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ESKOM Landfill Project

Environmental Noise Impact Assessment

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J. Hassall, Issue 3 – 11 May 2009

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EXECUTIVE SUMMARY

A landfill operation is to be established at an existing ESKOM-owned site adjacent to an existing landfill at the existing Matimba Power Station to be active over a 50-year period. The proposed area is adjacent to the power station and its supporting infrastructure and therefore already has a degraded ambient noise climate more typical of an industrial area than a rural environment. The investigation's purpose was to estimate any potential noise impact on the existing ambient noise climate in the surrounding area of the landfill operation. This was achieved by measuring the noise of operations at a similar, functioning, landfill operation, which is currently operated in a similar manner to the proposed operation, and with similar equipment and procedures, and therefore can be considered representative of the situation to be expected at the proposed operation.

The expected response from the local community to the noise impact, i.e. any increase of predicted operational noise over the original ambient noise, is primarily based on the relevant SANS document, 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 daytime noise impact is generally rated as NONE to VERY LOW. The impact at some of the nearest surrounding residences, in the worst case of the noisiest operations being at their closest to those dwellings during part of the lifetime of the landfill, is rated as LOW.

The impact of the increase in noise caused by transportation by road, which amounts to less than 1 vehicle movement per hour on internal gravel roads is classed as VERY LOW.

The placement of the landfill site at alternative A is preferred from the viewpoint of minimizing the influence the noise it is likely to have on the nearest residential areas.

Other methods of mitigation, including barriers, operational and administrative procedures, plant maintenance, and on-site monitoring to ensure that any agreements are adhered to, are discussed.

1. PURPOSE OF THE INVESTIGATION And TERMS OF REFERENCE

A long term, 50-year, landfill operation is to be established at an existing ESKOM-owned site adjacent to an existing landfill at the Matimba Power Station. The area already has a degraded ambient noise climate more typical of an industrial area than a rural environment. The investigation's purpose was to estimate any potential noise impact on the existing ambient noise climate in the surrounding area of the proposed landfill operation. This was achieved by measuring the noise of operations at a similar, functioning, operation, which is currently operated in a similar manner to the proposed operation, and with similar equipment and procedures, and therefore can be considered representative of the situation to be expected at the proposed operation.

1.1. 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. Construction is in any case likely to span a very short time period.

1.2. Operational phase

This is the primary purpose of this report. Formal complaints regarding noise disturbance should be responded to.

1.3. 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.

1.4. Possible residual and latent impacts

No residual or latent noise impacts are expected.

2. INVESTIGATIVE METHODOLOGY

2.1 Introduction

A landfill operation is to be established at an existing ESKOM-owned site adjacent to an existing landfill at the existing Matimba Power Station to take place over a 50-year period. The area has a degraded ambient noise climate more typical of an industrial area than a rural environment. The investigation's purpose was to estimate any potential noise impact on the existing ambient noise climate in the surrounding area of the proposed landfill operation. This was achieved by measuring the noise of operations at a similar, functioning, operation, which is currently operated in a similar manner to the proposed operation, and with similar equipment and procedures, and therefore can be considered representative of the situation to be expected at the proposed operation. In order to be able to assess both the quantitative and geographical extent of the potential impact, it is necessary to have baseline data in the form of existing ambient noise levels at the site. These can then be compared to the predicted noise levels of the proposed operation. 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 Proposed Site

The existing ambient noise levels were measured over sampling periods of ten minutes for representative time periods during a typical weekday. Two positions remote from the both the site and the existing power station were chosen as representative of the remote area and its noise climate.

2.3 Measurement Of Noise from similar Operations

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

2.4. Prediction Of Noise Levels At The Proposed Site

The values measured in accordance with section 2.3. above then formed the basis of calculations to predict the worst case noise levels at specific locations of interest outside the boundaries of the proposed site. 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 the operation are assumed to correctly represent the noise from the 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 vehicles, for example, are fully represented in the measurements, representing a neutral to mildly optimistic evaluation of the noise impact.
4) Ambient noise levels. Measured levels were assumed typical of the environment, representing a neutral evaluation of the noise impact.
5) Screening effect of temporary stockpiles, buildings and other barriers. The effect of these temporary structures, including screening by the reception pit itself, 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 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 was used as the criterion value for the noise predictions at the proposed project, representing a pessimistic evaluation of the potential noise impact.

8) Worst case operational assumption. The assumption has been made that plant is positioned closest to the assessment point, 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 landfill, during different periods of the day.

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 6 of SANS 10103 (ref. 1), but expressed in terms of the effects of impact, on a scale of 'none' to 'very high'.

Existing noise sources include:

- Natural sounds of the bush
- Livestock and agricultural activity on surrounding land.
- Local community and domestic noise
- Vehicles and other transport serving the local community.

Noise level (dBA)	Source	Subjective description
160-170	Turbo-jet engine	Unbearable
130	Pneumatic chipping and 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

The recommended noise levels in a suburban residential area are described in Table 2 of SANS 10103 (ref. 1), and Table 5 of the same document.

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 appropriate district criteria for this assessment are in **bold script** in the above table.

1	2	3
Excess $\Delta L_{Req,T}$[a] dBA	**Estimated community/group response**	
Category	**Description**	
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

a $L_{Req,T}$ should be calculated from the appropriate of the following:

1) $)L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS $L_{Req,T}$ of the residual noise (determined in the absence of the specific noise under investigation).
2) $)L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS the maximum rating level for the ambient noise given in table 1.
3) $)L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS the acceptable rating level for the applicable district as determined from table 2.
4) $\Delta L_{Req,T}$ = Expected increase in $L_{Req,T}$ of ambient noise in an area because of a proposed development under investigation.

NOTE Overlapping ranges for the excess values are given because a spread in the community reaction may be anticipated

Table 3A: SANS10103-2008 Table 5–Categories of Community/Group Response

INCREASE dB	RESPONSE INTENSITY	REMARKS	NOISE IMPACT
0	None	Change not discernible by a person	None
3	None to little	Change just discernible	Very low
3 ≤ 5	Little	Change easily discernible	Low
5 ≤ 7	Little	Sporadic complaints	Moderate
7	Little	Defined by National Noise Regulations as being 'disturbing'	Moderate
7 ≤ 10	Little to medium	Sporadic complaints	High
10 ≤ 15	Medium	Change of 10dB perceived as 'twice as	Very high

		loud' leading to widespread complaints	
15 ≤ 20	Strong	Threats of community/group action	Very high

Table 3B: Noise Impact/Community/Group Response Categories

3. AMBIENT NOISE MEASUREMENTS AT THE PROPOSED SITE

3.1. Introduction

Noise measurements were carried out at positions remote from the site to assess likely response at remote dwellings to noise from the proposed landfill. They agreed well with the SANS 10103 recommendations for rural areas, so these recommended values have been used in the following assessments. Further measurements are still be carried out at the currently proposed sites to identify any rise in ambient noise levels local to the sites due to the operation of Matimba power station which may serve to reduce the assessed impact.

3.2. Equipment Used:

01dB Type SdB01+ Precision Integrating Sound Level Meter, serial number 10180, fitted with 01dB Microphone Type MCE210, serial number 11474, and windscreen. Field calibration using and 01dB Type CAL01 Sound Level Calibrator, serial number 990640.

3.3. Calibration Certificates:

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

3.4. Procedures Used:

Measurements were carried out in full accordance with SOUTH AFRICAN STANDARD - Code of practice, SANS 10103:2008, Third revision, *The measurement and rating of environmental noise with respect to 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.

3.5. Ambient Noise Measurements at the Proposed Site:

Measurements were carried out at two locations as described below. These locations were chosen for the following reasons:

1) Useful for comparison purposes after development of the site.

2) Most likely to continue to exist after development of the site.
3) Easily identifiable and with easy access in case of need for future measurements.
4) In close proximity to any affected residences.
5) On the roads most likely to be affected by future traffic noise changes.

Note 1: SANS 10103:2008 defines: Day-time – 06:00 to 22:00
Night-time – 22:00 to 06:00

Note 2: As the proposed landfill is planned to operate during daytime periods only, assessments have only been made for this period.

Note 3: All noise levels in this report are A-weighted noise levels expressed in dB(A) re 20 microPascals, and measured according to SANS 10103:2008 (Ref. 1)

Location 1

At the intersection of the four farms Kameelbult, Zandbult, Gannavlakte, and Loopleegte at the edge of the dirt road as shown in the following photographs. GPS Coordinates – S 23° 40.336', E 27° 20.687', altitude 905 ± 5.4m.

View south to Ellisras/Steenbokpan road

View along fence between farms Kameelbult and Zandbult

View along fence line between Gannavlakte & Loopleegte

Measurement Table

Date	Time	Temp °C	Relative Humidity %	Wind	$L_{Aeq,I}$	L_{90}	Comments
Fri 05/09/08	**08:34 - 08:44**	18	65	<0.5	33.9	26	No traffic
Fri 05/09/08	**08:45 - 08:55**	18	65	<0.5	31.0	24	No traffic
Fri 05/09/08	**08:56 - 09:01**	22	46	<1.5	32.9	21	No traffic
Fri 05/09/08	**09:20 - 09:30**	25	37	<1.5	29.8	21	No traffic
Fri 05/09/08	**10:00 - 10:10**	28	30	<1.8	30.7	21	No traffic
Fri 05/09/08	**10:25 - 10:35**	28	30	<1.8	29.6	21	No traffic
Fri 05/09/08	**13:30 - 13:40**	28	30	still	28.1	21	No traffic

These values are typical of a rural area with little or no road traffic, with the natural sounds of birds and insects dominating the $L_{Aeq,I}$ value during the day. These values are generally lower than the SANS recommendations for a rural area, due to the remoteness of the area. The L_{90} (the sound level exceeded for 90% of the time, and

usually taken as the background noise without intruding events such as bird calls) is repeatable at 21-26 dB(A) during the day.

Location 2

At the gate of the farm Vlakfontein at the edge of the dirt road as shown in the following photographs. GPS Coordinates – S 23° 36.725', E 27° 18.894', altitude 879 ± 4.8m.

View west to the farm Vlakfontein

View south to tar road and location 1

View Northeast

Measurement Table

Date	Time	Temp °C	Relative Humidity %	Wind	$L_{Aeq,I}$	L_{90}	Comments
Fri 05/09/08	**07:15 - 07:25**	16	72	<0.5	34.3	24	No traffic
Fri 05/09/08	**07:26 - 07:36**	16	72	<0.8	32.0	24	No traffic
Fri 05/09/08	**07:39 - 08:00**	16	72	<0.8	34.2	24	No traffic
Fri 05/09/08	**08:02 - 08:12**	16	72	<0.8	38.8	25	No traffic
Fri 05/09/08	**12:15 - 12:25**	28	30	<0.5	33.2	21	No traffic
Fri 05/09/08	**13:10 - 13:20**	28	30	<0.5	31.9	20	No traffic
Thur 04/09/08	**14:23 - 14:33**	27.5	30	<4.8	38.5	29	Significant wind

These values are typical of a rural area with no road traffic, with the natural sounds of birds and insects dominating the $L_{Aeq,I}$ value during the day. These values are generally lower than the SANS recommendations for a rural area. The L_{90} (the sound level exceeded for 90% of the time, and usually taken as the background noise without intruding events such as bird calls) is rather variable, between 20 and 29

dB(A). This is primarily due to the activity of birds and insects, especially in the evening.

Location 3

At the fence line of the Matimba power station on the dirt road which follows the boundary fence as shown in the following photographs. GPS Coordinates – S 23° 40.531', E 27° 36.629', altitude 888 ± 6m.

View towards Matimba power station

View towards the power station entrance

Measurement Table

Date	Time	Temp °C	Relative Humidity %	Wind	$L_{Aeq,I}$	L_{90}	Comments
Thur 30/04/09	**14:50 - 15:00**	33	12	Still	48.2	44	No traffic
Thur 30/04/09	**15:01 - 15:11**	33	12	Still	50.1	48	No traffic
Thur 30/04/09	**15:12 - 15:22**	33	12	Still	52.1	50	No traffic
Thur 30/04/09	**17:14 - 17:24**	25	26	Still	55.1	53	No traffic
Thur 30/04/09	**17:25 - 17:35**	25	26	Still	54.6	53	No traffic

The noise climate around the power station is completely dominated by the noise emission from the power station, being continuous and stable in the short term, and gradually increasing towards and after dusk as temperatures fall and inversion conditions apply. Other noise from roads and other sources not connected with the power station are not audible at this measurement point.

Location 4

At the fence line of the Matimba power station opposite the proposed landfill area on the dirt road which follows the boundary fence as shown in the following photographs. The measurement position is 115m from the centreline of the public road to the Grootgeluk mine. GPS Coordinates – S 23° 40.139', E 27° 35.645', altitude 875 ± 5.7m.

View to Matimba power station which is partly obscured by the existing landfill

View to road to Grootgeluk mine

Measurement Table

Date	Time	Temp °C	Relative Humidity %	Wind	$L_{Aeq,I}$	L_{90}	Comments
Thur 30/04/09	**15:44 - 15:54**	33	12	<1.4	47.0	37	C=43, HGV=1
Thur 30/04/09	**15:56 - 16:06**	33	12	<1.4	50.4	38	C=69, HGV=1
Thur 30/04/09	**17:10 - 17:24**	33	12	Still	51.5	42	C=66, HGV=12
Thur 30/04/09	**17:25 - 17:36**	33	12	Still	51.6	45	C=51, HGV=8
Thur 30/04/09	**18:05 - 18:18**	25	26	Still	53.0	46	C=50, HGV=0
Thur 30/04/09	**18:20 - 18:30**	25	26	Still	53.7	47	C=33, HGV=6

The noise climate at this position is dominated by road traffic on the adjacent road to Grootgeluk mine, but the power station and the activity of the stockpile are both clearly audible at this position during lulls in road traffic.

3.6. Measurements at a Landfill Using Similar Procedures & Equipment

Measurements were made of operations at a similar Landfill site operated in a similar way and using similar equipment to that proposed for the ESKOM Matimba site. The operations were measured at a number of places at a number of different distances from the active front.

Location 1:

Measurements were made at a distance of 150m from the assumed acoustic center of the reception pit as shown in the photographs below. This corresponds to a sound level of 67 dB(A) at a nominal distance of 60m.


Views towards the reception pit

Meas. Nr.	1	2
L_{AeqI}	58.8	59.2

Location 2:

Measurements were made at a distance of 60m from the assumed acoustic center of the reception pit as shown in the photographs below.


Views towards the reception pit

Meas. Nr.	1	2
L_{AeqI}	72.6	72.9

4. IMPACT ASSESSMENT

4.1. General

The proposal is for the development of a landfill adjacent to an existing landfill site to the north of the access road to Matimba power station on ESKOM Land. A worst case scenario is considered, i.e. that the primary noise sources are positioned closest to the assessment point under consideration, that there is direct line of sight to such equipment, that there is a continuous cycle of noise from such equipment, and that the emitted noise is the maximum level measured over a representative period from that equipment.

Because of its mobile manner, 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 with the consequent varying of distance from noise-sensitive areas.
2. Much of the machinery itself is mobile in the short term, giving rise to 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 measurement positions depending on the progress of the excavation, unloading and filling processes.

4.2. Continuous Equivalent 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. 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 landfill site, but where an operation may nevertheless be audible to that person at some time.

4.3. Existing Ambient Noise Levels At The Site

The above ambient $L_{Aeq,I}$ and background noise measurements agree well with the values recommended as the highest acceptable for daytime in rural districts according to the relevant section (Table 2 above) of SANS 10103:2008 (see Ref. 1) as follows:

Type of District	Daytime
Rural	45

In view of the very consistent noise measurements obtained from the proposed site, these recommended values, 45 dB(A) during daytime (06:00 to 22:00), were used in the assessments which follow. It is not planned for the site to be operated during night-time hours (22:00 to 06:00).

4.4. Predicted Impact Of General Site Operation Noise

4.4.1. The Active Reception Pit

The two primary noise sources within the site are the delivery vehicles and the bulldozing of received and cover material. The measurements in section 3.6. above of a combination of both these sources working normally within the reception pit is the worst case. This gives a worst case noise level of 73 dB(A) at 60m. As all these activities are within the reception pit and therefore screened to varying degrees by the by the edges of the pit, a variable noise barrier effect will be provided by the reception pit edges. A conservative nominal allowance for this effect is taken as 7 dB. This is reinforced by the measurements at location 1, which provides a consistent value of 66 dB(A) for measured and predicted noise values 60m from the reception pit, giving a barrier effect of 7 dB.

The investigation shows that the proposed site 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 4.3. above, the daytime impact will be NONE beyond a distance of 700m from the active front and LOW at 400m from the active front. There are no dwellings indicated within this distance from the nearest property boundary at any of the three potential sites, the nearest dwelling being at 450m.

Exceedance dB	Noise Impact	Distance - day
0	None	700m
3	Very low	480m
3 ≤ 5	Low	400m
5 ≤ 7	Moderate	300m
7 ≤ 10	High	220m
10 ≤ 15	Very high	125m

Table 4: Distances from the active reception pit for a certain response intensity and noise impact for various increases over the ambient noise

4.4.2. Noise Generated by Road Transport

It is calculated from the planned delivery rate of 2000 tons/month (100 tons/day, calculated on a 288-day working year) that the transport requirement is maximum of 4 return journeys per day, or below 1 vehicle drive-by per hour. Along the gravel feeder road the very low current traffic volumes do not allow reliable calculation of an increase in the noise level generated by such a small number of vehicles per hour. For this reason alone, the effect of the noise of the addition of these vehicles to the road system area should be regarded as VERY LOW.

4.5. Conclusions

The measurements, predictions, and subsequent assessments contained in this report show that the noise impact on the environment of the project will in general vary from NONE at distances greater than 700m from the active areas during the daytime, even if the worst case scenario is experienced, rising to LOW at 400m from these active areas. There are no dwellings indicated within this distance from the nearest property boundary at any of the three potential sites, the nearest dwelling being at 450m.

The impact of the increase in noise caused by transportation by internal gravel road to the landfill site is classed as VERY LOW.

4.6. Noise Management and Mitigation Options

Site Location Preferences

There are three existing main noise sources in the area which provide background masking noise for the activities expected at the landfill site:

1. Matimba power station which is equally remote from all three sites, and therefore neutral from a noise influence viewpoint
2. The road to Grootgeluk mine, which has most positive influence for alternatives B & C, but still significant for alternative A
3. Activity at the coal stockpile, which has most positive masking influence for alternative A with the stockpile itself providing some noise attenuating barrier effects in addeition.

The placement of the landfill site at alternative A is preferred from the point of view of minimizing the influence of the noise it is likely to produce on the nearest residential areas.

Mitigation Measures:

1. Maintenance of equipment and operational procedures: Proper 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 material stockpiles should be placed so as to protect the boundaries from noise from individual operations and especially from internal roads, which for greatest effect should be placed directly behind them.
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: Should be carried out at regularly to detect deviations from predicted noise levels and enable corrective measures to be taken where warranted.

Noise management and mitigation options

Phase	**Impact: Noise**						
	Nature	**Extent**	**Duration**	**Intensity**	**Probability**	**Significance**	
						WM	**WOM**
Construction	Noise	Site local	Short term	Low Negative	Probable	None	Low
Operation	Noise	Site local	Long term	Low Negative	Probable	None	Low
Decommissioning	Noise	Site local	Short term	Low Negative	Possible	None	V 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 5. Summary of noise impacts at 300m during daytime

WM=With mitigation, WOM=Without mitigation

Source	**Remedial measures**
Mobile equipment noise	Select vehicle routes carefully by means of internalising the roads Fit efficient silencers and enclose engine compartments

Source	Remedial measures
	Damp mechanical vibrations Erect bank, screen or barrier along internal roads where feasible
Fixed plant noise	Reduce noise at source, damping acoustic treatment, etc. Isolate source by enclosure in acoustic building, room, etc. Carefully select fixed plant site for remoteness from sensitive areas Raise barriers or berms around noisy equipment

Table 6. Summary of major sources of noise associated with operations, and the possible remedial measures

5. REFERENCES

1. SOUTH AFRICAN NATIONAL STANDARD - Code of practice, SANS 10103:2008, *The measurement and rating of environ-mental noise with respect to land use, health, annoyance and to speech communication.*
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