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Environmental Noise Report

Rietvlei Opencast Mine

The consultants will not be responsible for any damages suffered by the client or any third party due to a delay in the delivery of the items in this contract caused by events not under the control of the consultant or any factors except for negligence by the consultant.

Updated Report issued on 04/07/2014

John R. Hassall

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4 July 2014

DECLARATION OF INDEPENDENCE

I, **John Hassall** as duly authorised representative of **JH Consulting**, hereby confirm my independence as a specialist and declare that neither I nor **JH Consulting** have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which WSP, Environment and Energy, Africa 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, specifically in connection with the Environmental Impact Assessment for the proposed Rietvlei mine.

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EXECUTIVE SUMMARY

An opencast coal mine is proposed on a site south of the R555 Middelburg to Stoffberg road approximately 25km northeast of Middelburg, in a rural area, currently a tree plantation, with the generally low noise levels associated with such areas. The investigation's purpose was to estimate the potential noise impact of the proposed mine on the existing ambient noise climate in the surrounding areas and on any potential sensitive receptors. This was achieved by measuring the existing ambient noise levels at the site and comparing with the noise of operations at a functioning opencast mine which is currently operated in a similar manner and with similar equipment and procedures, and therefore can be considered representative of the situation to be expected at the proposed mine. Measurements of the existing noise climate at the site were made at 3 defined positions across the proposed site as described in section 3, one on the side of the site adjacent to the main noise source in the area, the R555 road, one at the access road to a neighbouring farm which is likely to be the nearest to the opencast pit, and the third near the southern boundary of the site.

All measurements and comparisons were carried out with the recommended zone levels in accordance with the relevant SANS 10103:2008 Code of practice, and as required by the DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM. It is assumed that operations will take place during periods defined as daytime (06:00 to 22:00) and at least partially in the night-time period (22:00 to 06:00) in these publications.

The expected response from the local community to the noise impact, i.e. any increase of predicted operational noise over the original ambient or recommended zone noise levels, is primarily based on the relevant document, SANS 10103:2008, and expressed in terms of the effects of impact, on a scale of 'NONE' to 'VERY HIGH'.

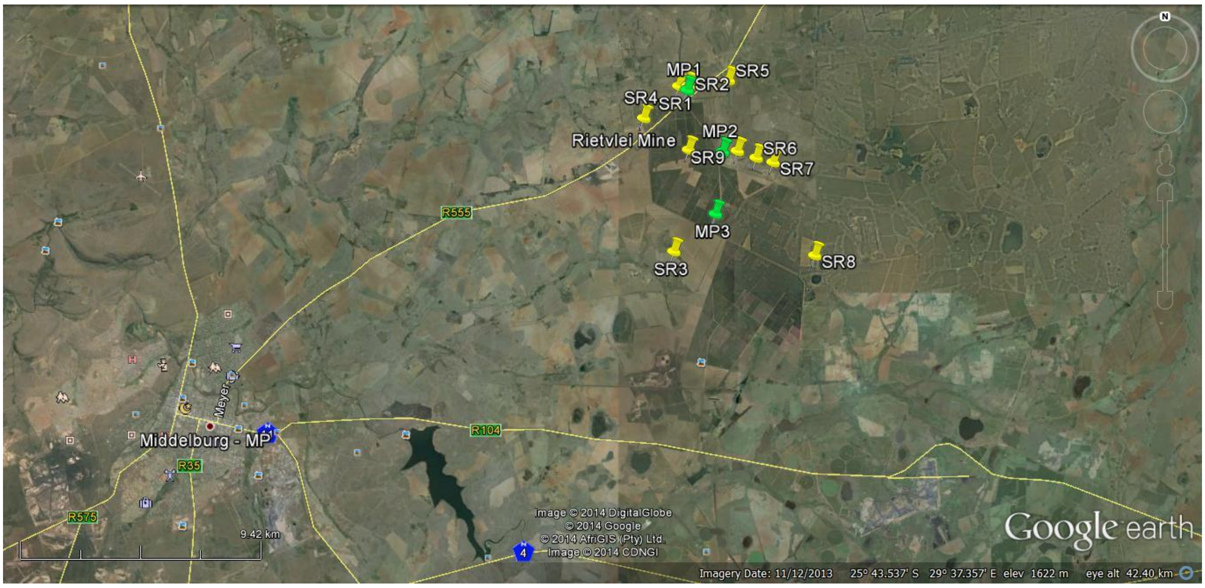
This report is an overall assessment designed to predict the collective response of a noise-exposed population and therefore the impact the operation is likely to have on them, and is based on measured and predicted equivalent continuous noise levels according to the relevant SANS code of practice.

The noise impact is generally rated as NONE at the nearest dwellings. In the worst case of the noisiest operations of the opencast pit being at their closest to those dwellings during a short duration for part of the lifetime of the mine, the impact is rated as VERY LOW, reducing to NONE, as these operations move further away, and as the activities move under ground level into the pit, whereby the noisy opencast activities are reduced by the barrier effect of the pit walls. Complaints of noise intrusion are therefore not to be expected from the nearest residences to the proposed mine. On the coal transport route from the mine to the treatment plant, the impact is likely to be NONE at distances greater than 250m from the gravel road centerline, rising to MODERATE at 50m from the road. There are no sensitive receptors within 600m of this road.

Methods of mitigation to reduce any potential noise impact, including placement of stockpiles, berms, barriers, and operational and administrative procedures, plant maintenance, and on-site monitoring to ensure that any agreements entered into regarding operating times are adhered to, are discussed.

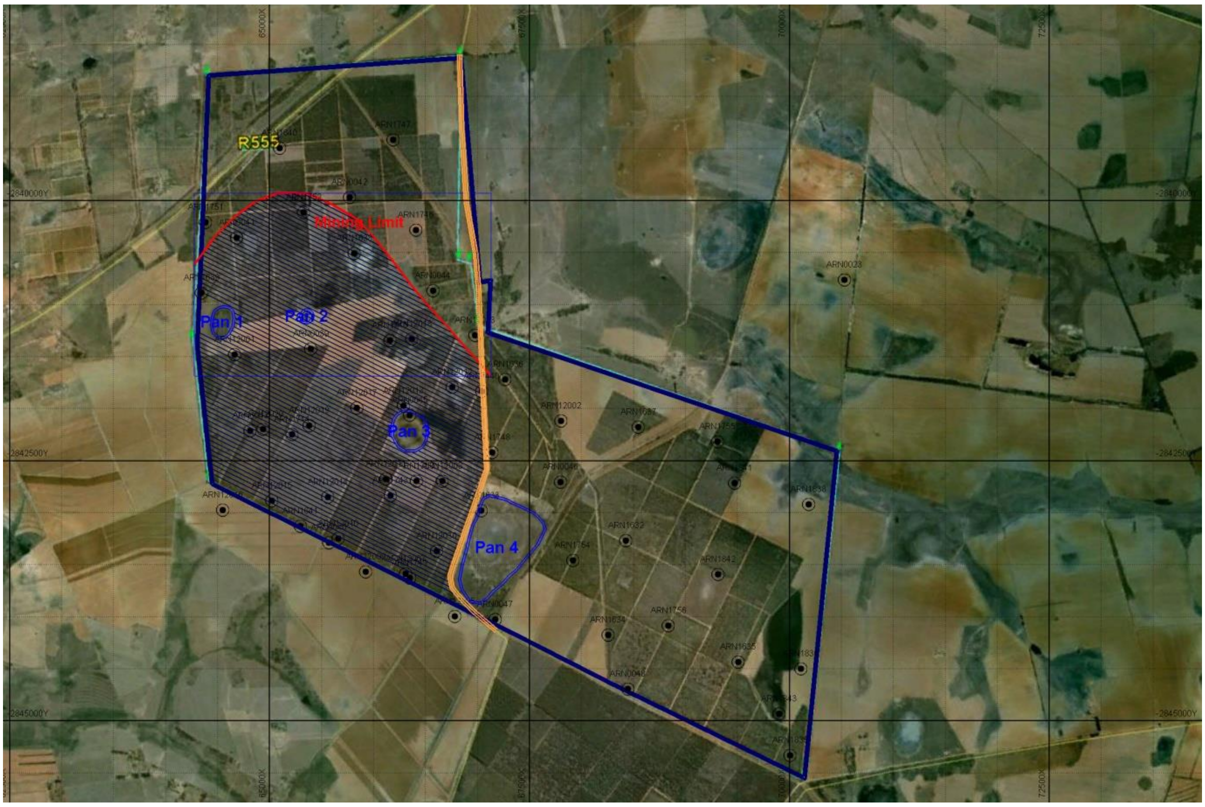
1. PURPOSE OF THE INVESTIGATION AND TERMS OF REFERENCE

An opencast coal mine is proposed on a site south of the R555 Middelburg to Stoffberg road approximately 25km northeast of Middelburg, in a rural area currently a tree plantation, with the generally low noise levels associated with such areas.



<u>The Mine area in relation to Middelburg, roads, measurement points, and sensitive receptors</u>

The proposed pit area is confined to the western section of the site, i.e. west of both the proposed export route via the existing north-south gravel road, and Pan 4.



<u>GoogleEarth map showing the expected extent of the pit within the mining area boundaries</u>

The investigation's purpose was to estimate the potential noise impact of the proposed mine on the existing ambient noise climate in the surrounding areas and on any potential sensitive receptors. This was achieved by measuring the existing ambient noise levels at the site and comparing with the noise of operations at a functioning opencast mine which is currently operated in a similar manner and with similar equipment and procedures, and therefore can be considered representative of the situation to be expected at the proposed mine. Measurements of the existing noise climate at the site were made at 3 defined positions across the proposed site as described in section 3.

Construction phase

Construction activities associated with the new infrastructure are unlikely to increase the noise level by more than that experienced for the operational phase. This is in any case likely to span a relatively short time period, approximately 18 months.

Operational phase

This is the primary purpose of this report. The opencast mine and the transport route are considered. Formal complaints regarding noise disturbance should be responded to using an agreed protocol.

Decommissioning and closure phase

No significant noise impacts are expected during the decommissioning phase of the site. This impact is in any case likely to be of a short duration.

Possible residual and latent impacts

No residual or latent noise impacts expected.

Cumulative Impacts

No cumulative impacts are expected as the required assessment comparisons are made with existing noise levels where these are significant and no significant noise sources exist which add to the noise expected from the operation of the mine.

2. INVESTIGATIVE METHODOLOGY

2.1 Introduction

An opencast coal mine is proposed on a site south of the R555 Middelburg to Stoffberg road approximately 25km northeast of Middelburg, in a rural area currently a tree plantation, with the generally low noise levels associated with such areas. The investigation's purpose was to estimate the potential noise impact of the proposed mine on the existing ambient noise climate in the surrounding areas and on any potential sensitive receptors. This was achieved by measuring the existing ambient noise levels at the site and comparing with the noise of operations at a functioning opencast mine which is currently operated in a similar manner and with similar equipment and procedures, and therefore can be considered representative of the situation to be expected at the proposed mine. Measurements of the existing noise climate at the site were made at three defined positions across the proposed site as described in section 3, one on the side of the site adjacent to the main noise source in the area, the R555 road, and one at the access road to a neighbouring farm which is likely to be the nearest to the opencast pit, and the third near the southern boundary of the site.

In order to be able to assess both the quantitative and geographical extent of the potential impact, it is necessary to predict the noise levels generated by the operation of the mine and compare these with the zone noise level for the type of district backed up by confirmatory noise measurements on site. The extent of community response can then be assessed according to national and international standards which take into account sociological factors as well as the estimated change in noise climate.

2.2 Ambient Noise Measurements at the Site

Confirmatory site measurements were carried out on Monday 20 April 2011. These are reported and discussed in section 3.5. below. The noise climate is very uniform over the entire area, apart from the northernmost section directly adjacent to and under the influence of the traffic on the R555 road, and in full agreement with the SANS 10103 recommendations for rural areas.

2.3 Measurement of Noise Emitted by Similar Operations at an Existing Mine

The approach used in this assessment is to identify all the characteristic noise-generating operations involving a number of machines working together at a specific location, and make measurements of each operation over a representative time period. This approach has the advantage that realistic noise values representing actual equipment maintenance condition and actual operating conditions and durations are used in the later predictions.

2.4 Prediction of Noise Levels at the Proposed Site

The values measured at the operating sites then formed the basis of calculations to predict the noise levels at specific locations of interest at the boundaries of the proposed mine. Using the point source and attenuation-by-distance model, the following assumptions were made:

1. Acoustically hard ground conditions. This assumes that no attenuation due to absorption at the ground surface takes place. The effects of frequency-dependent atmospheric absorption were also ignored. Both assumptions represent a pessimistic evaluation of the potential noise impact.
2. Meteorological conditions. Neutral weather conditions, i.e. windless and inversionless, and standard conditions of temperature and humidity (20°C and 50%RH) were assumed, representing a neutral evaluation of the noise impact.

3. Noise measurements were representative of normal operation. Equivalent continuous A-weighted noise levels, $L_{Aeq,I}$, measured for each type of operation correctly represent the noise from that operation. Impossible-to-predict (random) single noise events louder than the continuous noise level are not taken into account, although short events which are part of the process, such as the impact noise from material transport, and beepers indicating reversing vehicles, for example, are fully represented in the measurements, representing a neutral evaluation of the noise impact.
4. Ambient noise levels. Measured levels are assumed typical of the environment, representing a neutral evaluation of the noise impact.
5. Barrier effect of temporary stockpiles and levees. Because of the highly mobile nature of all operations on the proposed opencast pit, the effect of these temporary structures on the noise climate has been ignored, representing a pessimistic evaluation of the potential noise impact.
6. Current noise control technology is assumed. No allowance is made in the noise level predictions for improvements in noise control techniques or mitigation measures which may be incorporated into the proposed project, representing a pessimistic evaluation of the potential noise impact.
7. Worst case operational noise level assumption. The highest noise level of plant as measured at the operating site was used as the criterion value for the noise predictions at the proposed project, representing a pessimistic evaluation of the potential noise impact.

2.5 Quantifying the Noise Impact

The noise impact is quantified as the predicted increase in ambient noise level, in decibels, which can be attributed to the operation of the proposed mine appropriate to the proposed operating times. The mine and its plant are assumed to be operating continuously, at any time of the day or day of the week.

Existing noise sources include:

Natural sounds of the bush
Livestock and agricultural activity on surrounding land.
Local community and domestic noise
Remote vehicles and other transport serving the local community
Noise from traffic on the R555 road

Noise level (dBA)	Source	Subjective description
160-170	Turbo-jet engine	Unbearable
130	Pneumatic chipping/riveting (operator's position)	Unbearable
120	Large diesel power generator	Unbearable
110	Circular saw, Blaring radio	Very noisy
90 - 100	Vehicle on highway	Very noisy
80 - 90	Corner of a busy street Voice - shouting	Noisy
70	Voice - conversational level	Quiet
40 - 50	Average home - suburban areas	Quiet
30	Average home - rural areas Voice - soft whisper	Quiet
0	Threshold of normal hearing	Very quiet

Table 1: Typical noise level and human perception of common noise sources

Type of district	Equivalent continuous rating level ($L_{Req,T}$) for noise dB(A)					
	Outdoors			Indoors, with open windows		
	Day-night $L_{R,dn}$ 1)	Day-time $L_{Req,d}$ 2)	Night-time $L_{Req,n}$ 2)	Day-night $L_{R,dn}$ 1)	Day-time $L_{Req,d}$ 2)	Night-time $L_{Req,n}$ 2)
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 one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

Table 2: Acceptable rating levels for noise in districts (Ref.1)

NB: Day-time : 06:00 to 22:00, Night-time : 22:00 to 06:00
The worst case criterion appropriate for this assessment is for Rural districts as shown in **bold script** in the above table.

2.6. Assessing the Noise Impact

The expected response from the local community to the noise impact, i.e. the increase of noise over the original ambient, is primarily based on Table 5 of SANS 10103 (ref. 1), but expressed in terms of the effects of impact, on a scale of 'none' to 'very high'.

INCREASE dB	RESPONSE INTENSITY	REMARKS	NOISE IMPACT
0	None	Change not discernible to a person	None
3	None to little	Change just discernible	Very low
$3 \leq 5$	Little	Change easily discernible	Low
$5 \leq 7$	Little	Sporadic complaints	Moderate
7	Little	Defined by National Noise Regulations as being 'disturbing'	Moderate
$7 \leq 10$	Little to medium	Sporadic complaints	High
$10 \leq 15$	Medium	Change of 10dB perceived as 'twice as loud' leading to widespread complaints	Very high
$15 \leq 20$	Strong	Threats of community/group action	Very high

Table 3: Response intensity & noise impact for various increases over the ambient noise

2.7 Response of Communities to Blast Noise and Vibration

The characteristics of blast noise and ground-borne vibration, which is transient, its manner of propagation, its rare occurrence, and the assessment of the response of a community to it, is completely different from the assessment of the colliery equipment noise, which is either continuous or occurs for a significant proportion of the working day. In addition, there are no straightforward methods of assessment of community response to blast noise and vibration which are not based on actual blast event measurements. There is no reliable scientific method of predicting community response to it at present. Some good practices and mitigation methods to reduce the possible reaction to blasting are discussed in the relevant section 5.5.

3. AMBIENT NOISE MEASUREMENTS AT THE SITE

3.1 Introduction

Ambient noise measurements were carried out according to SANS Code of Practice 10103:2008 (Ref. 1) at three positions on or near the property boundary on Wednesday 20 April 2011 and the night of 9/10 April 2014. These positions are defined and the measurements reported in Section 3.5.

3.2 Equipment Used:

For the original (2011) measurements: Bruel and Kjaer Precision Integrating Sound Level Meter Type 2230, Serial number 1483775, fitted with Microphone Type 4155, serial number 1507751, and windscreen. Field calibration using and 01dB Type CAL01 Sound Level Calibrator, serial number 990640.

For the 2014 measurements: 01dB Class 1 Integrating Sound Level Meter Type SdB01+, serial number 10180, fitted with Microphone Type MCE210, serial number 001194, and windscreen. Field calibration using Bruel and Kjaer Type 4230 Sound Level Calibrator, serial number 1275868.

3.3 Calibration Certificates:

All equipment with valid calibration certificates, from the testing laboratories of De Beer Calibration Services. The calibration certificates are available for viewing if required.

3.4 Procedures Used:

Measurements were carried out strictly in accordance with SOUTH AFRICAN NATIONAL STANDARD - Code of practice, SANS 10103:2008, *The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication*, and as required by the regulations of the DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM. NO. R. 154. *Noise Control Regulations in Terms of Section 25 of the Environmental Conservation Act, 1989 (Act No. 73 of 1989)*. Govt. Gaz. No. 13717, 10 January 1992, e.g. Gauteng province, Department of Agriculture, Conservation and Environment, Notice 5479 of 1999. *Noise control regulations, 1999*, Provincial gazette extraordinary, 20 august 1999.

3.5 Measurements at the Proposed Site:

Measurements were carried out at three positions on or near the property boundary, and as described under each noise measurement position reported below. These positions were chosen for one or more of the following reasons:

1) Easily definable and with easy future access in case of need for comparison measurements after completion of the project.
2) Most likely to continue to exist after development of the site.
3) Representative of the important background noise regimes
4) Near sensitive receptors likely to be affected by future mine noise.

Note 1: All noise levels in this report are A-weighted noise levels expressed in dB(A).

Note 2: $\mathbf{L_{Aeq,I}}$ is the A-weighted equivalent sound level using the ‘I’ (Impulse) dynamic response characteristic as recommended in SANS 10103:2008 (ref. 1)

Note 3: The minimum A-weighted noise level recorded during the measurement period ($\mathbf{L_{AMin}}$) is taken as an expression of the lowest background noise in the absence of intrusive noisy events, primarily road traffic and random noise events such as pedestrians, animals, birds, and local road or air traffic.

Note 4: In the Comments column of the noise tables, C - Car, Minibus or LDV, HGV – Heavy Goods Vehicle or Bus, A/c – Commercial airliner, La/c – light aircraft, H – Helicopter, cN - noise level calculated from traffic count, for the measurement period, usually (but at least) 10 Minutes.

The measurement positions (MP1-MP3) and the closest dwellings to the mine (SR1-SR9)

Measurement Position 1

At the entrance to a gravel road going south into the proposed site towards MP2 at a position at the southern road reserve boundary, 15m from the centreline of the R555, as shown in the following photographs.
GPS co-ordinates – S25° 39.474′, E29° 39.227′. Height 1662m (±4.3m)

Location of Measurement Position MP1 on R555 and closest sensitive receptors

View west along R555 at gravel road corner

View east along R555 with site to right


View north over R555 towards farm SR1


View south into the proposed opencast area

Measurement Table

Day/Date	Time	T °C	RH %	Wind m/s	L_{eq}	L_{Min}	Comments
Wed 20/04/11	13:33-13:43	26.6	38	3.8	71.7	40.4	C=32, HGV=9
Wed 20/04/11	13:45-13:55	26.6	38	3.8	69.8	40.0	C=35, HGV=5
Wed 20/04/11	13:45-13:55	26.6	38	3.8	71.6	42.2	C=50, HGV=6
Wed 09/04/14	23:38-23:48	10.5	58	Still	59.4	22.7	C=4
Wed 09/04/14	23:51-00:01	10.5	58	Still	60.1	22.9	C=2, HGV=1
Thur 10/04/14	01:12-01:22	10.5	58	Still	63.0	23.5	HGV=3

Observations: These values are highly consistent lying between 70 and 72 dB(A), and very typical of a trafficked main road through a rural area, with the noise climate, L_{eq}, dominated by the road. The minimum background noise, the L_{Min}, represents natural sounds such as birds, insects, rustling vegetation, and farming activities is also highly consistent lying between 40 and 42 dB(A). Night-time noise levels are approximately 10 dB below the daytime level primarily associated with the night-time operation of coal transport trucks.

Measurement Position 2

At a position near the centre of the site, at the intersection with the gravel road to Rietvlei Farm, as shown in the following photographs.
GPS co-ordinates – S25° 40.7722′, E29° 40.061′. Height 1671m (±3.8m)

Location of Measurement Position MP2 and the closest sensitive receptor, Rietvlei Farm

View south toward site boundary and MP3

View east to Rietvlei Farm

View north towards MP1 and the R555

View west to the proposed opencast area

Measurement Table

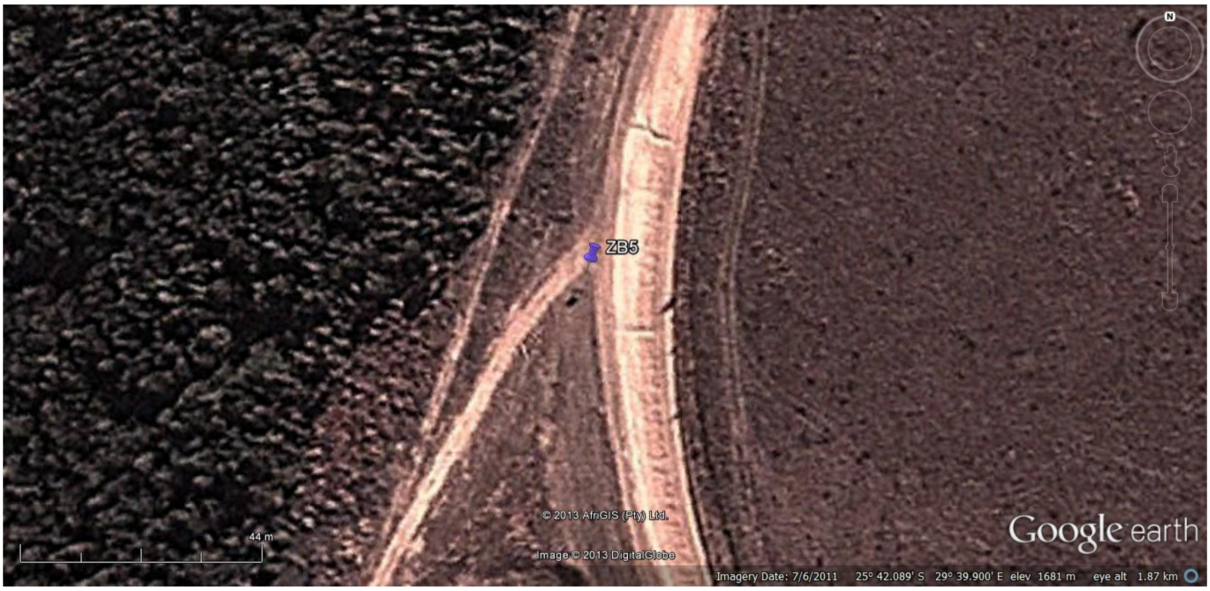
Day/Date	Time	T °C	RH %	Wind m/s	L_{eq}	L_{Min}	Comments
Mon 28/02/11	12:45-12:55	26.8	38	4.6	49.3	40.7	No vehicles
Mon 28/02/11	12:56-13:06	26.8	38	4.6	44.7	40.0	No vehicles
Mon 28/02/11	13:07-13:17	26.8	38	4.6	46.6	41.7	No vehicles
Thur 10/04/14	00:14-00:24	10.5	58	Still	25.9	22.5	No vehicles
Thur 10/04/14	00:51-01:01	10.5	58	Still	25.8	22.5	No vehicles

Observations: These values are highly consistent lying between 45 and 50 dB(A), and very typical of a rural area, with the noise climate, L_{eq}, dominated by natural sounds such as birds, insects, rustling vegetation, and farming and forestry activities, with very occasional remote vehicles on the local dirt roads. The minimum background noise, the L_{Min}, is also highly consistent lying between 40 and 42 dB(A). Night-time noise levels are typically 10 dB lower than recommended for a rural area, as low as 25 dB(A)

Measurement Position 3

At a position on a gravel road on the proposed mine boundary, at the entrance to the farmstead Driefontein, as shown in the photographs below. GPS co-ordinates – S25°42.086′, E29°39.898′. Height 1681m

<u>Location of Measurement Position MP3 and closest sensitive receptor, Driefontein farm</u>



<u>Location and surroundings of Measurement Position MP3</u>

<u>View north to Driefontein farm</u>

<u>View north towards MP2</u>

<u>View west into plantation</u>

<u>View east towards proposed opencast pit</u>

Measurement Table

Day/Date	Time	T °C	RH %	Wind m/s	L_{eq}	L_{Min}	Comments
Tues 21/05/13	07:10-07:20	5.8	69	1.5	42.8		No Traffic
Tues 21/05/13	07:23-07:33	6.6	76	0.9	44.5		No Traffic
Tues 21/05/13	10:05-10:15	17.5	49	2.4	58.9		HGV=1
Tues 21/05/13	10:17-10:27	18.1	51	1.0	41.9		No Traffic, A/c=1
Wed 20/04/11	12:15-12:25	26.5	36	4.3	47.5	34.1	No Traffic
Wed 20/04/11	12:27-12:37	26.8	38	4.3	46.4	33.7	No Traffic
Tues 21/05/13	12:52-13:02	22.2	42	2.8	45.0		No Traffic
Tues 21/05/13	13:04-13:14	22.7	43	2.4	43.0		C=1
Mon 20/05/13	15:10-15:20	22.2	42	2.5	53.2		No Traffic, Bird calls
Mon 20/05/13	15:23-15:33	20.6	43	2.1	43.5		No Traffic, Bird calls
Tues 21/05/13	18:20-18:30	7.8	50	0.7	43.9		No Traffic
Tues 21/05/13	18:40-18:50	4.8	47	0.7	34.7		No Traffic
Thur 10/04/14	00:33-00:43	10.5	58	Still	28.6	24.2	No Traffic

Observations: These values are very uniform, generally falling around 45 dB(A) in the absence of traffic on the gravel road, which is typical for a rural area, the normal noise source being natural sounds such as birds, insects, and rustling vegetation unless there is a vehicle pass-by during the measurement. Night-time noise levels are typically 10dB lower than those recommended for a rural area, as low as 25 dB(A)

4. OPERATION NOISE MEASUREMENTS FROM AN EXISTING MINE

In order to have actual measurements of operations from which to assess the forthcoming conditions at the proposed mine, noise from an existing mine's operations was measured. This existing mine's processing equipment is similar to and operates in a manner similar to that proposed for the mine. The two main operations measured were the drilling of blast holes, and the loading of haul trucks, both screened by the pit walls. The raw coal is then to be trucked south to an existing coal treatment plant along an upgraded existing gravel road.

4.1 The Drilling Operation:

Measurements were made at a distance of 10m from the assumed acoustic centre of the drilling rig, over a full drilling cycle, including relocation of the rig. Temperature 24.5°C, Humidity 20%, Wind speed 3.3 m/s max. The following relevant measurements were recorded.

Meas. Nr.	L_{Amax}	L_{AeqI}
1	93.9	84.8
2	94.6	88.2
3	92.5	87.5
4	94.8	89.5
Average	93.9	87.5

For calculation and prediction purposes the maximum measurement cycle value of 89.5 dB(A) at 10m (normalised to 86.0 dB(A) at 15m) has therefore been used.

4.2 The Loading Operation:

Measurements were made at a distance of 25m from the assumed acoustic center of the operation, over a full loading cycle. Temperature 24.5°C, Humidity 20%, Wind speed 3.0 m/s max. The following relevant measurements were recorded.

Meas. Nr.	L_{Amax}	L_{AeqI}
1	87.2	75.0
2	85.4	75.1
3	87.5	76.7
Average	86.7	75.6

For calculation and prediction purposes the maximum measurement cycle value of 76.7 dB(A) at 25m (81.1 dB(A) at 15m) has therefore been used.

4.3. The Crushing Operation

Measurements were carried out at a position directly to the side and 40m from the crusher and the associated wheel loaders serving it. For calculation and prediction purposes the maximum measured cycle value of 66.8dB(A) at 40m (75.3 dB(A) at 15m) has therefore been used.

5. IMPACT ASSESSMENT

5.1 General

Because of the highly mobile manner of opencast operation, this type of operation does not lend itself to simple static calculations of noise levels either at the site boundaries or at specific noise-sensitive locations for the following reasons:

1. The noise generating machinery migrates around the site in the long term as the material is extracted, with the consequent varying of distance from noise-sensitive areas.
2. Much of the machinery itself is mobile in the short term, e.g. excavators, front loaders, trucks, and road graders, giving rise to highly intrusive noise events for short periods, which stand out above the general background level, and are therefore more noticeable.
3. Noise sources may be more or less screened from receiver positions depending on the progress of the excavations. This is especially true of rock and soil removal, which may be well screened by their depth in the pit for long periods of their total operating time.

5.2 Continuous Noise Levels and Individual Noise Events

This report is an overall assessment designed to predict the collective response of a noise-exposed population and therefore the impact the operation is likely to have on them, and is based on measured and predicted equivalent continuous noise levels according to SANS 10103:2008. It will be possible to detect and distinguish individual noise events, even if the noise impact is assessed as NONE, or VERY LOW, i.e. where a person with normal hearing will not be able to detect the predicted increase in ambient noise level attributable to operation of the mine, but where an individual noise-generating operation may nevertheless be audible to that person.

5.3 Existing Ambient Noise Levels at the Site

The ambient noise in such rural communities is generally similar to and sometimes lower than the suggested values for suburban districts according to the relevant section (Table 2) of the recommendations of SANS 10103:2008 as follows:

Type of District	Daytime	Nighttime
Rural	45	35

Table 4. Part of Table 2 of SANS 10103:2008

The confirmatory measurements made on site agree very well with the recommendations of SANS 10103:2008 for a rural area, so for the purpose of this assessment the above zone levels for a rural area have been used in the subsequent assessments:

5.4. Predicted Impact of General Site Operation Noise

5.4.1. The Opencast Pit

The two continuously noisy activities within the opencast pit are the drilling and the shovel and truck loading processes. The combination of both these sources operating simultaneously at similar distances from the assessment position is the worst possible case. This gives a predicted value of 87.2 dB(A) at 15m. As all these activities will be within the pit and therefore screened by the pit wall, a very conservative allowance for the noise barrier effect of the pit wall is taken as 12dB, giving an effective value of 75.2 dB(A) at the surface, which is the same as the predicted noise from the surface crusher. The investigation shows that activities within the proposed pit will have a minor impact on the noise climate of the surrounding environment. In the worst case, as described above, with no mitigating measures, and using the limit levels in 5.3. above, the daytime impact will be NONE beyond a distance of 275m (870m should there be pit operations at night (22:00 to 06:00)) from the pit and LOW at 193m (610m at night) from the pit. Few dwellings are indicated within these distances from the nearest point of the pit boundary, the nearest being at 700m. For the opencast situation, the values represent the worst case, where equipment is always assumed to be located at the nearest point to the boundary within the pit. This will only happen while the pit is being excavated in that position, and this worst case noise level will therefore only be applicable close to this position for a short period while this is the case. As the excavations progress, different areas will be affected by this worst case noise level, and other areas will be exposed to lower levels of noise as extraction progresses to a more remote location, and/or deeper. For the noisiest opencast operations, these are thus generating a noise impact of NONE during the daytime and night-time (should mining activities occur between 22:00 and 06:00 hours), depending on their proximity to this location and the extent of the local noise shielding provided by the pit sides, positioning of temporary stockpiles, and local ground contours, all of which mitigate the noise impact to a greater or lesser extent.

Exceedance dB	Noise Impact	Distance - day	Distance – night
0	None	275m	870m
3	Very low	193m	610m
3 ≤ 5	Low	153m	485m
5 ≤ 7	Moderate	121m	385m
7 ≤ 10	High	86m	275m
10 ≤ 15	Very high	49m	155m

Table 5: Distances from the screened active pit for a certain response intensity and noise impact for various increases over the ambient daytime and night-time noise

Phase	Impact: Noise						
	Nature	Extent	Duration	Intensity	Probability	Significance	
						M	No M
Construction	Noise	Local to site	Short term	Low, Negative	Probable	Very Low	Low
Operation	Noise	Local to site	Long term	Low, Negative	Probable	None	Very Low
Decommissioning	Noise	Local to site	Short term	Very Low, Negative	Probable	Very Low	Very Low
Residual	None	n/a	n/a	n/a	n/a	n/a	n/a
Latent	None	n/a	n/a	n/a	n/a	n/a	n/a

Table 6: Summary of worse case impacts of noise

Note: M = With mitigation measures
No M = Without mitigation measures

5.4.2 The Transport route

The transport route from the mine to the coal treatment plant is along a stretch of the existing gravel road through the centre of the site to the south. It is assumed that transport occurs only at times defined as daytime in the relevant SANS Standard (Ref 1). At a monthly tonnage of 100000, 120 return journeys are generated per day, or 24 vehicle pass-bys per hour. The noise generated by these journeys is predicted to be an $\mathbf{L_{AeqI}}$ of 61 dB(A) at 10m from the road

centerline and applying calculations according to Ref.2. generates the following table for the noise generated by the transport of the coal to the coal treatment plant.
The noise impact is NONE at distances greater than 250m from the transport route. There are no dwellings within this distance.

Exceedance dB	Noise Impact	Distance - daytime
0	None	250m
3	Very low	125m
3 ≤ 5	Low	81m
5 ≤ 7	Moderate	50m
7 ≤ 10	High	25m
10 ≤ 15	Very high	8m

Table 7: Distances from the access road for a certain response intensity and noise impact for various increases over the ambient daytime noise

Mitigation Measures:

1. Maintenance of equipment and operational procedures: Proper design and maintenance of silencers on diesel-powered equipment, systematic maintenance of all forms of equipment, training of personnel to adhere to operational procedures that reduce the occurrence and magnitude of individual noisy events.
2. Placement of material stockpiles: Where possible earthworks and material stockpiles should be placed so as to protect the boundaries from noise from individual operations and especially from haul roads, which for greatest effect should be placed directly behind them. If a levee is constructed, it should be of such a height as to effectively act as a noise barrier, if line of sight calculations show this to be practicable.
3. Equipment noise audits: Standardised noise measurements should be carried out on individual equipment at the delivery to site to construct a reference data base and regular checks carried out to ensure that equipment is not deteriorating and to detect increases which could lead to increase in the noise impact over time and increased complaints.
4. Environmental noise monitoring: This should be carried out by an independent agency regularly at six-monthly intervals close to MP2 at the nearest mine boundary to Rietvlei Farm to detect deviations from predicted noise levels and enable corrective measures to be taken where warranted. In addition it is recommended to carry out continuous blast monitoring to check on the levels of air blast and groundborne vibration generated by individual blasts at the same position.

Source	Remedial measures
Mobile equipment noise	Select vehicle routes carefully by internalising the roads Fit efficient silencers and enclose engine compartments Damp mechanical vibrations Maintain equipment conscientiously Erect berm, screen or barrier at permanent sites and haul roads
Fixed plant noise	Carefully select permanent plant site remote from sensitive receptors Reduce noise at source by acoustic treatment, etc. Isolate source by acoustic enclosure, etc. Compressors and generators, if used on site, should be installed in separate

Source	Remedial measures
	acoustically treated buildings The crusher and front end loaders supplying the transport trucks should be centred within the coal stockpiles which should encircle the operation and maintained at a height of 4-5 meters as far as possible so they continuously act as noise berms. The essential situation is that there should be no line of sight from sensitive receptors outside the mine boundary to the operating equipment.

Table 8. Summary of major sources of noise associated with mining operations, and possible remedial measures

5.5 Predicted Response to Blasting Operations

General

The nature and magnitude of the response to noise and ground-borne vibration from blasting operations will depend critically on the blasting regime chosen, the nature of the rock to be blasted, the size and depth of the charge, the type of explosive, the local topography, and the detonation sequence. There are at present no reliable national or international guidelines to accurately predict human or livestock response to blast noise.

Neither the air blast nor the ground vibration are likely, in the author's experience, to have any damaging effect on humans, livestock, or buildings in the vicinity, if they are designed and carried out with due regard to normal good blasting practice and with the desire to obtain cost-effective results in operational terms. However, both air blast and ground vibration can give rise to secondary noise in a building, such as the rattling of windows and other loose objects in a state of neutral equilibrium, and this is often interpreted as a far more serious occurrence than it really is. An additional complication is that the blast will in general contain frequencies below those which can be heard by the human ear i.e. below 20Hz. These low frequencies also contain sufficient energy to give rise to secondary noise, just as with ground vibration, making it characteristically difficult to differentiate between airborne blast and ground-borne vibration, and the secondary effects of both.

Humans are extremely sensitive to vibration and can detect levels of ground vibration of less than 0.1 mm/s, which is less than $1/100^{th}$ of the levels which could cause even minor cosmetic damage to a building. Complaints and annoyance regarding ground vibration are therefore much more likely to be determined by human perception than by noticing minor structural damage. However, these effects, and the startling effect of sudden impulses of both sound and ground vibration are often perceived as intrusion of privacy and could be a source of considerable annoyance to the local community. For this reason, and because of the absence of information on either the likely community response to blast noise or the likely levels of blast overpressure or audible noise, the noise impact should be considered MODERATE. However, previous notification of blasting activities at predetermined times on stated days, and careful design of the blasting regime to reduce the levels of both airborne blast noise and ground borne vibration will contribute significantly to the minimisation of the overall impact of blasting on the surrounding community.

Mitigation:

1. Calculating the charge size to keep air blast and ground vibration levels below pre-determined acceptable values.

2. Monitoring blast, ground vibration and human response to ensure accepted levels are in fact acceptable and are being adhered to, and to modify the blasting regime as appropriate.
3. Pre-notification of affected persons of the intention to blast and the time of blast, preferably at the same time of day to remove the element of surprise.
4. Correct stemming of blastholes.

Effect of Vibration on Surrounding Structures.

There is wide agreement in the industry that the Peak Particle Velocity (PPV) is the parameter which best correlates with observed damage caused by vibration, and is widely applied in assessments. The first observable damage to structures, the forming of hairline cracks in plaster, begins at a PPV of about 25mm/s. The US Bureau of Mines recommends twice this value, 50mm/s, as the limit for residential property. Minor structural damage can occur to traditional masonry structures at values in excess of 100mm/s, and serious damage occurs at values in excess of 200mm/s, according to a range of authors (see ref. 9-12). Effects on temporary structures are likely to occur at values which are lower than for masonry structures, though the high variability in the type and construction quality of such structures renders reliable prediction of these values impossible.

For a surface blast, the relationship between the Peak Particle Velocity (**C**), the distance from the explosion (**R**), and the mass of the explosive (**W**), can be simply expressed (ref. 10) as follows:

$$\mathbf{C = a\left[\frac{R}{\sqrt{W}}\right]^{-b}}$$

where **C** is the PPV in mm/s

R is the distance of the monitoring position from the explosion in meters.

W is the mass of the explosive charge in Kg.

a is a site-specific constant expressing the efficiency of excitation of the ground by a given charge, and depends on local geology, explosive coupling efficiency, resonance effects, ground condition and water content.

b is a site-specific constant expressing the attenuation of the PPV with distance.

The above equation enables the size of the charge to be determined so that the PPV at a specified distance can be kept below a predefined limit. The constants **a** and **b** are determined empirically by a small number of test blasts before the commencement of operational blasting. Vibration levels at a sensitive engineering structure have been successfully managed by using this technique at an opencast colliery. This colliery is said to be similar in structure and operating procedures to the proposed colliery, so results from that investigation, especially the values of the constants **a** and **b** should be broadly applicable to the conditions. It is recommended in the first instance that that, when known, the planned explosive charge sizes be entered into this equation to check whether there is any possibility that the PPV at sensitive structures could exceed the accepted limit for cosmetic damage. If this proves to be the case, then a set of test blasts should be considered before operations begin to determined the constants **a** and **b** specifically for the site, and calculate actual PPVs at sensitive buildings. Because ground vibration due to blasting can be controlled by competent blast design and because the levels likely to cause even cosmetic structural damage at the nearest farmhouses, the vibration impact is considered VERY LOW.

Mitigation:

As for section above, plus the following
1. Monitoring of sensitive structures for signs of attributable damage.
2. Vibration monitoring of the structure to ascertain actual vibration levels

Effect of Operating Noise and Blast Noise on Livestock

Very little information exists on the response of livestock, or indeed wildlife, to noise, blast noise, and ground vibration. There is no evidence whether or not these will be adversely affected by the noise of blasting operations and how, or how much, they will be affected. The impact on livestock of operating noise is considered VERY LOW, whereas the impact of blast noise, because its occurrence is sudden and unpredictable and its effects also unpredictable is probably MODERATE.

Mitigation:

As above, plus the following:

1. Regular monitoring of the exposed livestock to ascertain if there are any adverse reactions.

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