global environmental solutions

AFPLATS
Leeuwkop Mine

Noise compliance assessment

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CONTENTS

APPENDICES

1.0 INTRODUCTION

Afplats, a member of the Implats Group, has appointed SLR Consulting (Africa) Limited to undertake a noise survey at the Leeuwkop mining operation near Rustenburg in the North West Province of South Africa.

The noise survey is required to assess compliance with recognised noise guidelines and to compare to the requirements of the Environmental Impact Report (EIR) for the Leeuwkop operation.

This report presents the following information:

- details of the noise monitoring locations with respect to the site and nearby noise-sensitive receptor locations;
- details of the equipment used to undertake the noise monitoring exercise;
- details of the prevailing weather conditions during the noise monitoring exercise;
- the findings of the noise monitoring exercise;
- details of the noise sources audible including any off site noise sources affecting the noise climate; and
- details of any significant on site noise source(s) identified and possible mitigating measures which can be applied to reduce their impact.

Whilst every effort has been made to ensure that this report is easy to understand, it is technical in nature; to assist the reader, a glossary of terminology is included in Appendix A.

2.0 THE ENVIRONMENTAL IMPACT REPORT CONDITION RELATING TO NOISE

Section 7.12 of the EIR[1] states the following:

Base noise level: According to Table 2 of SANS 10103-1, the typical day and night-time ambient noise levels in a 'rural residential' district are 45 dBA and 35 dBA respectively. Therefore, the base levels were chosen to be 45 dBA and 35 dBA.

[1] Leeuwkop Platinum Mime, Environmental Impact Report . Prepared for Afplats (Pty) Ltd. Prepared by Knight Piesold Consulting. Report number 4906. March 2006.

3.0 NOISE MONITORING PROGRAM

The noise monitoring program proposed that monitoring shall be undertaken at four noise-sensitive properties, namely:

1. Existing residential properties on the northern boundary of Segwaelane adjacent to the R556 at the location of the proposed new project site access;
2. Existing residential properties the northern boundary of Segwaelane adjacent to the southernmost point of the proposed new project site access;
3. Existing residential properties on the south western boundary of Makolokwe; and
4. Existing residential properties on the northern boundary of Makolokwe at a point closest to the proposed tailings dam.

In addition, one reading was taken at the boundary of the Leeuwkop project site (Point 5).

The noise monitoring locations are detailed in Table 3-2 and shown on the Figure in Appendix B. Table 3-2 also presents the details of the wind. The morning monitoring session took place between 09:00 and 12:00, the afternoon session between 12:00 and 17:00 and the night-time session between 22:30 and 01:30.

Table 3-1 below summarises the consented noise limits contained in the noise monitoring plan for each location during the daytime and night-time periods.

The noise impact assessment, undertaken in 2006, stated that the total ambient noise levels resulting from noise emissions of site operations were assessed in terms of the guidelines provided by SANS 10103 and, by implication, the World Health Organisation *Guideline for Community Noise*. In effect this means that for a rural area, such as the present environment of Leeuwkop, the daytime and night-time noise emissions, $L_{Req,d}$ of 45dBA and $L_{Req,n}$ of 35dBA, should not be exceeded.

Table 3-1
Guideline noise levels applicable for the Leeuwkop operation dB

Location	Daytime noise guideline for the Leeuwkop operation $L_{Aeq\ d}$	Night-time noise guideline for the Leeuwkop operation, $L_{Aeq,n}$
1. Segwaelane village (East)	45	35
2. Segwaelane village (West)	45	35
3. Makolokwe village (South)	45	35
4. Makolokwe village (North)	45	35

Table 3-2
Coordinates, wind speed and wind direction of the monitoring locations

Position	Co-ordinates	Wind speed – m/s (Day - morning)	Wind speed – m/s (Day - afternoon)	Wind direction	Wind speed – m/s (Night)	Wind direction
1	25°39'20.5" S 027°37'17.8"E	Up to 2.6	Up to 2	Northerly	Up to 4	Easterly
2	25°39'20.5" S 027°37'17.8"E	Up to 2	Below 1	Northerly	Up to 3	Westerly
3	25°38'10.2" S 027°36'50.9"E	Below 0.5	Up to 3	Northerly	Up to 5	Westerly
4	25°37'12.3" S 027°36'47.6"E	Up to 3.5	Up to 2	Northerly	Up to 5	Westerly
5	25°39'10.5" S 027°36'09.1"E	-	Up to 3	Northerly	-	-

4.0 NOISE SURVEY

The noise survey was undertaken on the 5th December 2012 to determine daytime and night-time operational levels at the nearest noise-sensitive residential areas around the site.

The survey methodology and results are set out below.

4.1 Survey Methodology

The equipment used during the survey is set out in Table 4-1 below.

Table 4-1
Noise Measurement Equipment

Location	Equipment	Serial Number
Locations 1, 2, 3, 4 & 5	Quest technologies 3M Sound Pro DL Sound Level Meter	BLL070006
	Quest technologies 3M Acoustic Calibrator Model: QC-10/QC-20	QIL080002

The sound level meter was calibrated before and after the measurements and no drift in calibration was found to have occurred.

The noise monitoring equipment had been calibrated by the manufacturers within 6 months preceding the survey.

The microphone was placed 1.5m above the ground. In all cases the meter was placed in open ground and at least 50m form the closet residential house. The sound level meter was programmed to monitor over a continuous 30 minute period during both the daytime and night-time. The following noise parameters were recorded:

- L_{Aeq} dB;
- L_{A90} dB;
- L_{A10} dB;
- L_{Amax} dB; and
- L_{Amin} dB.

It was confirmed by Afplats that the project site was operating normally during the daytime and night-time periods.

4.2 Weather Conditions

The weather during the daytime survey periods was suitable for noise measurement, it being dry with light to moderate winds. A thunderstorm occurred just prior to the commencement of the night-time survey period, resulting in humid conditions with moderate winds.

4.3 Survey Results

Day-time:

The daytime noise climate at location 1 consisted of road traffic noise from the R556 which dominated, village related sources (i.e. music, children playing), birds chirping and occasional air traffic. The Leeuwkop site was not audible from this location.

The noise climate at location 2 was dominated by noise from the Leeuwkop site, namely the underground ventilation system and heavy machinery. The site is considered to be a distant source being greater than 500m from the receptor. The intensity of the source fluctuated through the monitoring period. Village related noises (i.e. music, children playing, goats and chickens) were also prevalent.

The noise climate at Location 3 included road traffic noise from the R556, vehicles passing on the nearby dirt road to the village and bird calls. The Leeuwkop site was not audible from this location.

The noise climate at location 4 included soft music from the adjoining village, birds chirping and distance machinery. The Leeuwkop site was not audible from this location.

Only a daytime measurement of the noise climate at location 5 was taken as this was an additional request by Afplats. As the location was adjacent to the Leeuwkop site the noise was dominated by heavy machinery, trucks and vehicles entering/leaving and moving within the project site. This included the reverse warning system noise. The ventilation system did not appear to be operating during this period.

Night-time:

The night-time noise climate at Location 1 consisted road traffic from the R556, insects chirping and dogs barking in the adjoining village. The Leeuwkop site was again not audible from this location.

At location 2, the noise climate consisted of mining related sources from the Lonmin mining operation south of the village (including machinery and a train) as well as the compressor from the Leeuwkop site. Other sources included insects and frogs chirping as well as dogs barking. The weather was unsettled with winds increasing to greater than $5ms^{-1}$. Due to the high wind speed, the first monitoring event had to be aborted and was re-started once the wind settled.

At location 3 noise from the Leeuwkop site was just audible contrary to the day-time. It is understood that the source of the noise was the compressor. Other sources included road traffic from the R556, vehicles (including buses transporting miners) passing on the nearby dirt road to the village and insects.

At location 4, insects were chirping and, occasionally, squealing piglets could be heard from the adjoining village. Operations from the Leeuwkop site were just audible, contrary to the daytime. Thunder was audible in the distance but faint. Wind was gusty up to $5ms^{-1}$.

A summary of the survey results is given in Table 4-2 below.

Table 4-2
Summary of Measured Noise Levels – Free-field dB

Location	Period	Duration (mins)	$L_{Aeq,T}$	L_{A90}	L_{A10}	$L_{Amax, F}$
1. Segwaelane village (East)	Daytime (morning)	30	44.8	36.8	46.5	76.8
	Daytime (afternoon)	30	42.7	36.5	45.8	57.5
	Night-time	30	47.2	41.8	50.5	60.1
2. Segwaelane village (West)	Daytime (morning)	30	44.9	36.9	47.3	69.1
	Daytime (afternoon)	30	42.9	35.8	46.2	59.2
	Night-time (session 1)	15	50.1	44.4	53.5	59.4
	Night-time (session 2)	15	50.1	44.5	53.4	58.8
3. Makolokwe village (South)	Daytime (morning)	30	46.7	36.9	49.7	66.0
	Daytime (afternoon)	30	48.9	38.2	52.7	62.8
	Night-time (session 1)	15	50.9	37.7	46.6	76.3
	Night-time (session 2)	15	51.0	37.7	48.4	79.0
4. Makolokwe village (North)	Daytime (morning)	30	36.5	31.1	39	56.9
	Daytime (afternoon)	30	35.4	30.0	37.6	56
	*Night-time (session 1)**	*15*	*51.7*	*49.2*	*53.6*	*59.4*
	Night-time (session 2)	15	49.8	47.9	51.2	55.6
5. Leeuwkop project site	Daytime (afternoon)	30	43.3	36.7	46.1	64.8

** Wind speed exceeded 5 ms^{-1} so results are not considered*

5.0 ASSESSMENT OF COMPLIANCE

5.1 Assessment of compliance with typical rating levels

Tables 5-1 and 5-2 set out a comparison between the measured noise levels and the guidelines stated in the EIR for each location during the daytime and night-time respectively.

Table 5-1
Comparison of measured noise levels against daytime noise guidelines

Location	Period	Measured Noise Level $L_{Aeq,T}$ dB	Daytime Noise Guideline, $L_{Req,d}$ dB	Difference
1 Segwaelane village (East)	Morning	44.8	45.0	-0.2
	Afternoon	42.7		-2.3
2 Segwaelane village (West)	Morning	44.9	45.0	-0.1
	Afternoon	42.9		-2.1
3 Makolokwe village (South)	Morning	46.7	45.0	+1.7
	Afternoon	48.9		+3.9
4 Makolokwe village (North)	Morning	36.5	45.0	-8.5
	Afternoon	35.4		-9.6
5 Leeuwkop project site	Afternoon	43.3	45.0	-1.7

Table 5-2
Comparison of measured noise levels against night-time noise guidelines

Location	Measured Noise Level $L_{Aeq,T}$ dB	Night-time Noise Guideline, $L_{Req,n}$ dB	Difference
1 Segwaelane village (East)	47.2	35.0	+12.2
2 Segwaelane village (West)	50.1	35.0	+15.1
3 Makolokwe village (South)	51.0	35.0	+16.0
4 Makolokwe village (North)	49.8	35.0	+14.8

Table 5-1 indicates that the measured daytime noise levels were within the typical rating level at locations 1, 2, 4 and 5 and above the typical rating level at location 3.

Table 5-2 indicates that measured night-time noise levels were above the typical rating level at all locations.

5.2 Reasons for excesses over typical rating levels

As highlighted in Section 4.3 of this report, the daytime and night-time noise climate at location 3 was dominated by road traffic using the dirt access road from the R566 to Makolokwe village. Cars, buses and trucks used this road, which was corrugated, resulting in high levels of noise being generated.

Section 4.3 also states that the night-time noise climate at all locations consisted of a combination of road traffic and insect and frog calls. These night-time calls were the main source of the elevated noise levels recorded.

With reference to the above it is considered that these sources, rather than those associated with the site, are responsible for the typical rating levels being exceeded.

It could be argued that the area is more a “suburban district with little road traffic” than a “rural district”, as it is located at the edge of a town rather than being located in a fully rural district away from a town and/or main road. This would increase the typical rating levels to 50dBA and 40dBA respectively and the daytime typical rating level would be met.

6.0 CONCLUSION

Afplats has appointed SLR Consulting (Africa) Limited to undertake a noise survey at their newly established Leeuwkop mining operation.

The noise survey is required to assess compliance with the guidelines provided by the SANS 10103 standard.

The assessment has shown that the measured operational noise levels during the daytime period were within the typical rating level at locations 1, 2, 4 and 5 but above the typical rating level at location 3.

The assessment has also shown that measured operational noise levels during the night-time were above the typical rating levels at all locations (note that location 5 was not assessed during the night).

However with reference to Section 4.3 of this report, which details the audible noise sources at each location during the survey periods, it is considered that sources other than those associated with the Leeuwkop mine are responsible for the typical rating levels being exceeded.

The sources that were audible from the mine included vehicles (cars and trucks), excavator's involved in construction operations and the ventilation system.

It could be argued that the area is more a "suburban district with little road traffic" than a "rural district", as it is located at the edge of a town rather than being located in a fully rural district away from a town and/or main road. This would increase the typical rating levels to 50dBA and 40dBA for the daytime and night-time respectively and the daytime typical rating level would be met.

7.0 CLOSURE

This report has been prepared by SLR Consulting (Africa) Limited with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of Afplats; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

Appendix A – Glossary of Terminology

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0dB (the threshold of hearing) to over 120dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A-1
Sound Levels Commonly Found in the Environment

Sound Level	Location
0dB(A)	Threshold of hearing
20 to 30dB(A)	Quiet bedroom at night
30 to 40dB(A)	Living room during the day
40 to 50dB(A)	Typical office
50 to 60dB(A)	Inside a car
60 to 70dB(A)	Typical high street
70 to 90dB(A)	Inside factory
100 to 110dB(A)	Burglar alarm at 1m away
110 to 130dB(A)	Jet aircraft on take off
140dB(A)	Threshold of Pain

Acoustic Terminology

dB (decibel) The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure ($2x10^{-5}$Pa).

dB(A) A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies. Commonly termed dB(A) or with an "A" in the noise level descriptor, such as $L_{Aeq,T}$.

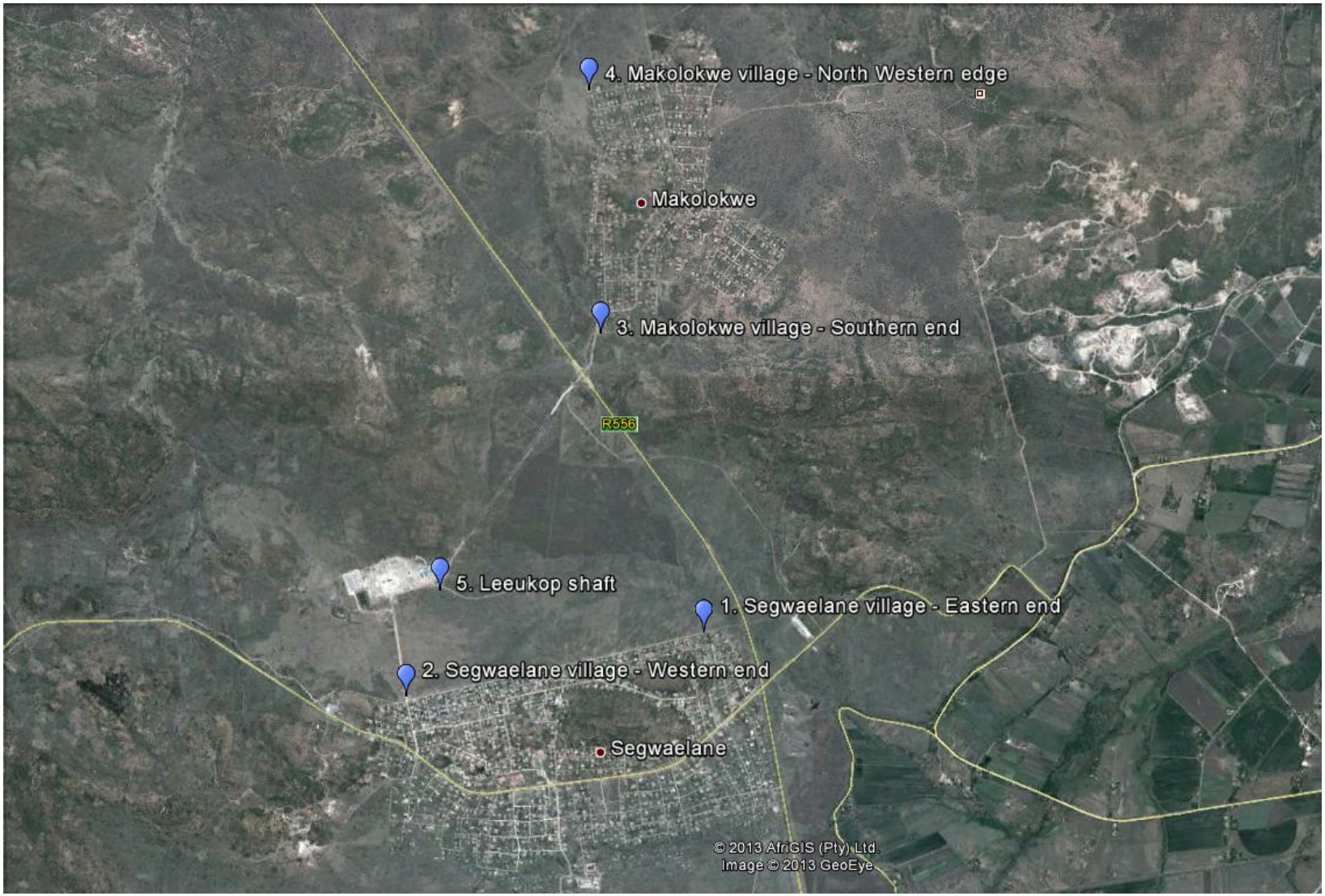
Linear A linear or unweighted noise level, commonly termed dB(Lin) or with an "L" in the noise descriptor, such as $L_{Leq,T}$, has no weighting, such as the A-weighting, applied.

LAeq L_{Aeq} is defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.

L10 and L90 If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be

	regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.
LAmax	L_{Amax} is the maximum A-weighted sound pressure level recorded over the period stated. LAmax is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
Ambient noise	The totally encompassing sound in a given situation at a given time and usually composed of sound from many sources, both near and far.
Distant source	A sound source that is situated more than 500m from the point of observation.
Impulsive sound	Sound characterised by brief excursions of sound pressure (acoustic impulses) that significantly exceed the residual noise.
Initial noise	The component of the ambient noise present in an initial situation before any change to the existing situation occurs.
Intelligible speech	Speech that can be understood without undue effort.
Low frequency noise	Sound, which predominantly contains frequencies below 100Hz.
Nearby source	A sound source that is situated at a distance of 500m or less from the point of observation.
Specific noise	A component of the ambient noise which can be specifically identified by acoustical means and which may be associated with a specific source. NOTE! Complaints about noise usually arise as a result of one or more specific noises.
Ambient sound level	Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation.
Disturbing noise	Means a noise that cause the ambient noise level to raise 7dBA above the designated zone, or if no zone level has been designated, the typical rating levels for ambient noise in districts.
Noise nuisance	Means any sound which disturbs or impairs the convenience or peace of any person.

Appendix B – Noise Monitoring Locations



Appendix C – Limitations to this Report

This entails a physical investigation of the site with a sufficient number of sample measurements to provide quantitative information concerning the type and degree of noise affecting the site. The objectives of the investigation have been limited to establishing sources of noise material to carrying out an appropriate assessment.

The number and duration of noise measurements have been chosen to give reasonably representative information on the environment within the agreed time, and the locations of measurements have been restricted to the areas unoccupied by building(s) that are easily accessible without undue risk to our staff.

As with any sampling, the number of sampling points and the methods of sampling and testing cannot preclude the existence of “hotspots” where noise levels may be significantly higher than those actually measured due to previously unknown or unrecognised noise emitters. Furthermore, noise sources may be intermittent or fluctuate in intensity and consequently may not be present or may not be present in full intensity for some or all of the survey duration.