control Regulations and SANS 10103 of 2008 – The measurement and rating of environmental noise with respect to land use, health annoyance and to speech communication.
- Identification, Evaluation and Control of noise sources in industry.

The following are noise impact assessments of existing alleged noise related problems where I was involved with during the identification, evaluation and mitigation phases:

- EIA and scoping phases of new wind farms at Caledon;
- Installation of new power generation plants at Sandton City, Eastgate shopping centre and smaller locations;
- Fence line monitoring of the power generation at Kelvin Power Plant, Kempton Park;
- Noise impact assessment of blasting at pylons in Centurion for Gautrain Project;
- Noise problem at Protea Hotel – Zambia;
- Fence line noise and vibration monitoring for new mine in Rustenburg – Project period - two years;
- Fence line noise monitoring – Engen Refinery, Durban;
- Sasol engine testing laboratory in Cape Town;
- Sasol coal train in Secunda;
- Export of maize at East London harbour;
- Top Gear event at the Dome, Randburg;
- Various environmental noise evaluation at places of entertainment, churches and industries;
- Mitigation recommendations for Checkers at their refrigeration and mechanical ventilation plants; and
- Involved in some of the outdoor soccer fan parks during the soccer world cup.

2 INTRODUCTION

2.1 Background

The purpose of the environmental noise study was to determine the prevailing ambient levels along the boundaries of the power lines and in the vicinity of the abutting noise sensitive areas. The evaluation and assessment of the different areas will assist management to identify possible noise impacts during the decommissioning phase of the project.

The R21 and M57 roads run in the vicinity of the Apollo sub-station, Apollo power lines and the Verwoedburg sub-station. The traffic noise is widely audible and makes up the prevailing ambient noise level for the study area.

The prevailing ambient noise levels within and adjacent to the study area will vary because of the existing roads, aircraft activities and domestic type noises. The levels of noise emissions are a function of:

- The distance the receptors are from the existing noise sources;
- The operation hours of the existing noise sources;
- The intervening topography and structures that may shield the noise from the receiver;
- Meteorological conditions such as wind speed, temperature and the season.

The study area indicated as a yellow line between Verwoedburg sub-station and Apollo sub-station is illustrated in Figure 1.

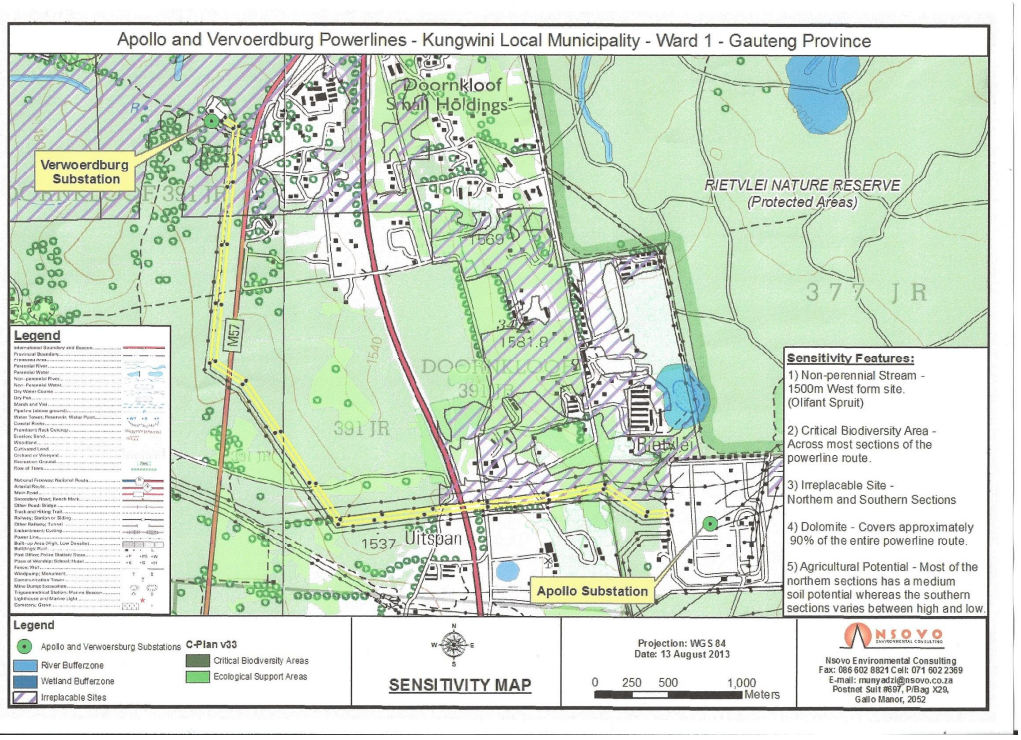

Figure 1: Noise assessment study area

2.1.1 Environmental noise

Sound is a wave motion, which occurs when a sound source sets the nearest particles of air in motion. The movement gradually spreads to air particles further away from the source. Sound propagates in air with a speed of approximately 340 m/s.

The sound pressure level in free field conditions is inversely proportional to the square of the distance from the sound source – Inverse Square Law. Expressed logarithmically as decibels, this means the sound level decrease 6 dB with the doubling of distance. This applies to a point source only. If the sound is uniform and linear then the decrease is only 3 dB per doubling of distance.

The decibel scale is logarithmic therefore decibel levels cannot be added together in the normal arithmetic way, for example, two sound sources of 50 dB each do not produce 100 dB but 53 dB, nor does 50 dB and 30 dB equal 80 dB, but remains 50 dB.

Air absorption is important over large distances at high frequencies and it depends on the humidity but is typically about 40 dB/km @ 4000 Hz. Traffic noise frequencies are mainly mid/low and will be unaffected below 200m.

When measuring the intensity of a sound, an instrument, which duplicates the ear variable sensitivity to sound of different frequency, is usually used. This is achieved by building a filter into the instrument with a similar frequency response to that of the ear. This is called an A-weighting filter because it conforms to the internationally standardized A-weighting curves. Measurements of sound level made with this filter are called A-weighted sound level measurements, and the unit is dB.

Sound propagation is affected by wind gradient rather than the wind itself. The profile of the ground causes such a gradient. The sound may be propagated during upwind conditions upwards to create a sound shadow. A downwind refracts the sound towards the ground producing a slight increase in sound level over calm isothermal conditions.

The velocity of sound is inversely proportional to the temperature therefore a temperature gradient produces a velocity gradient and a refraction of the sound. Temperature decreases with height and the sound is refracted upwards.

For a source and receiver close to the ground quite large attenuation can be obtained at certain frequencies over absorbing surfaces, noticeably grassland. This attenuation is caused by a change in phase when the reflected wave strikes the absorbing ground and the destructive interference of that wave with the direct wave. The reduction in sound tends to be concentrated between 250 Hz and 600 Hz.

Noise screening can be effective when there is a barrier between the receiver and the source i.e. walls, earth mounds, cuttings and buildings. The performance of barriers is frequency dependent. To avoid sound transmission through a barrier the superficial mass should be greater than 10 Kg/m^2.

There is a complex relation between subjective loudness and the sound pressure level and again between annoyance due to noise and the sound pressure level. In general the ear is less sensitive at low frequencies and the ear will only detect a difference in the sound pressure level when the ambient noise level is exceeded by 3-5 dBA.

There are certain effects produced by sound which, if it is not controlled by approved acoustic mitigatory measures, seem to be construed as undesirable by most people and they are:

- Long exposure to high levels of sound, which may damage the hearing or create a temporary threshold shift – in industry or at areas where music is played louder than 95 dBA. This will seldom happen in far-field conditions;
- Interference with speech where important information by the receiver cannot be analyzed due to loud noises;
- Excessive loudness;
- Annoyance.

A number of factors, for example clarity of speech, age of listener and the presence of noise induced threshold displacement, will influence the comprehensibility of speech communication.

The effect of noise (with the exception of long duration, high level noise) on humans is limited to disturbance and/or annoyance and the accompanying emotional reaction. This reaction is very difficult to predict and is influenced by the emotional state of the complainant, his attitude towards the noisemaker, the time of day or night and the day of the week.

Types of noise exposure:

- Continuous exposure to noise – The level is constant and does not vary with time such as traffic on freeway and 24-hour mining activities;
- Intermittent exposure to noise – The noise level is not constant and occurs at times such as reverse signals and sirens;
- Exposure to impact noise – A sharp burst of sound at intermittent intervals such as explosions and low frequency sound.

Depending upon the intensity of the sound, the length of time of exposure and how often over time the ear is exposed to it, noise affects humans differently. People are besieged by noise, not only in the city streets but also in the busy workplaces and household noises.

Table 1: Recommended sound pressure levels for certain areas.

Descriptor	Limit	Situation or effect
LAeq, 24	70 dBA	Negligible risk of hearing impairment
LAeq, 8	75 dBA	Negligible
LAeq	30 dBA	Excellent speech intelligibility
LAeq	55 dBA	Fairly good speech intelligibility
LAeq	30 dBA	No sleep disturbance in a bedroom
LAmax	45 dBA	No sleep disturbance – peak inside bedroom
LAeq	55 dBA	Residential areas, outdoors, daytime
LAeq	45 dBA	Residential areas, outdoors, night time

This time-varying characteristics of environmental noise are described using statistical noise descriptors:

Leq: The Leq is the constant sound level that would contain the same acoustic energy as the varying sound level, during the same period of time.

L_{Max}: The instantaneous maximum noise level for a specified period of time.

L_{Min}: The instantaneous minimum noise level for a specified period of time.

The following relationships occur for increases in A-weighted noise levels:

- The trained healthy human ear is able to discern changes in sound levels of 1 dBA under controlled conditions in an acoustic laboratory;
- It is widely accepted that the average healthy ear can barely perceive noise level changes of 3 dBA;
- A change in sound level of 5 dBA is a readily perceptible increase in noise level;
- A 10-dBA change in the sound level is perceived as twice as loud as the original source.

The World Bank in the Environmental Health and Safety Regulations has laid down the following noise level guidelines:

- Residential area – 55 dBA for the daytime and 45 dBA for the nighttimes period;
- Industrial area – 70 dBA for the day- and night time periods.

The difference between the actual noise and the ambient noise level and the time of the day and the duration of the activity, will determine how people will respond to sound and what the noise impact will be. In order to evaluate such, there must be uniform guidelines to evaluate each scenario. The SANS 10103 of 2008 has laid down sound pressure levels for specific districts and has provided the following continuous noise levels per district as illustrated in Table 2.

Table 2: Recommended noise levels for different districts.

Type of district	Equivalent continuous rating level $L_{Req.T}$ for ambient noise - dBA					
	Outdoors			Indoors, with open windows		
	Day-night	**Daytime**	**Night-time**	***Day-night***	**Daytime**	**Night-time**
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with some workshops, with business premises and with main roads	60	60	50	50	50	40
e) Central business district	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

The reference time intervals can be specified to cover typical human activities and variations in the operation of noise sources and are for daytime between 6h00 to 22h00 and for night time between 22h00 and 6h00.

The response to noise can be classified as follows:

- An increase of 1dBA to 3dBA above ambient noise level will cause no response from the affected community. For a person with normal hearing an increase of 0dBA to 3 dBA will not be noticeable
- An increase between 1dBA – 10dBA will elicit little to sporadic response. When the difference is more than 5 dBA above the ambient noise level a person with normal hearing will start to hear the difference.
- An increase between 5dBA and 15 dBA will elicit medium response from the affected community.
- An increase between 10dBA and 20 dBA will elicit strong community reaction.

Because there is no clear-cut transition from one community response to another as well as several variables, categories of responses can overlap. This should be taken into consideration during the evaluation of a potential noise problem.

There is therefore a mixture of activities and higher noise levels as per the above recommended continuous rating levels within i.e. residential, industrial and feeder roads in close proximity of each other.

The ambient noise level will therefore differ throughout the study area, depending on the region and the measuring position in relation to areas with existing mining

activities.

People exposed to an increase in the prevailing ambient noise level will react differently to the noise levels and the response is given in Table 3.

Table 3: Estimated community/group response when the ambient noise level is exceeded

1	2	3
Excess $)L_{Req,T}$ [1)]	**Estimated community/group response**	
dB	**Category**	**Description**
0	None	No observed reaction
0-10	Little	Sporadic complaints
5-15	Medium	Widespread complaints
10-20	Strong	Threats of community/group action
>15	Very strong	Vigorous community/group action

1) Calculate $)L_{Req,T}$ from the appropriate of the following:

a) $)L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS $L_{Req,T}$ of the residual noise (determined in the absence of the specific noise under investigation).

b) $)L_{Req,T}$ = $L_{req,T}$ of ambient noise under investigation MINUS the maximum rating level for the ambient noise given in table 1.

c) $)L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS the typical rating level for the applicable district as determined from table 2.

The difference between the actual noise and the ambient noise level will determine how people will respond to sound.

The human perception of sound may be influenced by the acoustical characteristics of the noise (whether it has audible tones or other characteristics that may annoy the receptor) and how much louder the propagated sound is above the prevailing ambient noise level. The perception of the noise is furthermore influenced by the attitude towards the noise source. One person may find the singing of birds in the morning delightful whereas another person may find the sound aggravating. If a person has a negative attitude towards a noise source is much more likely to view the new noise itself negatively however low it is (Rogers and Manwell, 2002).

2.2 Legislative and Policy Context

International Guidelines

- Environmental, Health and Safety (EHS) Guidelines, World Health Organisation (WHO, 2002).

National legislation

- National Environmental Management Act. 2006 Act 62 of 2008 (RSA, 2008).

Provincial legislation

- Noise Regulations (1998).

National Standards

- SANS 10357 of 2004 – The calculation of sound propagation by the concave method (SANS, 2004);
- SANS 10210 of 2004 – Calculating and predicting road traffic noise (SANS, 2004);
- SANS 10328 of 2008 – Methods for environmental noise impact assessments (SANS, 2008); and
- SANS 10103 of 2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication (SANS, 2008).

A noise disturbance is classified in terms of the Noise Control Regulations as a noise that cause the ambient noise level to rise above the designated zone level, or if no zone level has been designated, the typical rating levels for ambient noise in districts, indicated in table 2 of SANS 10103.

2.2.1 Legislative requirements

Constitution of South the Republic of South Africa (RSA, 1996)[i]

Article 24: Everyone has the right -
(a) to an environment that is not harmful to their health and well-being; and
(b) to have the environment protected for the present and future generations through reasonable legislative and other measures that-
(i) prevent pollution and ecological degradation;
(ii) promote conservation; and
(iii) secure ecological sustainable development and use of natural resources, while promoting justifiable economic and social development.

2.3 Scope and limitations

The scope of the noise study is to determine the prevailing environmental noise levels along the boundaries of the sub-stations and along the route of the power lines between the two sub-stations. There are no limitations to the noise study and the prevailing baseline noise data and the acquired noise data will be used to evaluate such with the recommended noise levels of Table 2 of SANS 10103 of 2008.

2.4 Methodology

2.4.1 Instrumentation

The noise survey was conducted in terms of the provisions of SANS 10103 of 2008 - The measurement and rating of environmental noise with respect to annoyance and to speech communication and the Noise Control Regulations.

The instruments that was used in the environmental noise and ground vibration survey:

Instrument 1 – Environmental noise survey

- Larsen Davis Integrated Sound Level meter Type 1 – Serial no. S/N 0001072;
- Larsen Davis Pre-amplifier – Serial no. PRM831 0206;
- Larsen Davis ½" free field microphone – Serial no. 377 B02 SN 102184; and
- Larsen Davis Calibrator 200 – Serial no.9855.

2.4.2 Measuring points

The measuring points for the study area are illustrated in Figure 2. These measuring points (MPs) were selected to be at or in the vicinity of the abutting NSAs.

Figure 2: Measuring points in and around the study area.

The geographic information of the measuring points in terms of the spatial position and characteristics is illustrated in Table 4.

Table 4: Measuring points and co-ordinates

Position	X WGSDD	Y WGSDD	Remarks
1	25^0 53'43.85"S	28^0 14'50.01"E	Eastern side of Verwoedburg Substation in the vicinity of the M57 road. Traffic noise.
2	25^0 53'34.09"S	28^0 14'42.86"E	Western side of Verwoedburg Substation. Distant traffic noise.
3	25^0 53'33.59"S	28^0 15'02.50"E	Western side of the hotel and conference centre. R21 and M57 traffic noise.
4	25^0 54'18.21"S	28^0 14'59.71"E	Eastern side of the M57 and in line with the noise sensitive areas. Traffic noise.
5	25^0 55'2.73"S	28^0 15'43.48"E	Eastern side of the R21 and in line with the noise sensitive areas. Traffic noise from the R21.
6	25^0 55'9.38"S	28^0 15'36.81"E	Western side of the R21 and in line with the noise sensitive area. Traffic noise.
7	25^0 54'58.41"S	28^0 15'57.56"E	Northern side of the power lines and some distance from the R21. Traffic noise.
8	25^0 55'6.10"S	28^0 16'11.82"E	Southern side of the power lines and some distance from the R21. Traffic noise.
9	25^0 54'57.16"S	28^0 16'14.04"E	Northern side of the power lines and some distance from the R21. Traffic noise.
10	25^0 54'57.61"S	28^0 16'21.89"E	Northern side of the power lines and some distance from the R21. Apollo sub-station noise.

2.4.3 Site Characteristics

The topography is undulated areas with scattered trees, grass, and medium ground conditions and feeder roads.

2.4.4 Current noise sources

Traffic noise, wind noise, domestic noise and agricultural type noise. The prevailing noise level is proportional to the distance from the main noise sources and the prevailing ambient noise level is higher in the vicinity of the existing feeder roads.

2.5 Assessment Methodology

The impact approach will be to determine what the impact of the decommissioning phase of the Apollo sub-station and Apollo power lines/Verwoedburg sub-station may have on the abutting noise sensitive areas. The following methodology was followed:

- Identify all the noise sensitive areas within the vicinity of the study area and identify such by means of their spatial position on Google Imagery;
- Determine the prevailing ambient noise level at each of the measuring points by means of the recommended noise measuring procedure in SANS 10103 of 2008;
- Calculate or determine the acceptable rating level for each measuring point;
- Calculate, determine and/or research the projected noise level of each noise source that is part of the construction and/or operational phase of the project;
- Calculate the noise impact at each of the noise sensitive areas; and
- Assess the proposed project in terms of the SANS 10103 of 2008, SANS 10328 of 2008, Noise Control Regulations, Environmental Health and Safety Guidelines for Mining by the World Bank.

The control of noise in Tshwane is regulated by the Noise Control Regulations, Notice 5479 of 1999, which was promulgated under the Environment Conservation Act, 1989. Act No 73 of 1989.

Section 4 of the above Noise Regulations say that “No person shall make , produce or cause a disturbing noise, allow it to be made, produced or caused by any person, animal, device or apparatus or any combination thereof.” A disturbing noise means a noise level that exceeds the prevailing ambient noise level.

In order to determine the level of intrusion it will be required to determine the prevailing ambient noise levels at each measuring point and to calculate the increase in the noise level during the operational phase of the project. The following formula (SANS 10328 of 2008) is used to determine the difference between the future expected rating level (calculated noise levels) and the typical rating level (prevailing ambient noise level):

$N_i = L_{\text{Req.T (expected)}} - L_{\text{Req. T (typical)}}$

Where

N_i is the noise impact, in decibels;
$L_{\text{Req.T (expected)}}$ is the calculated equivalent continuous A-weighted sound pressure level, in decibels;
$L_{\text{Req. T(typical)}}$ is the prevailing ambient equivalent continuous A-weighted sound pressure level, in decibels.

The alleged noise impact on the environment and the residents living in the vicinity of the demolition activities will be investigated.

2.5.1 Study area sensitivity analysis

The proposed decommissioning phase is situated in an area where there are higher prevailing noise levels because of two linear noise sources with the subsequent increased noise levels. The sensitivity analysis of the study area is illustrated in Table 5.

Table 5: Sensitivity Analysis

	Description
Low Sensitivity	Residential properties in the vicinity of roads.
Medium Sensitivity	Isolated residential areas where there are intermittent type noises such as passing traffic and distant sub-station activity noise.
High Sensitivity	Noise sensitive areas within a radius of 100m from the proposed Apollo sub-station, Verwoedburg/Apollo power line.

3 DESCRIPTION OF RECEIVING ENVIRONMENT

The noise sensitive areas A to G are in the vicinity of the sub-stations and the power lines. These noise sensitive areas (NSAs) are illustrated in Figure 3. The NSAs are already exposed to traffic noise because of the R21 and M57 which runs through or in the vicinity of the study area.

Figure 3: Location of the noise sensitive areas

The distances between the decommissioning activities and the NSAs are given in Table 6. The existing noise sources such as traffic create a finite to continuous noise during the day and night time periods. This will increase the prevailing ambient noise levels in the vicinity of these linear and/or point noise sources on a permanent or temporary basis.

Table 6: Distance between proposed decommissioning and the noise sensitive areas

Noise sensitive area	**Distance between the noise sensitive area and the decommissioning activities - m**	**Other noise sources between or in the vicinity of the decommissioning activities and the noise sensitive area**
A	560	Vacant land, M57 and R21 Roads
B	512	M57 Road
C	266	M57 Road
D	150	R21 Road, gravel road
E	185	Vacant land, R21 Road
F	260	Gravel road, R 21 Road and vacant land
G	300	Vacant land and noise from Apollo sub-station

The noise levels at the different NSAs to which the residents will be exposed to during the decommissioning phase of the project is illustrated in Table 7. The calculations are based on a noise level of 90.0dBA.

The calculations to determine the noise level at the noise sensitive areas are based on the following equation:

$L_R = SPL - 20\log(R) - \alpha_a$
Where:
L_R = Sound pressure level at a distance from the source;
SPL = Sound pressure level at the source;
R = Distance from the source;
α_a = Sound reduction due ground conditions and trees and distance from the source and an average value of 5.0dB is used according to BS5228:Part1(1997).

Table 7: Calculated noise level at the different noise sensitive areas

Noise sensitive area	**Calculated noise level during the decommissioning activities at the different sites - dBA**	**Prevailing noise level at the NSAs - dBA**
A	30.0	61.9
B	30.8	45.9
C	36.5	48.4
D	41.5	58.5
E	39.7	64.7
F	36.7	43.5
G	35.5	44.0

3.1 Prevailing noise regime

3.1.1 Results

The noise survey was done at the different measuring points during the day and night time with a north-westerly wind blowing during the daytime between 1.4m/s to 1.9m/s. The wind speed at each measuring point will however be indicated with the prevailing ambient noise levels in Table 11.

Table 11: Noise levels and wind speed for the day time period.

Measuring point	Daytime			
	Leq-dBA	Remarks	Wind speed – m/s	Wind
1	**55.4**	M57 traffic noise	1.5	N/W
2	**45.9**	Distant traffic noise from M57 and R21 roads	1.9	N/W
3	**61.7**	Traffic noise from M57 and R21 roads	1.7	N/W
4	**48.4**	Distant traffic noise from M57 road	1.4	N/W
5	**58.0**	Distant traffic noise R21 Freeway	1.9	N/W
6	**64.7**	Noise from R21 Freeway	1.9	N/W
7	**43.5**	Distant traffic noise R21 Freeway	1.7	N/W
8	**44.6**	Distant traffic noise R21 Freeway	1.9	N/W
9	**45.9**	Distant traffic noise R21 Freeway	1.6	N/W
10	**44.0**	Distant traffic noise R21 and Apollo sub-station noise	1.6	N/W

3.2 Discussion

3.2.1 Prevailing noise levels within the study area

The traffic noise in the vicinity of the NSAs contributes to the higher ambient noise levels within these areas.

3.3 Noise survey results

Two aspects are important when considering potential noise impacts of a project and it is:

- The increase in the noise level because of the decommissioning phase, and;
- The overall noise level produced by the proposed demolition and transport activities.

The demolition activities during the decommissioning phase of the sub-station and the power lines will increase the prevailing noise level along the immediate boundary of the footprint at the sub-station and at the overhead power line pillars. The following noise levels at different distances are applicable during the decommission phase. These noise levels are illustrated in Table 9. Engineering control measures and topography can have an influence on how the noise level is perceived by the receptor some distance away from the activities.

Table 9: Sound pressure levels of the demolition machinery

Equipment		Line-of-Sight Estimated Noise Level Attenuation - dBA						
	5m	30m	60m	120m	240m	480m	660m	960m
Dump truck	91.0	61.3	55.2	49.1	43.1	34.9	29.6	26.6
Backhoe	85.0	55.3	49.3	43.3	37.3	29.1	23.7	20.8
Flatbed truck	85.0	55.3	49.3	43.3	37.3	29.1	23.7	20.8
Pickup truck	70.0	40.3	34.3	27.3	21.3	15.3	10.6	9.3
Crane	85.0	55.3	49.3	43.3	37.3	29.1	23.7	20.8
Generator	90.0	61.3	55.2	49.1	43.1	34.9	29.4	26.6
Compressor	85.0	55.3	49.3	43.3	37.3	29.1	23.7	20.8
Jackhammer	90.0	61.3	55.2	49.1	43.1	34.9	29.4	26.6
Pneumatic tools	85.0	55.3	49.3	43.3	37.3	29.1	23.7	20.8
Excavator	90.0	61.3	55.2	49.1	43.1	34.9	29.4	26.6
TLB	92.0	61.3	55.2	49.1	43.1	34.9	29.8	26.6

The highest noise level at 150m from the specific demolition area during the decommissioning phase will be 49.1dBA during some of the machinery which will be used. The noise increase during the decommissioning phase will be on a temporary basis for short spells.

4. IMPACTS IDENTIFICATION AND ASSESSMENT

4.1 Introduction

The following activities will generate noise on a temporary basis during the decommissioning phase of the sub-station and the power lines:

- Rehabilitation of the disturbed areas;
- Demolition of power line pillars and infra-structure;
- Emergency generators.

The impact rating during the decommissioning phase of the sub-station and power lines is given in Table 10.

Table 10: Impact rating during the rehabilitation phase

Aspect	Impact (Consequence + Likelihood) *	Significance Rating	Mitigation	Impact after mitigation measures	Significance rating after mitigatory measures	EMP
Rehabilitation of the disturbed areas	63	Low Medium	Vehicles to comply with the standards as provided in the IFC's Environmental Health & Safety Regulations.	48	Low	Baseline noise monitoring
Removal of power line pillars and infra-structure	63	Low Medium	Vehicles to comply with the standards as provided in the IFC's Environmental Health & Safety Regulations.	48	Low	Baseline noise monitoring
Emergency generators	30	Low	Generators must be placed in such a manner that it is away from noise sensitive areas	24	Very Low	Baseline noise monitoring

5. Recommendations

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

- The source – Reduction of noise at the source;
- The transmission path – Reduction of noise between the source and the receiver;
- The receiver – Reduction of the noise at the receiver.

The last option is not practical as it is easier to control the noise levels at the different sources at the demolition areas.

5.1 Acoustic screening recommendations

The acoustic screening measures are summarized and given in Table 14. These are based on the best practicable methods, acoustic screening techniques and the IFC's Health and Safety Regulations.

Table 11: Recommended acoustic screening measures

Activity	Recommendations
Decommissioning phase	1. Machinery with low noise levels to be used which is in accordance with the IFC's Health and Safety Regulations; 2. Demolition in the vicinity of noise sensitive areas to take place during daytime periods only; 3. Vehicles and machinery with low noise levels to be used; 4. Generators to be placed in such a manner that it is away from residential areas; 5. Vehicles, equipment and machinery to comply with the standards as provided in the IFCs environmental health & safety regulations.

The following are the Environmental, Health and Safety Guidelines of the IFC of the World Bank, which should be taken into consideration during the decommissioning phase of the project:

- Selecting equipment with lower sound power levels;
- Installing silencers for fans;
- Installing suitable mufflers on engine exhausts and compressor components;
- Installing acoustic enclosures for equipment causing radiating noise;
- Installing vibration isolation for mechanical equipment;
- Re-locate noise sources to areas which are less noise sensitive, to take advantage of distance and natural shielding;
- Taking advantage during the design stage of natural topography as a noise buffer;
- Develop a mechanism to record and respond to complaints.

6. Conclusion

The residents in the vicinity of the proposed demolition activities are already exposed to the different and higher ambient noise levels created by traffic noise. The projected noise levels during the decommissioning phase are in line and lower than the prevailing ambient noise levels for each specific noise sensitive area.

The noise level at the different sites can however be controlled by means of approved acoustic screening measures, state of the art equipment, proper noise management principles and compliance to the Local Noise Control Regulations, and the International Finance Corporation's Environmental Health and Safety Guidelines.

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7. References

Consultnet.ie. http.//www.consultnet.ie/environmental;

Guild, R., R.I. Ehrlich, J.R. Johnston & M.H. Ross. 2001: *Handbook of Occupational Health Practice in the South African Mining*. First Printing 2001, ISBN 1-919853-02-2. Repro & Print by Creda Communications;

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

Sans 10103 of 2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication – ISBN 978-0-628-20832-5;

Sans 10328 – Methods for environmental noise impact assessments – ISBN 978-0-626-20831-8;

Wylie D.C. & C.W. Mah. 2004: Rock Slope Engineering, ISBN 041528001 X.

Appendix A

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CERTIFICATE OF CALIBRATION

CERTIFICATE NUMBER	2013-0741
ORGANISATION	dB ACOUSTICS
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CALIBRATION OF	INTEGRATING SOUND LEVEL METER, ½" MICROPHONE and built-in ⅓-OCTAVE/OCTAVE FILTER
CALIBRATED BY	M. NAUDÉ
MANUFACTURERS	LARSON.DAVIS and PCB
MODEL NUMBERS	831 and 277B02
SERIAL NUMBERS	0001072 and 02184
DATE OF CALIBRATION	25 APRIL 2013
RECOMMENDED DUE DATE	APRIL 2014
PAGE NUMBER	PAGE 1 OF 4

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26 April 2013
DATE OF ISSUE

Director: Marianka Naudé

Appendix B – Risk assessment matrix

SEVERITY OF IMPACT	RATING
Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful	5
SPATIAL SCOPE OF IMPACT	**RATING**
Activity specific	1
Mine specific (within the mine boundary)	2
Local area (within 5 km of the Activity boundary)	3
Regional	4
National	5
DURATION OF IMPACT	**RATING**
One day to one month	1
One month to one year	2
One year to ten years	3
Life of operation	4
Post closure / permanent	5

SIGNIFICANCE

FREQUENCY OF ACTIVITY / DURATION OF	RATING
Annually or less / low	1
6 monthly / temporary	2
Monthly / infrequent	3
Weekly / life of operation / regularly / likely	4
Daily / permanent / high	5
FREQUENCY OF IMPACT	**RATING**
Almost never / almost impossible	1
Very seldom / highly unlikely	2
Infrequent / unlikely / seldom	3
Often / regularly / likely / possible	4
Daily / highly likely / definitely	5

LIKELIHOOD

Color Code	Significance Rating	Value	Negative Impact Management Recommendation	Positive Impact Management Recommendation
	Very high	126-150	Improve current management	Maintain current management
	High	101-125	Improve current management	Maintain current management
	Medium-high	76-100	Improve current management	Maintain current management
	Low-medium	51-75	Maintain current management	Improve current management
	Low	26-50	Maintain current management	Improve current management
	Very low	1-25	Maintain current management	Improve current management

LIKELIHOOD (Frequency of activity + Frequency of impact)	CONSEQUENCE (Severity + Spatial Scope + Duration)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150