Environmental Noise and Vibration Monitoring Report

Report Prepared for

Gulf Power Ltd.

NEMA Reference No. NEMA/PR/5/2/6972

Report No. 201004-EIA-004

July 2010

Prepared By: **SGS (SA)**
6 Sookhai Place, Derby Downs
Westville 3630

Your Health, Safety & Environment Partner

Environmental Noise and Vibration Monitoring Report

Prepared for

The Proposed Gulf Energy Thermal Power Plant

OS 2376

Date of survey: 23 February 2010 – 26 February 2010

ECOSERV (Pty) Ltd. is an
APPROVED INSPECTION AUTHORITY
in terms of the Occupational Health and Safety Act, 1993
Certificate number: CI056OH
Date: 1997-12-04

OS 2376

Attention: Mr.Sanjay Gandhi
SGS Kenya

RE: Environmental Noise and Vibration Report

Dear Sanjay,

Please find enclosed the report for baseline environmental noise and vibration prepared for Gulf Energy Power Plant, Athi River.

If you have any queries regarding the report, please do not hesitate to contact me.

Thank you for your support.

Yours faithfully,

_____
Bryan Taylor

EXECUTIVE SUMMARY

A new power generating plant is to be built on behalf of Gulf Energy at Athi River, Nairobi, Kenya. SGS were contracted to perform a baseline environmental noise and vibration survey as part of the environmental impact assessment of the project. The survey was performed from the 23 February 2010 to the 25 February.

There is limited development and in the area, however the proposed site is fronted by the A 109 roadway (which is the most significant source of noise in the vicinity of the proposed site) and is next to the Athi River Steel Mill Limited. The environment is however still very rural and as a result ambient noise levels away from the main road are relatively low. The proposed plant will have an affect the present ambient noise climate due to its noise emissions

The general procedure used to determine the noise impact was guided by the requirements of the South African National Standard: *Methods for Environmental Noise Impact Assessments with d*aytime (06:00 to 22:00) and night-time (22:00 to 06:00) noise measurements performed at each of the monitoring locations.

The findings of the noise survey are summarised as follows:

- The site of the proposed development is located in a predominantly rural environment. The proposed site is however fronted by the A 109 roadway and is bordered to the north-west by the Athi River Steel Mill Limited.
- The main source of noise in the area is from traffic on the A109, particularly heavy motor vehicles and trailers travelling on uneven road surfaces. The Athi River Steel Mill Limited is the main development in the immediate environment of the proposed development site. Noise emissions from the Mill appear to be only audible in relatively close proximity to the site.
- The closest sensitive receptor is the Green Park Village, a residential complex located approximately 800 m from the proposed site. As the area is largely flat, offering little topographical screening against noise, consideration should be given to natural screening between the proposed site and the residential complex.
- The World Bank Guideline of 55 dBA during the day was exceeded at 5 of the 16 sample points. The highest equivalent noise measurement of 66.7 dBA was recorded sample point MO15 (the approximate entrance to the proposed site). Exceedances at each of these locations were attributed to the proximity to the road and impacts from traffic, particularly heavy motor vehicles on uneven road surfaces.

- The World Bank Guideline of 45 dBA during the night-time was exceeded at 9 of the 16 sample points. The highest equivalent noise measurement of 64.2 dBA was similarly recorded at sample point MO15 (the approximate entrance to the proposed site). Relatively higher noise levels were attributed to the proximity of the proposed site to the road and impacts from traffic, particularly heavy motor vehicles on uneven road surfaces.

The findings of the vibration survey are summarised as follows:

- The objective of the vibration survey was to quantify the baseline against which the results of subsequent surveys can be compared.
- The *Threshold of Perception for Human Reaction* level of 0.3 mm/s was not exceeded at any of the measurement points.
- Based on the results of this survey it appears does not appear that there are any significant sources, other than heavy vehicle activity, of vibration on the immediate vicinity of the site.

REPORT DETAILS

REFERENCE:	OS 2376
REPORT TITLE:	Environmental Noise and Vibration Report
DATE OF SURVEY:	23 February 2010 to 25 February 2010
SITE DETAILS:	Gulf Power Plant Athi
CONTACT PERSON	Sanjay Gandhi
SURVEY CONDUCTED BY:	Bryan Taylor Signature
REPORT PREPARED BY:	Bryan Taylor **ECOSERV (Pty) Ltd** 6 Sookhai Place Derby Downs Westville, 3630 Tel: +27 (0)31 279 1452 E-mail: @sgs.com
CERTIFIED OCCUPATIONAL HYGIENIST (AIA):	Brett Williams Signed:
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LIST OF ABBREVIATIONS

AIA	Approved Inspection Authority
COP	Code of Practice
NIOSH	National Institute of Occupational Safety & Health (USA)
OHS Act	Occupational Health and Safety Act
PPE	Personal Protective Equipment
SANS	South African National Standards
dB (A)	Decibels (A) Weighted
HCP	Hearing Conservation Programme
HPD	Hearing Protection Device
$L_{Req,8h}$	Eight Hour Rating Level
$L_{Req,Ti}$	Equivalent Continuous Rating Level
NIHL	Noise Induced Hearing Loss
SLM	Sound Level Meter

1 ENVIRONMENTAL NOISE SURVEY

1.1 Introduction

A new power generating plant is to be built on behalf of Gulf Energy at Athi River, Nairobi, Kenya. SGS were contracted to perform a baseline environmental noise survey as part of the environmental impact assessment of the project. The survey was performed from the 23 February 2010 to the 25 February 2010.

The proposed site is fronted by the A 109 roadway and is next to the Athi River Steel Mill Limited. There is already a presence of development in the area, however, the environment is still very rural and as a result ambient noise levels are relatively low. There is a probability that the proposed plant could affect the present ambient noise climate due to its noise emissions.

The objective of this survey was to quantify the existing noise climate of the study area in order to establish a baseline against which the results of subsequent surveys can be compared. The general procedure used to determine the noise impact was guided by the requirements of the South African National Standard: *Methods for Environmental Noise Impact Assessments with d*aytime (06:00 to 22:00) and night-time (22:00 to 06:00) noise measurements performed at each of the monitoring locations.

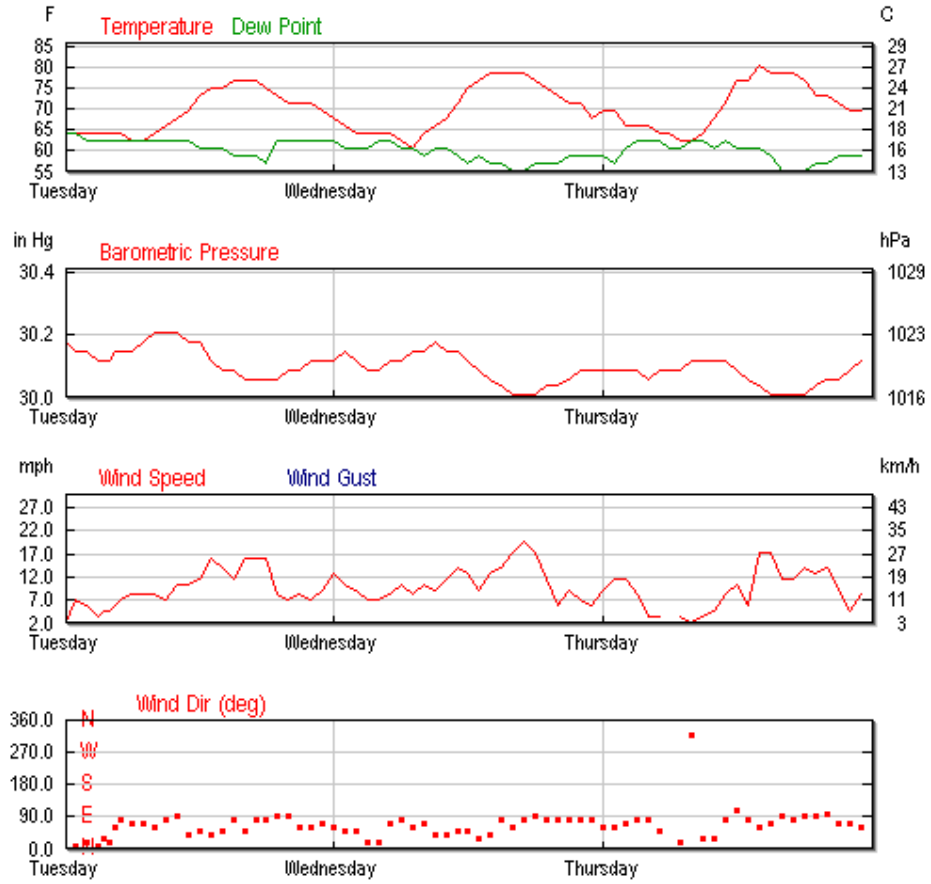
1.2 Scope of work

- To identify the existing noise sources in the environment of the proposed development.
- To identify the existing noise sensitive areas in the environment of the proposed development.
- To estimate the present ambient noise levels in the environment of the proposed development.

1.3 Environmental conditions during the survey period

Average weather conditions during the survey period are displayed in Table 1.3.1 overleaf.

Table 1.3.1: Average Weather Conditions, for Nairobi Airport 23 February 2010 to 25 February 2010



Note: Weather information for Nairobi International Airport was sourced from www.wunderground.com and is based on hourly measurements.

1.4 Measurement Sites

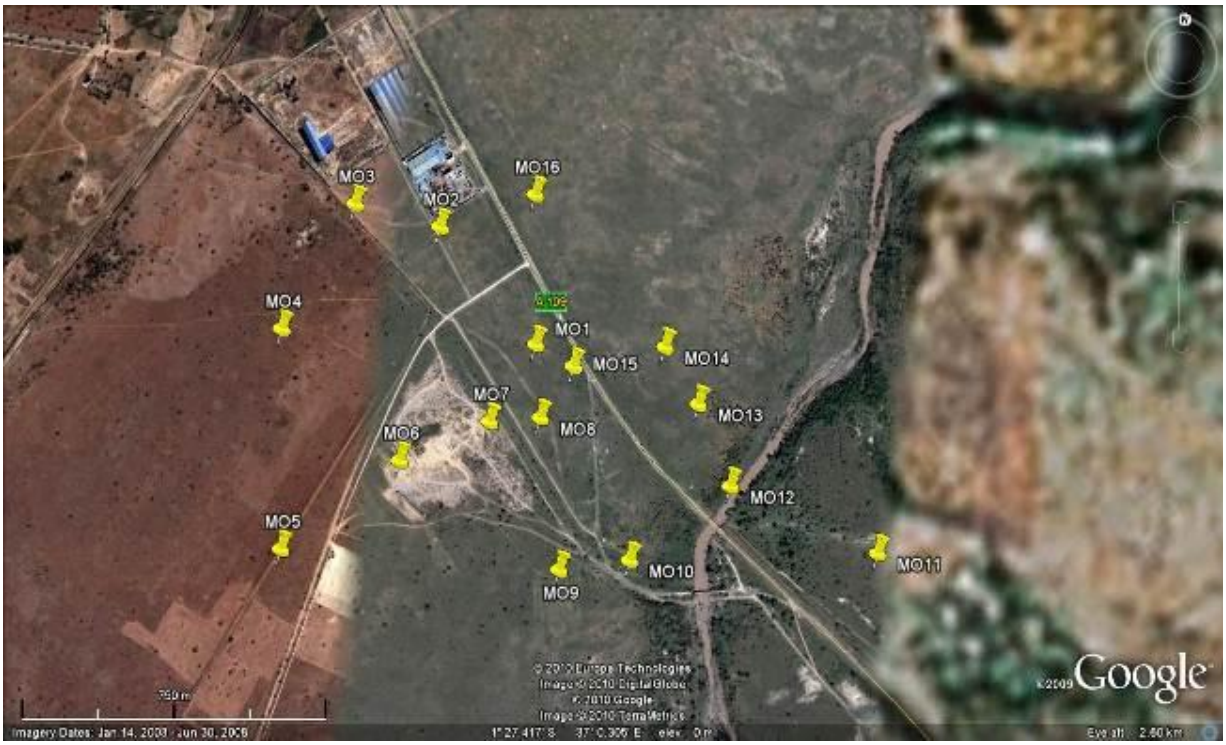
A description of each of the monitoring sites is displayed in Table 1.4.1 below.

Table 1.4.1: Measurement points for noise and

Site Number	GPS Co-ordinates	
MO1	S 01°27.375'	E 37°00.139' E
MO2	S 01°27'17.3"	E 37°00'03.2" E
MO3	S 01°27'16.4"'	E 37°59'56.3" E
MO4	S 01°27'26.0"'	E 36°59'51.5" E
MO5	S 01°27'41.8"'	E 36°59'53.2" E
MO6	S 01°27'34.4"'	E 37°00'01.9" E
MO7	S 01°27'30.8"'	E 37°00'8.7" E

MO8	S 01°27'30.1"'	E 37°00'12.7" E
MO9	S 01°27'40.8"'	E 37°00'15.4" E
MO10	S 01°27'39.5"'	E 37°00'20.9" E
MO11	S 01°27'36.8"'	E 37°00'40.5" E
MO12	S 01°27'33.3"'	E 37°00'28.3" E
MO13	S 01°27'27.7"'	E 37°00'25.1" E
MO14	S 01°27'23.9"'	E 37°00'22.1" E
MO15	S 01°27'26.1"'	E 37°00'14.9" E
MO16	S 01°27'14.4"'	E 37°00'10.5" E

Figure 1.4.2: Measurement points for noise and vibration



Photos displaying measurement sites are shown in Figure 1.4.3 overleaf.

Figure 1.4.3: Showing from clockwise, the sample point bordering the Athi River, the Athi River Steel Mill, the Quarry measurement point, the flat topography of the area offering little natural attenuation of noise, the Greenpark Residential development and the proximity of the site to the main road which is the highest source of noise in the area.

1.5 Environmental Noise Statutory Requirements

Kenya in general, applies the World Health Organisation (WHO) and World Bank (WB) environmental standards. The South African National Standards (SANS) codes of practice and procedures have been developed based on the requirements of the International Standards Organization (ISO). As the South African documents are more detailed and more prescriptive than the generic guidelines, it is recommended that the South African as well as the international standards be applied for this project. Monitoring was performed during the daytime (06:00 to 22:00) and night-time (22:00 to 06:00).

These guidelines imply that in order to ascertain an acceptable living environment, ambient noise in a given type of environment should not exceed a specified absolute level. This is the approach provided by the WHO and WB which specify a limit of 55 dBA during the day and 45 dBA during the night for residential purposes, determined over any hour.

Table 1.5.1: World Health Organisation (WHO) Guidelines for Ambient Sound Levels

Environment	Ambient Sound Level (dBA)			
	Daytime (06:00 to 22:00)		Night-time (22:00 to 06:00)	
	Indoor Space	Outdoor Space	Indoor Space	Outdoor Space
Dwellings	50	55		
Bedrooms			30	45
Schools	35	55		
Hospitals (general)	35		35	45

Table 1.5.2: World Bank (WB) Guidelines for Ambient Sound Levels

Receptor	Maximum Allowable Ambient Noise Levels (1-hour L_{eq} (dBA)	
	Daytime (07:00 to 22:00)	Night-time (22:00 to 07:00)
Residential, Institutional, educational	55	45
Industrial, commercial	70	70

1.6 Community Response to Noise

Communities generally respond to change in the ambient noise levels in their environment. The guidelines set out in SANS 10103:2008 stipulate the probable environmental response related to the degree of difference in levels between the ambient (intrusive) noise and the residual noise. The suggested severity criteria for the noise impacts are summarised in Table 1.4.1 below.

Table 1.6.1: Categories of environmental/group response (SANS COP 10103:2004)

EXCESS Lr dB (A)	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

Changes in noise levels are perceived as follows:

- 3 dBA: For a person with average hearing ability, an increase in the general ambient noise level of 3 dBA will just be detectable
- 5 dBA: For a person with average hearing ability, an increase in the general ambient noise level of 5 dBA will be significant, that is he or she will be able to identify the source of the intruding noise. According to SANS 10103 the community response for an increase of less than 5 dBA will be “little” with “sporadic complaints”. For an increase of 5 dBA or more the response changes to “medium” with “widespread complaints”.

- 10 dBA: A person with average hearing will subjectively judge an increase of 10 dBA as a doubling in the loudness of the noise. According to SANS 10103, the estimated community reaction will change from “medium” to “strong” with “threats of community action”.

1.7 Methodology and Instrumentation

Noise levels were determined using a Larson Davis Integrating Sound Level Meter with built-in ⅓-octave / octave filters and ½” microphone, serial number 814A0232 and 101940. The sound level meter was calibrated at an accredited laboratory, M and N Acoustic Services on 06 October 2009, certificate number 2009-1314. Copies of the calibration certificates are contained in the appendices.

For all measurements taken to establish the ambient noise levels, the equivalent noise level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) during that measurement period were recorded. For each of the measuring points, the L_{A10} and L_{A90} were also noted. Measurement periods of five minutes were used. For all measurements, a windshield cover was placed on the microphone of the sound level meter. At the same time as each individual measurement was being taken, the nature of the noise climate in the area was assessed and recorded. This comprised an auditory observation by the surveyor, as well as identifying those noise incidents which influenced the sound level meter readings during that measurement period.

1.8 Environmental Noise Results

The results of the measurement programme are shown in Table 1.8.1.1. The results have been shown in relation to the World Bank Guidelines.

Table 1.8.1: Results of noise measurements performed on the 23 February 2010

Measurement Site	Measured Sound Pressure Level (Noise) (dBA)						World Bank Guideline		Site Notes
	Daytime Period			Night-time Period			Daytime	Night-time Period	
	L_{Aeq}	L_{max}	L_{min}	L_{Aeq}	L_{max}	L_{min}	L_{Aeq}	L_{Aeq}	
MO1	53.4	64.0	42.2	52.4	66.0	40.2	55	45	Measurement taken midway between Athi River Steel Mill and proposed site. Noise emissions from the Mill not audible. Background noise from traffic on main road
MO2	51.5	68.2	44.0	48.6	61.5	41.2	55	45	Measurement taken approximately 30 m from the Athi River Steel Mill. Noise emissions from the Mill audible. Background noise from traffic on main road
MO3	51.9	65.0	47.2	47.0	67.2	40.6	55	45	Measurement taken approximately 30 m downwind from the Athi River Steel Mill. Noise emissions from the Mill audible, includes tapping and hammering.
MO4	44.0	62.0	39.5	45.2	66.0	38.2	55	45	Measurement taken between proposed site and the industrial area to the west of the proposed site. Low noise emissions from the Mill audible, includes tapping and hammering.
MO5	42.8	62.0	37.1	42.1	60.6	34.3	55	45	Measurement taken to the SW of the proposed site. Very low noise emissions from the Mill audible, includes tapping and hammering.
MO6	44.5	70.2	35.9	40.4	63.6	31.3	55	45	Measurement taken to the SW of the proposed site in the area of a disused quarry. Background noise from traffic on main road.
MO7	52.4	72.4	44.4	46.1	64.5	35.2	55	45	Measurement taken to the SW of the proposed site, closer to the main road and close to boundary of proposed site. Noise from traffic on main road.
MO8	55.3	71.8	45.9	46.9	66.1	36.0	55	45	Measurement taken as close to the middle of the proposed site as possible. Noise from traffic on main road, particularly trailers on uneven road surfaces.

MO9	51.6	63.0	43.1	42.9	62.7	30.6	55	45	Measurement taken towards the SE boundary of the proposed site. Noise from traffic on main road, particularly trailers on uneven road surfaces.
MO10	55.3	69.0	46.4	51.1	67.1	37.5	55	45	Measurement taken adjacent the Athi River to the S of the proposed site. Noise from traffic on main road, particularly trailers on uneven road surfaces.
MO11	43.9	55.0	38.2	43.5	61.8	28.4	55	45	Measurement taken in the Greenpark Village to the E of the proposed site. Construction activity and noise from traffic on main road, particularly trailers on uneven road surfaces.
MO12	58.9	72.4	40.5	51.0	67.9	34.7	55	45	Measurement taken between the Greenpark Village and the proposed site. Construction activity and noise from traffic on main road, particularly trailers on uneven road surfaces
MO13	49.2	65.9	41.6	46.0	67.0	33.1	55	45	Measurement taken to the NE of the proposed site, directly across the main road. Noise from traffic on main road, particularly trailers on uneven road surfaces
MO14	48.6	61.7	38.9	43.3	63.2	32.6	55	45	Measurement taken to the NE of the proposed site, directly across the main road. Noise from traffic on main road, particularly trailers on uneven road surfaces
MO15	66.7	81.2	51.8	64.2	76.5	40.0	55	45	Measurements taken adjacent the main road at the approximate entrance to the site. Significant impact from motor vehicle traffic, especially trailers on uneven road. Expect high
MO16	58.0	69.7	40.5	55.9	67.7	39.7	55	45	Measurement taken to the NE of the proposed site, directly across the main road. Noise from traffic on main road, particularly trailers on uneven road surfaces

Figure 1.8.2: Graph showing the LAeq, Lmax and Lmin measured at each of the sample points during the daytime shown in relation to the World Bank daytime LAeq guideline of 55 dBA

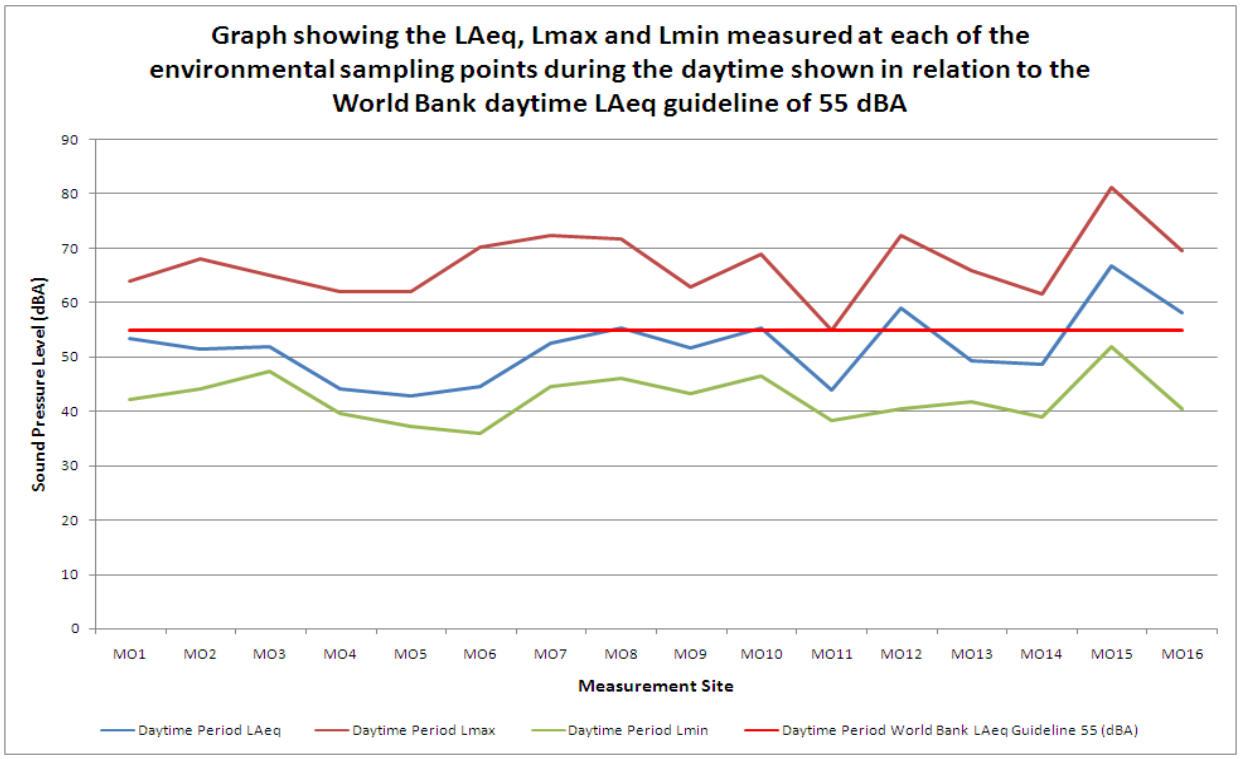


Figure 1.8.3: Graph showing the LAeq, Lmax and Lmin measured at each of the sample points during the night-time shown in relation to the World Bank night-time LAeq guideline of 45 dBA

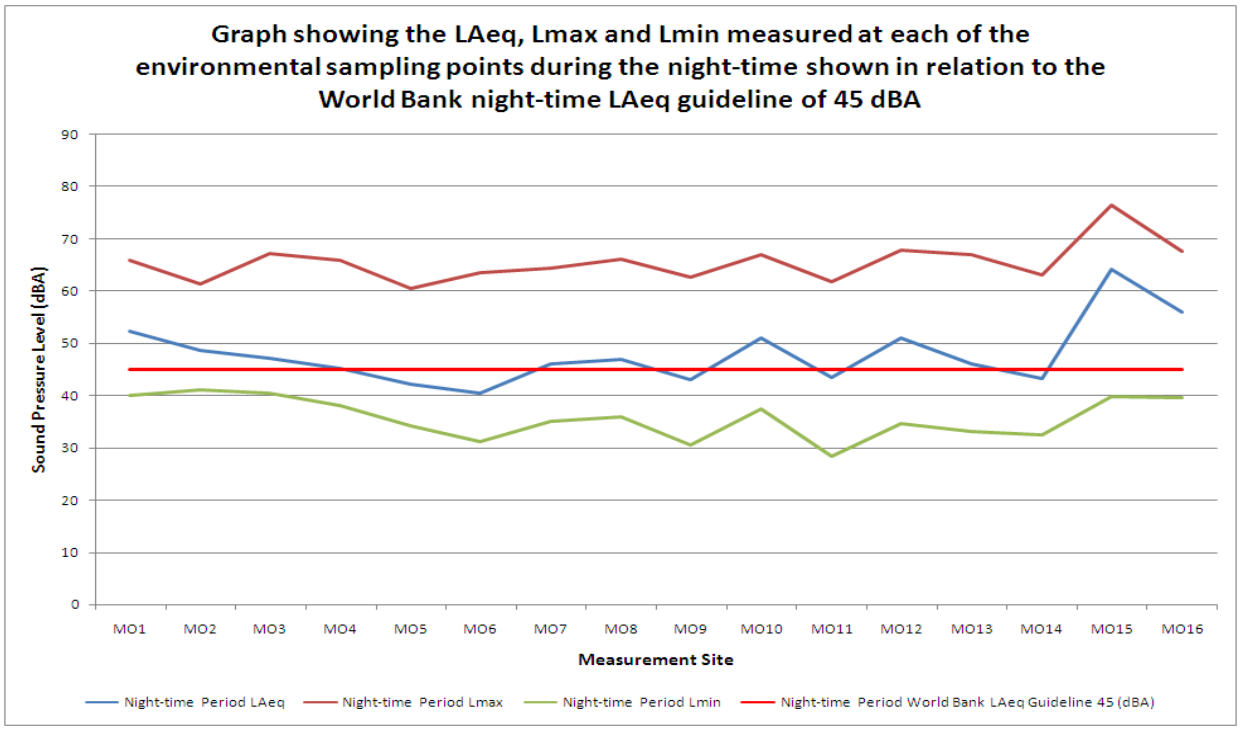


Figure 1.8.4: Graph showing L_{10} and L_{90} measured during the daytime at the environmental sampling points

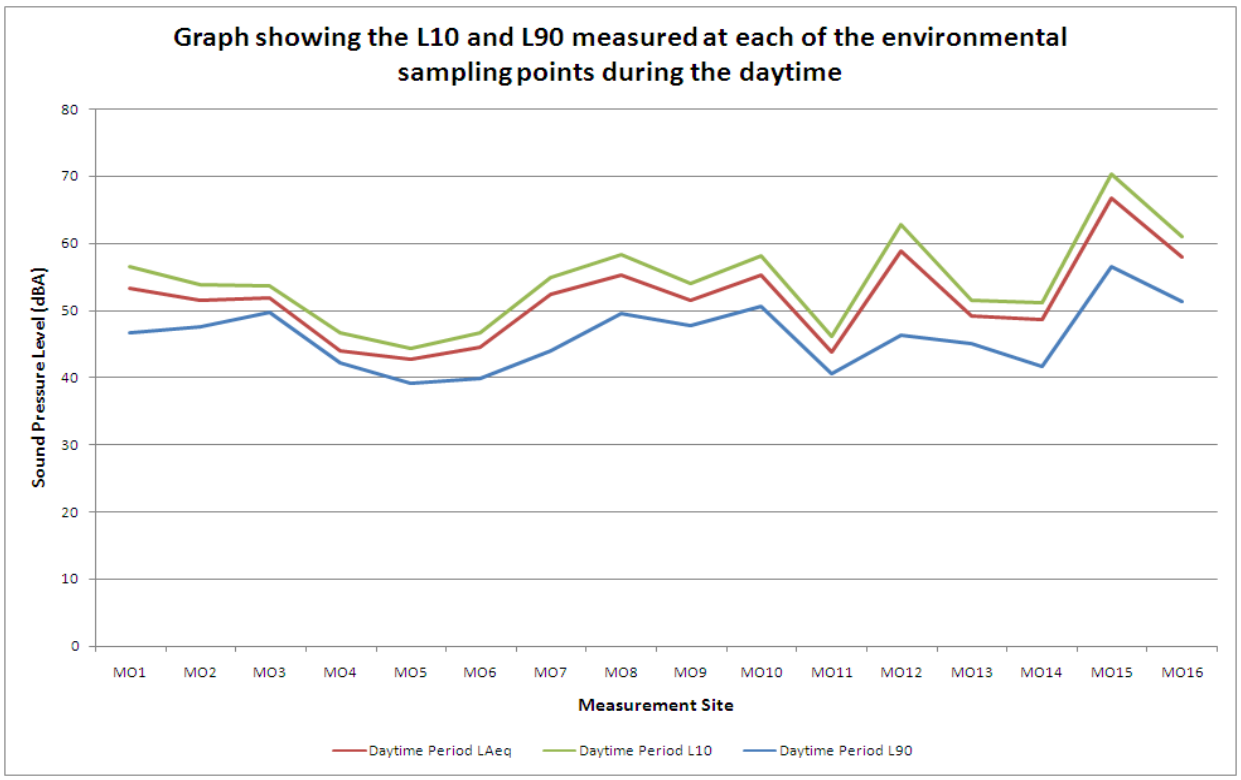
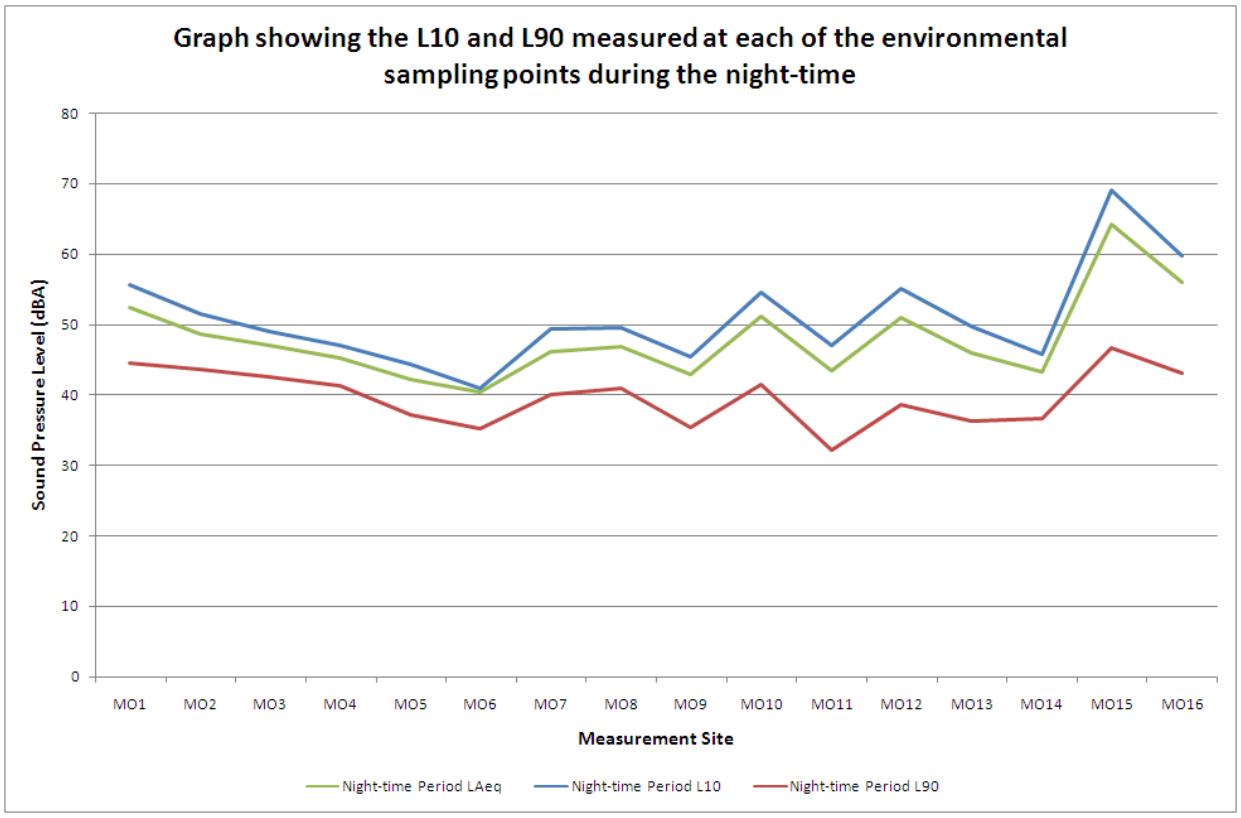


Figure 1.8.5: Graph showing L_{10} and L_{90} measured during the night-time at the environmental sampling points



1.9 Discussion of Noise Monitoring Results

1.9.1 Baseline Noise

The objective of this survey was to quantify the existing noise climate of the study area in order to establish a baseline against which the results of subsequent surveys can be compared. The general procedure used to determine the noise impact was guided by the requirements of the South African National Standard: *Methods for Environmental Noise Impact Assessments with d*aytime (06:00 to 22:00) and night-time (22:00 to 06:00) noise measurements performed at each of the monitoring locations.

The findings of the noise survey are summarised as follows:

- The site of the proposed development is located in a predominantly rural environment. The proposed site is however fronted by the A 109 roadway and is bordered to the north-west by the Athi River Steel Mill Limited.
- The main source of noise in the area is from traffic on the A109, particularly heavy motor vehicles and trailers travelling on uneven road surfaces. The Athi River Steel Mill Limited is the main development in the immediate environment of the proposed development site. Noise emissions from the Mill appear to be only audible in relatively close proximity to the site.
- The closest sensitive receptor is the Green Park Village, a residential complex located approximately 800 m from the proposed site. As the area is largely flat, offering little topographical screening against noise, consideration should be given to natural screening between the proposed site and the residential complex.
- The World Bank Guideline of 55 dBA during the day was exceeded at 5 of the 16 sample points. The highest equivalent noise measurement of 66.7 dBA was recorded sample point MO15 (the approximate entrance to the proposed site). Exceedances at each of these locations were attributed to the proximity to the road and impacts from traffic, particularly heavy motor vehicles on uneven road surfaces.
- The World Bank Guideline of 45 dBA during the night-time was exceeded at 9 of the 16 sample points. The highest equivalent noise measurement of 64.2 dBA was similarly recorded at sample point MO15 (the approximate entrance to the proposed site). Relatively higher noise levels were attributed to the proximity of the proposed site to the road and impacts from traffic, particularly heavy motor vehicles on uneven road surfaces.

2 ENVIRONMENTAL VIBRATION SURVEY

2.1 Effect of Vibration

Vibration can cause varying degrees of damage in buildings and affect vibration-sensitive machinery or equipment. Its effect on people may be to cause disturbance, annoyance or at higher levels, affect a person's ability to work. The effect of vibration on people is highly subjective, as one person may tolerate high levels that would be unacceptable to someone else. Levels will have to take account of local conditions and the nature of the workings.

To put vibration levels in context, below is a list of common tasks and the level of vibration they produce:

Table 2.1.1: Levels of vibration associated with common tasks

Activity	Vibration (mm/s – Peak Particle Velocity(PPV)
Jumping	Up to 250
Hammering nail	Up to 100
Sliding door	Up to 10
Shutting door	Up to 30

These vibration levels should be interpreted in conjunction with Table 2.1.2 below.

Table 2.1.2: Vibration Levels and Intensity

Peak Particle Velocity (mm/s)	Human Reaction	Effect on Buildings
0.15 to 0.3	Threshold of perception	Vibrations unlikely to cause damage
2	Vibrations readily perceptible	Recommended upper level of vibration to which ruins and ancient monuments should be subjected
2.5	Level at which continuous vibrations begin to annoy people	Virtually no risk of damage to normal buildings
5	Vibration annoying to people in the buildings	Threshold at which there is a risk of damage to normal dwellings (houses with plastered walls and ceilings)
10 to 15	Vibrations considered unpleasant by people subjected to continuous vibration	Vibrations at a greater level than normally expected from traffic, but would cause damage and possible minor structural damage
Source: A survey of Traffic-Induced Vibrations by Whiffen, A.C. England, 1971		

Typical levels measured during construction activities are shown below.

Table 2.1.3: Typical vibration levels measured during construction activities

Construction Activity	Typical Ground Vibration Level
Vibratory roller	Up to 1.5mms @ 25m
Hydraulic rock breakers	4.5 mm/s @ 5m, 0.4 @ 20m, 0.1 @ 50m
Compactor	20mm/s @ 5m, <0.3mm/s @30m
Pile driving	1-3mm/s @ 50m depending on soil conditions and piling technique
Bulldozer	1-2mm/s @ 5m, 0.1 @ 50m
Truck traffic (smooth surface)	<0.2mm/s @ 20m

2.2 Community Response to Vibration

Human response to ground vibration is complex and is dependent upon a range of factors of which the actual vibration magnitude is only one and not necessarily the most important. It is well recognised that the human body is very sensitive to the onset of vibration albeit very poor at distinguishing relative magnitudes. Although sensitivity to vibration varies significantly between individuals, a person will generally become aware of vibration at levels of around 0.5 mms-1 mms peak particle velocity, however individuals are very poor at distinguishing between vibrations of differing magnitudes. This threshold of perception of vibration is very much lower than the onset of even cosmetic damage (plaster cracking at typically least <12mm/s). Once a received vibration is greater than an individual's perception threshold then it is possible for concern to be expressed about the blasting or construction activity involved. Such concern normally relates to the vibration's potential for causing damage to the complainant's property. Concern may be expressed that damage has already occurred due to the recent discovery of cracking that may have been present for some time or have been caused by natural processes. More often, however, concerns are based on the fear that damage will be caused at some time in the future as a result of repeated vibration. It is usually the case that adverse comments are less likely once a neighbour has become accustomed to the perceived effects of blasting. Good communication is one of the best ways to help minimise vibration complaints around a construction site. Keeping neighbours informed of the nature of the work and progress is the best way to help alleviate unnecessary concern

2.3 Methodology and Instrumentation

In order to completely define ground vibration, the amplitude and frequency of the motion are measured in the three orthogonal directions, generally in terms of velocity which is considered to be the best descriptor for assessing human comfort and the potential damage response of structures. The vibration velocity signals are summed (in real time) and the maximum amplitude of this vector sum is defined as the Peak Vector Sum (PVS). The parameter normally used to assess the ground vibration is the peak particle velocity (ppv) expressed in millimetres per second (mm/s).The measurement of vibration was undertaken using an *Instantel Minimate Plus* vibration monitor, serial number BE 12090, capable of recording both ground and airborne vibration. Ground vibration is recorded in terms of peak particle velocity in millimetres per second in 3 mutually perpendicular directions (T, V & L). Airborne vibration is measured in terms of decibels (dB). The unit was calibrated on the 03 March 2009, file number BE 12090-032009.

2.4 Environmental Vibration Results

Table 2.4.1 overleaf shows the results of environmental vibration monitoring performed at Vale. The results have been shown in relation to the values measured during the EIA and the Human Threshold of Perception as identified by Whiffen (1971).

Table 2.4.1: Environmental vibration results

Measurement Site	Peak Vector Sum (mm/s)	Human Reaction-Threshold of
MO1	0.105	0.3
MO2	0.154	0.3
MO3	0.093	0.3
MO4	0.094	0.3
MO5	0.300	0.3
MO6	0.217	0.3
MO7	0.081	0.3
MO8	0.081	0.3
MO9	0.143	0.3
MO10	0.174	0.3
MO11	0.102	0.3
MO12	0.180	0.3
MO13	0.133	0.3
MO14	0.087	0.3
MO15	0.236	0.3
MO16	0.137	0.3

2.5 Discussion of Vibration Monitoring Results

The findings of the vibration survey are summarised as follows:

- The objective of the vibration survey was to quantify the baseline against which the results of subsequent surveys can be compared.
- The *Threshold of Perception for Human Reaction* level of 0.3 mm/s was not exceeded at any of the measurement points.
- Based on the results of this survey it appears does not appear that there are any significant sources, other than heavy vehicle activity, of vibration on the immediate vicinity of the site.

2.6 References

1 (OHS Act) Occupational Health & Safety Act (85 of 1993).

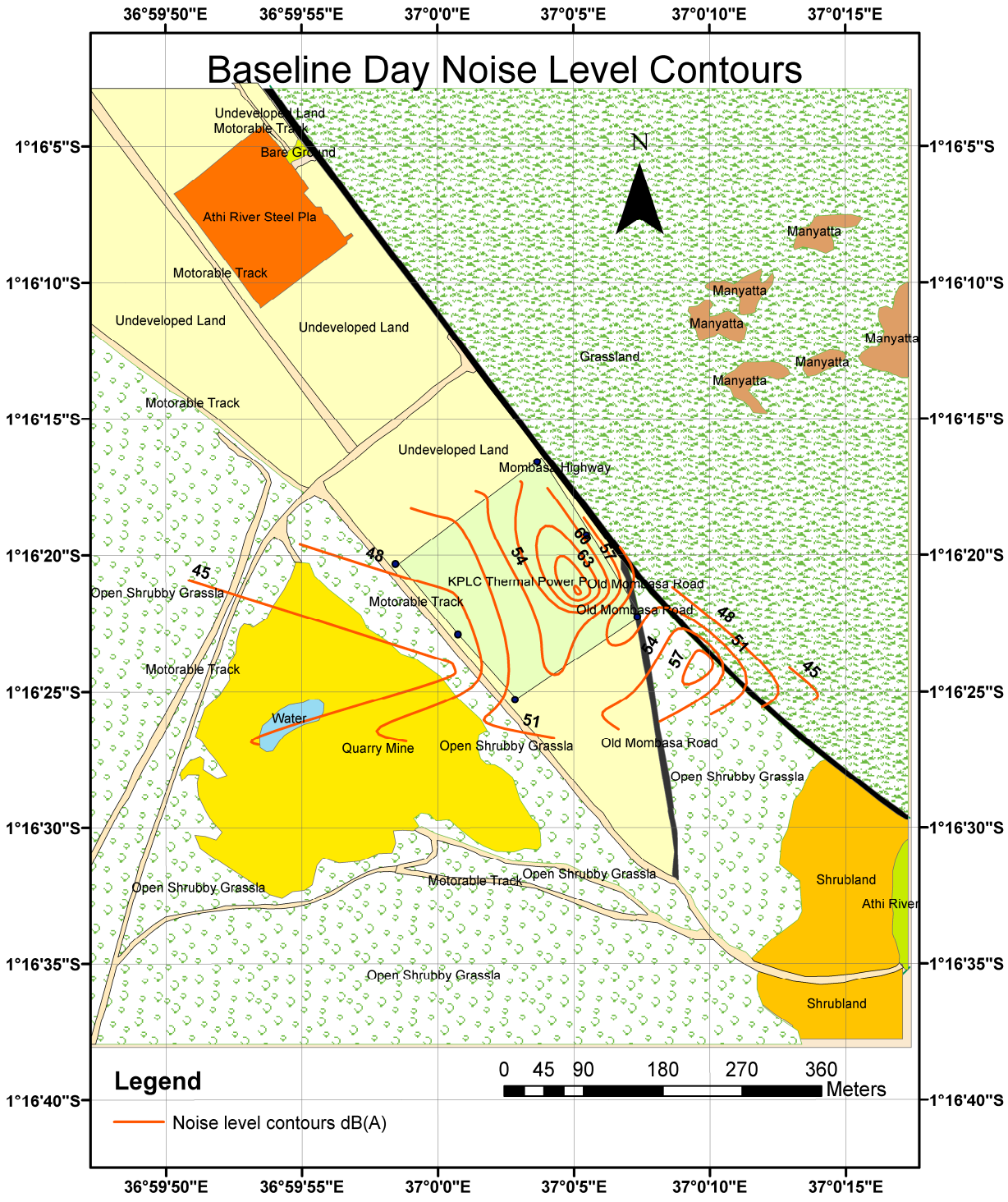
2 Noise Induced Hearing Loss Regulations, 7 March 2003, framed under the OHS Act.

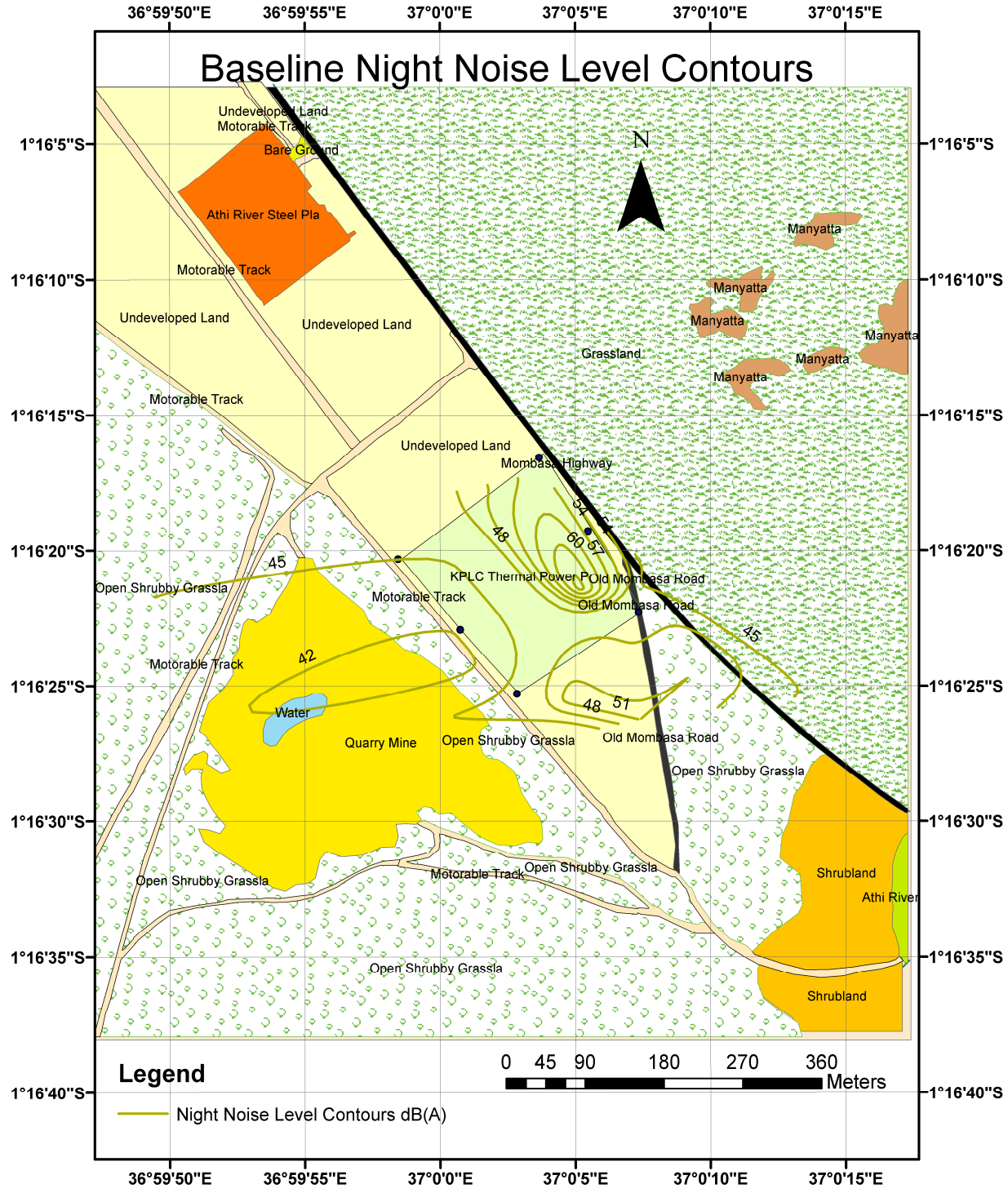
3 (SANS) South African National Standards 10083 – 2004. Fourth Revision, 'The Measurement and Assessment of Occupational Noise for Hearing Conservation Purposes', South African National Standards.

4 Environmental Regulations for Workplaces, Framed Under of Occupational Health and Safety Act (Act 85 of 1993)

APPENDIX

1


Baseline Day Noise Level Contours
36°59'50"E
36°59'55"E
37°0'0"E
37°0'5"E
37°0'10"E
37°0'15"E
1°16'5"S
1°16'10"S
1°16'15"S
1°16'20"S
1°16'25"S
1°16'30"S
1°16'35"S
1°16'40"S
N
Undeveloped Land
Motorable Track
Bare Ground
Athi River Steel Pla
Motorable Track
Undeveloped Land
Undeveloped Land
Grassland
Manyatta
Manyatta
Manyatta
Manyatta
Manyatta
Manyatta
Motorable Track
Undeveloped Land
Mombasa Highway
KPLC Thermal Power P
Old Mombasa Road
Old Mombasa Road
Motorable Track
Motorable Track
Open Shrubby Grassla
Water
Quarry Mine
Open Shrubby Grassla
Old Mombasa Road
Open Shrubby Grassla
Open Shrubby Grassla
Motorable Track
Open Shrubby Grassla
Open Shrubby Grassla
Shrubland
Athi River
Shrubland
45
48
54
60
63
57
48
51
54
57
45
51
Legend
Noise level contours dB(A)
0 45 90 180 270 360
Meters


Baseline Night Noise Level Contours
36°59'50"E
36°59'55"E
37°0'0"E
37°0'5"E
37°0'10"E
37°0'15"E
1°16'5"S
1°16'10"S
1°16'15"S
1°16'20"S
1°16'25"S
1°16'30"S
1°16'35"S
1°16'40"S
N
Undeveloped Land
Motorable Track
Bare Ground
Athi River Steel Pla
Motorable Track
Undeveloped Land
Undeveloped Land
Motorable Track
Undeveloped Land
Mombasa Highway
Grassland
Manyatta
Manyatta
Manyatta
Manyatta
Manyatta
Manyatta
45
48
60
57
54
KPLC Thermal Power P
Old Mombasa Road
Old Mombasa Road
Open Shrubby Grassla
Motorable Track
45
42
Motorable Track
Water
Quarry Mine
Open Shrubby Grassla
48
51
Old Mombasa Road
Open Shrubby Grassla
Open Shrubby Grassla
Motorable Track
Open Shrubby Grassla
Shrubland
Athi River
Open Shrubby Grassla
Shrubland
Legend
Night Noise Level Contours dB(A)
0 45 90 180 270 360
Meters

APPENDIX 1

Environmental Vibration Event Report

APPENDIX 2

Instrument Calibration Certificates