NOISE IMPACT ASSESSMENT OF THE ALTERNATIVE SITES FOR THE PROPOSED CCGT POWER STATION AT MAJUBA

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1. INTRODUCTION

1.1. General

Eskom is planning the construction of a 2 100MW Combined Cycle Gas Turbine (CCGT) Power Station in the Amersfoort area in Mpumalanga Province. Bohlweki Environmental (Pty) Ltd is undertaking the environmental impact assessment (EIA). As part of the EIA, a noise impact assessment has been undertaken by Jongens Keet Associates (JKA). The study was undertaken by Mr Derek Cosijn and assisted by Dr Erica Cosijn. This report documents the findings of the Scoping Phase of the investigation.

1.2. Location and Extent of the Study Area and Development Sites

The Study Area lies in the area of the existing Majuba Power Station, namely Amersfoort Area in Mpumalanga. The Study Area extends from Amersfoort in the north (line of latitude 27º00'00") to line of latitude 27º14'00" in the south (15km south of Majuba Power Station); and from lines of longitude 29º40'00" (10km west of Majuba Power Station) in the west and 29º57'00" (8km east of National Road N11) in the east.

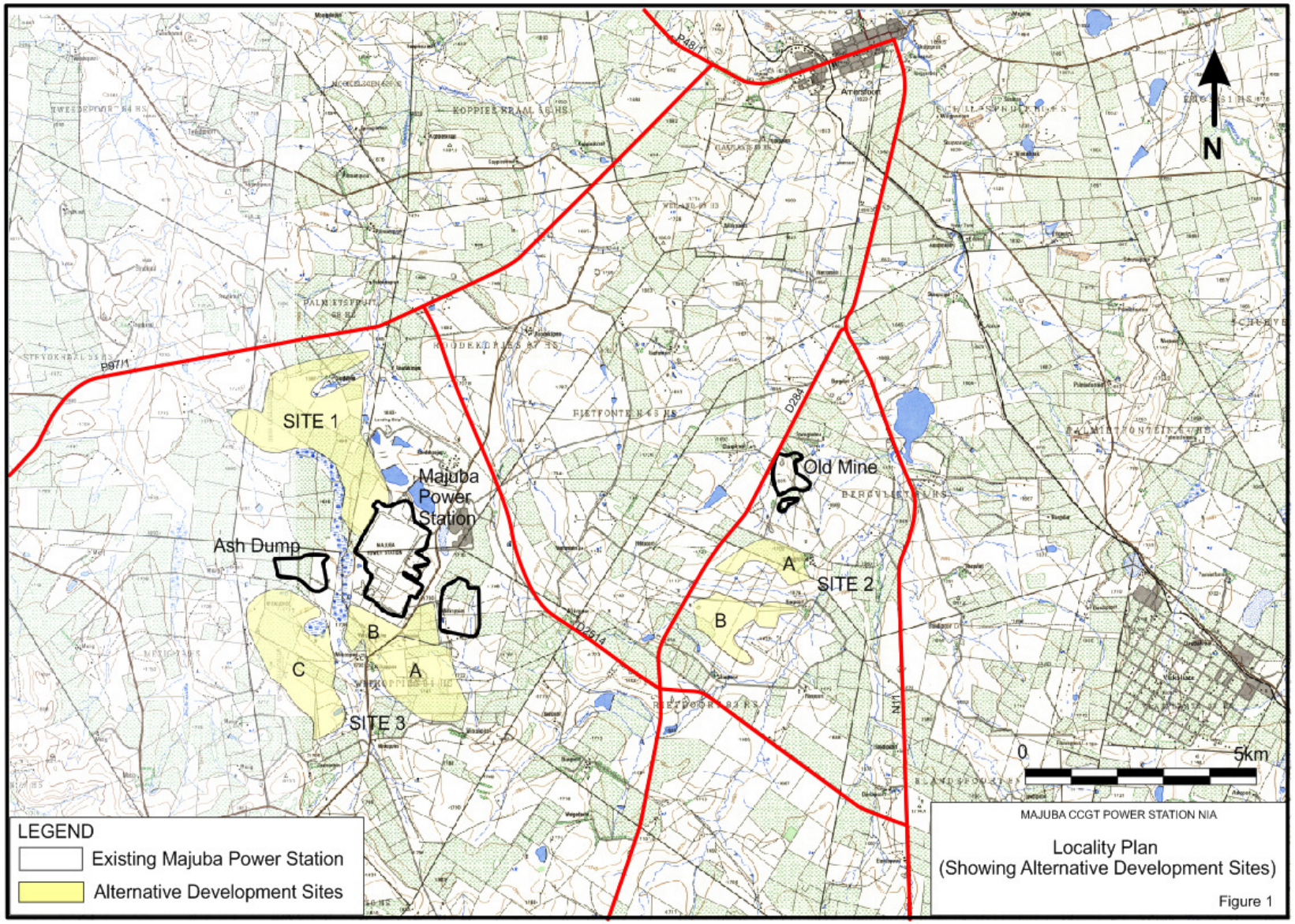
Three main candidate development sites (areas) are being evaluated for the CCGT Power Station. Two of these are divided into subareas for investigation. Refer to Figure 1. The likely position for the Power Station at these sites (the Power Station "footprint") has still to be determined. The areas are:

i) Site 1 (Portions 1, 3 and 7 of the farm Palmietspruit 68 HS; Portion 6 of the farm Strydkraal 53 HS; Portion 1 of the farm Roodekopjes 67 HS)

ii) Site 2
   - Site 2a (Portion 7 of the farm Bergvliet 65 HS; Portion 4 of the farm Rietpoort 83 HS; and Werda 116 HS)
   - Site 2b (Portions 3 and 4 of the farm Rietpoort 83 HS and Werda 116 HS)

iii) Site 3
   - Site 3a (Portions 1, 2, 6, 10 and 11 of the farm Witkoppies 81 HS)
   - Site 3b (Portions 1, 5 and 6 of the farm Witkoppies 81 HS)
   - Site 3c (Portions 4, 5, 8, 9, 12, 13 and 14 of the farm Witkoppies HS).

The core study area at each of the three development sites will be that within the area of influence of the noise generated by the operations at and the traffic generated by the respective CCGT Power Station and appurtenant works.


P48/1
P97/1
D284
D2514
N11
SITE 1
Majuba
Power
Station
Ash Dump
Old Mine
SITE 2
SITE 3
A
B
C
A
B
N
0
5km
LEGEND
Existing Majuba Power Station
Alternative Development Sites
MAJUBA CCGT POWER STATION NIA
Locality Plan
(Showing Alternative Development Sites)
Figure 1

1.3. Details of the Planned CCGT Power Station

The planned CCGT Power Station will have an electricity generating capacity of 2 100MW. The key components that will make up the CCGT Power Station are as follows:

i) The CCGT power plant (comprising 6 units of approximately 350 MW each).
ii) a compressor plant.
iii) a gas cleaning plant.
iv) Ignition gas for unit start-up (using commercial propane).
v) Weather and communication mast of up to 60 meters in height.
vi) high voltage yard.
vii) a gas pipeline from the UCG plant to the CCGT.
viii) a water pipeline from the Rietpoort Balancing Dam.
ix) a water treatment plant as well as ancillary works such as access roads, borrow pits and other associated infrastructure.
x) Sewage treatment plant.
xi) Borrow pits (limited to 1.5 ha each).

The extent of the CCGT Power Station property could be of the order of 1000m x 1000m although a smaller area is possible.

2. SCOPE AND LIMITATIONS

The following components are not part of this investigation:

i) the water pipeline from the Rietpoort Balancing Dam
ii) the underground coal gasification (UCG) plant
iii) the gas pipeline from the UCG plant to the CCGT
iv) the borrow pits

The optimum position of the CCGT Power Station on the six alternative sites has not been specified for this study. There are also a number of possible development positions for the CCGT Power Station on some of the sites. The best development position will be determined once the best site has been selected during the Scoping Phase, and will only be evaluated during the EIA Phase. Thus it was not possible at this stage to calculate and assess the specific detailed noise impacts at each noise sensitive site related to a specific development site.

Although much of the technical details of the planned CCGT Power Station are already determined, the specific noise characteristics of plant and equipment to be installed are not. There is also no operational CCGT Power Stations anywhere else in South Africa where

noise profiles can be verified. Conservative predictions based on equipment baseline noise levels of similar plant to that which will be installed have therefore been made.

3. METHODOLOGY

The general procedure used to determine the noise impact was guided by the requirements of the Code of Practice SANS 10328:2003: *Methods for Environmental Noise Impact Assessments.* The level of investigation was the equivalent of a Scoping. A comprehensive assessment of all noise impact descriptors (standards) has been undertaken. The noise impact criteria used specifically take into account those as specified in the South African National Standard SANS 10103:2003, *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and Speech Communication* as well as those in the National Noise Control Regulations. The investigation comprised the following:

i) Determination of the existing situation (prior to the planned Development).
ii) Determination of the situation during construction and after commissioning.
iii) Assessment of the change in noise climate and impact.
iv) Comparison of alternative development sites.
v) Identification of mitigating measures.

3.1. Determination of the Existing Conditions

This phase comprised the following:

i) The relevant technical details of the planned CCGT Power Station, the existing traffic patterns and the existing and planned land use in the study area were reviewed in order to establish a comprehensive understanding of all aspects of the project that will influence the future noise climate in the respective study areas.
ii) Using these data, the limits of the study area for each alternative development site were determined and the potential noise sensitive areas, other major noise sources and potential problems in these areas were identified.
iii) Applicable noise standards were established. The National Noise Control Regulations, and the SANS 10103:2003 standards were applied.
iv) The existing *noise climates* of the six study areas were determined by means of a field inspection and a noise measurement survey. The measurement survey appropriately covered the whole extent of the six study areas, focussing specifically on the identified noise sensitive/problem areas. The sound pressure level (SPL) (noise) measurements were taken in accordance with the requirements of the Code of Practice SANS 10103:2003, *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and to Speech Communication*. Type 1 Integrating

Sound Level meters were used for the noise measurements. All measurements were taken under dry weather and normal traffic (that is mid-week/school term) conditions.

v) On the general field inspection and at the same time as each individual measurement was being taken, the qualitative nature of the *noise climate* in the area of the measurement site was assessed and recorded. This comprised an appraisal of the general prevailing acoustic conditions based on the subjective response to the sounds as perceived by the listener (i.e. *auditory observation* by the surveyor), as well as identifying those noise incidents, which influenced the noise meter readings during that measurement period. This procedure is essential in order to ensure that that there is a *human* correlation between the noise as perceived by the human ear and that, which is measured by the meter, as well as to establish any anomalies in the general ambient noise conditions.

vi) The existing noise climates along the main roads as related to the current traffic volumes and patterns were established. These traffic noise levels were calculated using the South African National Standard SANS 10210 (SABS 0210) *Calculating and Predicting Road Traffic Noise*. The latest traffic was used as the baseline reference. The calculated 24-hour period noise indicators, as well as those for the daytime period and night-time period provided the main data for the impact assessment. The measured data provided a field check of the acoustic conditions.

3.2. Assessment of Planning/Design Phase and Construction Phase Impacts

Aspects of the pre-design field surveys and construction activities that potentially will have a noise impact were identified and, where appropriate, mitigating measures have been recommended.

3.3 Assessment of Operational Phase Impacts

The main focus of the operational phase assessment was to establish the nature, magnitude and extent of the potential change in *noise climate* in the study area directly related to and within the area of influence of each of the six alternative development sites. This was done as follows:

i) The likely noise that will be generated by the CCGT Power Station operations was established and this was used to determine the potential footprint of impact.

ii) In order to determine the most appropriate farm on which to construct the CCGT Power Station, the six alternative sites were compared by rating nine noise impact aspects related to the development infrastructure and site characteristics.

iii) Based on the findings, appropriate noise mitigating measures (site scale) have been investigated and recommendations made. These are conceptual and not detailed to final design level.

4. DETAILS OF THE OVERALL STUDY AREA

4.1. General

Only the details relevant to the noise impact assessment are given.

4.2. Topography

The terrain across the study area is mildly undulating. There are localised low hills throughout the area.

4.3. Land Use

The area is predominantly agricultural. Other significant land uses in the area are:

i) Residential.
   a) The town of Amersfoort is located approximately 14-kilometres north-east of Majuba Power Station.
   b) The urban settlements (townships) of Vlakplaats which located 12 kilometres south-east of Amersfoort and 4 kilometres east of National Road N11.

ii) Educational:
   a) There are two schools in Amersfoort.
   b) There is a farm school on the farm Rietpoort 83-HS.

iii) Industrial. Majuba Power Station.

The residential, and educational land uses are considered to be noise sensitive sites.

4.4. Roads

There are a number of major roads and secondary roads servicing the area:

i) National Road N11, which links Amersfoort to Volksrust is aligned in a north-south direction through the eastern sector of the study area.

ii) Road P48/2 (Route R35), which links Amersfoort to Morgenzon, is aligned in an east-west direction through the north-eastern sector of the study area.

iii) Road P97/1 which links Amersfoort to Perdekop, is aligned in a north-east to south-west direction through the western sector of the study area. It passes 4 kilometres to the north-west of Majuba Power Station.

iv) Road D2514, which links from Road P97/1 to National Road N11, is aligned in a north-west to south-east direction through the central portion of the study area. It is the main access road to Majuba Power Station.

v) Road D284, which links from Road D2514 to National Road N11, is aligned in a south-west to north-east direction through the central portion of the study area. It is the main access road to Majuba Colliery (no longer in operation).

4.5. Railway Lines

Two railway lines pass through the study area:

i) The Amersfoort-Volksrust line is aligned through the eastern portion of the study area. It is not operational at present.

ii) The Majuba Coal Supply line is aligned through the southern portion of the study area. It links from Palmford station to Majuba.

4.6. Factors of Acoustical Significance

The relatively flat topographical features in the study area provide little acoustic shielding between the possible development sites and the adjacent noise sensitive areas. There are localised low hill which will provide some shielding. Noise will tend to be channelled along the shallow drainage valleys in the area.

The main meteorological aspect that will affect the transmission (propagation) of the noise is the wind. The wind can result in periodic enhancement downwind or reduction upwind of noise levels. Analysis of the wind records for the area indicates that the main prevailing winds blow from the east (35% of the time) and the west (29%). Approximately 0,6% *still* periods are experienced annually.

5. FINDINGS AND IMPACT ASSESSMENT

5.1. The Residual (Existing) Noise Climate

The determination of the residual (existing) noise climate in the three respective potential development areas (six sites) is based on the measurements and observations made in the area, and where relevant also from the calculation of the noise from the traffic on the main roads. For details of the noise measurement survey and the results refer to Appendix B.

In overview, the existing situation with respect to the existing *noise climate* in the study area was found to be as follows:

i) The main sources of noise in the area are from:

a) Traffic on National Road N11, Road P48/1, Road P97/1, Road D2514 and Road D284.

b) The existing Majuba Power Station. The noise from the power station operations has a significant influence for up to about 4000 metres from the facility.

ii) The existing *noise climate* alongside the main roads is degraded with regard to suburban residential living. In some areas residences are negatively impacted from traffic noise (particularly at night) for up to the following distances from these roads:

a)	National Road N11	-	350m
b)	Road P48/1	-	180m
c)	Road P97/1 (N)	-	400m
d)	Road P97/1 (S)	-	180m
e)	Road D2514 (W)	-	200m
f)	Road D2514 (E)	-	Road reserve boundary (no impact)
g)	Road D284	-	Road reserve boundary (no impact)

iii) The residual (existing background) noise levels are relatively low (quiet) in the sections of the study area that are not close to and that are relatively shielded by the terrain from the main roads. Daytime ambient conditions range from about 38dBA to 44dBA. These are typical of the ambient noise conditions in a rural (farming) area. The late evening and night-time conditions fall to about 30dBA.

iv) The area at the school (measurement Site 2 as described in Appendix B) on the farm Rietfontein (just west of Road D284 and about 700 metres north of Road D2514) is quiet with ambient noise levels within the limits appropriate for educational facilities.

5.2. The Predicted Noise Climate (Pre-construction Phase)

Activities during the planning and design phase that normally have possible noise impact implications are those related to field surveys (such seismic testing and geological test borehole drilling for large building foundations). As these activities are usually of short duration and take place during the day, they are unlikely to cause any noise disturbance or nuisance in adjacent areas.

5.3. The Predicted Noise Climate (Construction Phase)

This Section summarises the more detailed analysis of the construction, which is documented in Appendix C.

Construction will likely be carried out during the daytime only (07h00 to 18h00 or 20h00). It should however be noted that certain activities may occasionally extend into the late evening period, while others such as de-watering operations may need to take place over a 24-hour

period. Some of the activities such as the construction of the chimney stacks could take place continuously (24-hours a day) over a number of weeks if a continuous sliding shutter concreting operation is used. It is estimated that the development of the project will take place over a period of 3 to 4 years. A large construction camp will need to be established. Details of the anticipated main sources of construction noise and the noise levels generated are given in Table C1 and Table C2 in Appendix C.

The nature of the noise impact from the construction sites is likely to be as follows:

i) Source noise levels from many of the construction activities will be high. Noise levels from all work areas will vary constantly and in many instances significantly over short periods during any day working period.

ii) Ideally the daytime outdoor ambient noise levels should not exceed 45dBA for rural residential areas or 55dBA for urban residential areas (as specified in SANS 10103). The night-time outdoor ambient noise levels should not exceed 35dBA for rural residential areas or 45dBA for urban residential areas

iii) Exact daytime period and night-time period continuous equivalent sound pressure levels are not possible to calculate with certainty at this stage as the final construction site layout, work programme, work *modus operandi* and type of equipment have not been finalised. Working on a worst case scenario basis, it is estimated that short term maximum noise levels from general construction operations should not exceed 62dBA at a distance of 1500 metres from the activity site.

iv) For general construction, the ambient noise levels generated should not exceed 56dBA at 250 metres offset. Refer to Table C2 in Appendix C.

v) There are likely to be noise disturbance and noise nuisance effects on people living in close proximity to the construction sites.

vi) It should be noted that for residential areas, higher ambient noise levels than recommended in SANS 10103 are normally accepted as being reasonable during the construction period, provided that the very noisy construction activities are limited to the daytime and during the week, and that the contractor takes reasonable measures to limit noise at the work site. Note that it has been assumed that surface facility construction will generally take place from 07h00 to 18h00 with no activities (or at least no noisy construction activities) at night and so there should not be a problem.

vii) No assessment of the construction traffic has been made at this stage. A project of this size will generate significant traffic daily. The noise impact from this source is not expected to be severe but this aspect will need to be investigated in more detail at the EIA Phase once the site of the new power station is finalised.

viii) For all construction work, the construction workers working with or in close proximity to equipment will be exposed to high levels of noise as can be seen from Table C1 (refer to the 5 metres offset noise levels) in Appendix C.

5.4. The Predicted Noise Climate (Operational Phase)

5.4.1. ***CCGT Power Station***

With the construction of the CCGT Power Station, the noise climates close to these facilities will alter. Refer also to Appendix C.

The main noise sources at the CCGT Power Station will be from the cooling fans (is dry cooling is utilised), the compressors and the gas turbines. As the generating units and associated plant are likely to be enclosed in a building, the noise from the cooling fans will be the loudest contributing source that will predominate at areas outside the CCGT Power Station property. It is predicted that the noise levels from the CCGT Power Station could be of the following order at the given offsets from the cooling fan installation:

Offset from the Plant		**Noise Level (dBA)**
1000m	-	55
2000m	-	49
3000m	-	44
4000m	-	39
5000m	-	35

The noise levels given are the unmitigated values. A conservative approach has been taken in that a hard intervening ground condition has been modelled. There will be greater attenuation than shown with distance where there are houses, other buildings and terrain restraints in the intervening ground between the source and the receiver point. The sparse vegetation in the area will not assist the attenuation with distance.

Using a night-time maximum noise limit standard of 40dBA, noise sensitive sites within 4000 metres of the new CCGT Power Station could potentially be impacted. This has been used as the distance for assessment around each of the potential development sites.

5.4.2. ***CCGT Power Station Generated Traffic***

No assessment of the construction traffic which will be generated by the CCGT Power Station once it has been commissioned has been made at this stage by the Traffic Impact Team. The total daily traffic that will be generated by the new facility will be relatively small in

comparison to the total volume of traffic on the adjacent main roads affecting all of the six potential development sites.

6. EVALUATION OF THE ALTERNATIVE DEVELOPMENT SITES

The analysis of each potential development site was based on an area of influence lying within 4000 metres of relevant site.

6.1. Site 1 Study Area

The following were the findings regarding the Site 1 study area.

i) Areas to the north and west of the site are quiet (typical of a rural/agricultural area), although the noise climate alongside Road D97/1 is degraded.

ii) There will be significant cumulative effects from the existing Power Station to the south of this site.

iii) There are a significant number (35 identified from the topocadastral map) of noise sensitive sites (mainly farmhouses and farm labourer homes) in the study area that have the potential to be impacted by noise from the new Power Station.

iv) Access to the site is relatively easy from Road D97/1 and minor road construction will be necessary. Traffic noise impact from the new facility is not expected to be significant.

6.2. Site 2a Study Area

The following were the findings regarding the Site 2a study area.

i) Areas in all directions from the site are quiet (typical of a rural/agricultural area), although the noise climate alongside National Road N11 is degraded. The volumes of traffic on Road D284 and Road D2514(E) are low and presently have little effect on the noise climate.

ii) There will be minor cumulative effects from the existing Power Station to the west of this site.

iii) There are a significant number (50 identified from the topocadastral map) of noise sensitive sites (mainly farmhouses and farm labourer homes) in the study area that have the potential to be impacted by noise from the new Power Station. A farm school will also be significantly affected.

iv) Access to the site is relatively easy from Road D284 and minor road construction will be necessary. Traffic noise impact from the new facility is expected to be high along Road D284 and Road D2514(E) due to existing low traffic volumes on these two facilities. This will be so during construction and operation phases.

6.3. Site 2b Study Area

The following were the findings regarding the Site 2b study area.

i) Areas in all directions from the site are quiet (typical of a rural/agricultural area), although the noise climate alongside National Road N11 is degraded. The volumes of traffic on Road D284 and Road D2514(E) are low and presently have little effect on the noise climate.

ii) There will be minor cumulative effects from the existing Power Station to the west of this site.

iii) There are a significant number (50 identified from the topocadastral map) of noise sensitive sites (mainly farmhouses and farm labourer homes) in the study area that have the potential to be impacted by noise from the new Power Station. A farm school will also be significantly affected.

iv) Access to the site is relatively easy from Road D284 and minor road construction will be necessary. Traffic noise impact from the new facility is expected to be high along Road D284 and Road D2514(E) due to existing low traffic volumes on these two facilities. This will be so during construction and operation phases.

6.4. Site 3a Study Area

The following were the findings regarding the Site 3a study area.

i) Areas to the south-west, south and east of the site are quiet (typical of a rural/agricultural area). The ash dump lies to the west.

ii) There will be significant cumulative effects from the existing Power Station to the north of this site.

iii) There are a significant number (31 identified from the topocadastral map) of noise sensitive sites (mainly farmhouses and farm labourer homes) in the study area that have the potential to be impacted by noise from the new Power Station.

iv) It is assumed that access to this site will be via a new road linking eastwards to Road D2514. Traffic noise impact from the new road facility is not expected to be significant.

v) The Majuba Coal Train Railway Line is aligned through the southern and central section of this site's area of influence. This facility does not, however, have a major influence on the noise climate of the area.

6.5. Site 3b Study Area

The following were the findings regarding the Site 3b study area.

i) Areas to the south-west, south and east of the site are quiet (typical of a rural/agricultural area). The ash dump lies to the west.

ii) There will be significant cumulative effects from the existing Power Station to the north of this site.

iii) There are a significant number (31 identified from the topocadastral map) of noise sensitive sites (mainly farmhouses and farm labourer homes) in the study area that have the potential to be impacted by noise from the new Power Station.

iv) It is assumed that access to this site will be via a new road linking eastwards to Road D2514. Traffic noise impact from the new road facility is not expected to be significant.

6.6. Site 3c Study Area

The following were the findings regarding the Site 3c study area.

i) Areas to the south-east and west of the site are quiet (typical of a rural/agricultural area). The ash dump lies to the north.

ii) There will be significant cumulative effects from the existing Power Station to the north-east of this site.

iii) There are a significant number (31 identified from the topocadastral map) of noise sensitive sites (mainly farmhouses and farm labourer homes) in the study area that have the potential to be impacted by noise from the new Power Station.

iv) There is no indication from which side the access road to this site will be built. A logical alternative is from the west. If this is the case, there will be some traffic noise impact on the farms to the west of Site 3c.

v) The Majuba Coal Train Railway Line is aligned through the southern and central section of this site's area of influence. This facility does not, however, have a major influence on the noise climate of the area.

6.7. Site Preference Rating and Ranking

The details of the site preference rating methodology are given in Sections C5.7 and C5.8 of Appendix C.

A five point positive rating system (was applied was applied to various noise aspects in order to compare the six alternative sites. The details of the rating analysis of the six alternative sites and aspects compared are summarised in Table C3 in Appendix C. In this approach, namely that of a positive rating, the higher the rating score, the more preferred the site.

The site final preference rankings for the six alternative sites are given in Table 1.

TABLE 1: SITE FINAL PREFERENCE RATING

Farm Site	Rating Score	Site Final Preference Ranking
Site 1	30	Second Preference
Site 2a	21	Fourth Preference
Site 2b	21	Fourth Preference
Site 3a	31	First Preference
Site 3b	31	First Preference
Site 3c	27	Third Preference

7. CONCLUSIONS

The following may be concluded from the foregoing analysis:

i) Although not all of the final baseline noise design data was available for the analysis, the assumptions made are considered adequate to give a meaningful analysis of the noise impact situation at Scoping level.

ii) The area of potentially serious noise impact around the planned CCGT Power Station will be relatively small (contained within a radius of about 4 kilometres). There are noise sensitive receptors within this area of influence at all six analysis sites. Provided that the optimum location on the respective development area is selected, noise impact can be reduced.

iii) Although the numerical rating and ranking analysis (as summarised in Table 1) indicates that, from a noise perspective, there are some sites which are equally ranked, there are other qualitative aspects which give clearer perspective to the choice of a preferred option.

iv) None of the sites are “no go” areas. In general the development sites closer to the existing Power Station namely Sites 1, 3a, 3b and 3c are preferable to Sites 2a and 2b due to the degraded noise climate near to the Majuba Power Station.

v) There are practical mitigating measures that can be implemented to prevent or reduce impact.

8. MITIGATING MEASURES

Potential noise mitigating measures for the project were assessed on a preliminary basis.

8.1. Pre-construction Phase

Local residents are to be notified of any potentially noisy field survey works or other works during the planning and design phase and these activities are to be undertaken at reasonable times of the day. These works should not take place at night or on weekends.

During this phase, consideration must be given to the noise mitigating measures required during the construction phase and which should be included in the tender document specifications and the design.

8.2. Construction Phase

The noise mitigating measures to be considered during the construction phase are as follows:

i) Construction site yards, concrete batching plants, asphalt batching plants, construction worker camps (accommodation) and other noisy fixed facilities should be located well away from noise sensitive areas adjacent to the development site.

ii) All construction vehicles and equipment are to be kept in good repair.

iii) Construction activities, and particularly the noisy ones, are to be contained to reasonable hours during the day and early evening.

iv) With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, the contractor should liaise with local residents on how best to minimise impact.

v) In general operations should meet the noise standard requirements of the Occupational Health and Safety Act (Act No 85 of 1993).

vi) Construction staff working in areas where the 8-hour ambient noise levels exceed 75dBA should wear ear protection equipment.

8.3. Operational Phase

The following noise mitigating measures, which will need to be considered where appropriate, are preliminary indicators that may assist further in the selection of the best alternative site:

i) The design of the CCGT Power Station is to incorporate all the necessary acoustic design aspects required in order that the overall generated noise level from the new installation does not exceed a maximum equivalent continuous daytime rating level ($L_{Req,d}$), namely a noise level of 70dBA (just inside the *property projection plane*, namely the property boundary) as specified for industrial districts in SANS 10103. Refer to Appendix A. Notwithstanding this provision, the design is also to take into account the maximum allowable equivalent continuous day/night rating level of the potentially impacted sites outside the new installation's property. Where the $L_{Req,d}$ for the external site is presently lower than the maximum allowed, the maximum shall not be exceeded. Where the $L_{Req,d}$ for the external site is presently at or exceeds the maximum, the existing $L_{Req,d}$ shall not be increased.

ii) The latest technology incorporating maximum noise mitigating measures for the CCGT Power Station components should be designed into the system. This is particularly relevant to the design of the cooling fans.

iii) The design process is to consider, *inter alia*, the following aspects:
   a) The position and orientation of buildings on the site.
   b) The design of the buildings to minimise the transmission of noise from the inside to the outdoors.
   c) The insulation of particularly noisy new plant and equipment.

It should be noted that any measures taken at the development site will limit the impacts in the specific areas designed for, and will not necessarily contribute to improving the degraded noise climates in adjacent areas where there is already a problem.

9. RECOMMENDATIONS

The following are recommended:

i) The National Noise Control Regulations and SANS 10103 should be used as the main guidelines for addressing the potential noise impact on this project.

ii) Once the preferred development site is selected, further more detailed analysis of the noise impact situation will need to be undertaken. For this future work, the final footprint of the CCGT Power Station on the selected development site, the technical details of the Power Station plant (layout and baseline noise profiles of all equipment), the operating conditions (including traffic) must be known.

iii) The noise mitigating measures indicated in Section 8 should be applied as guidelines for further design on the project.

10. REFERENCES

1. South African National Standard SANS 10103:2003, *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and to Speech Communication*.
2. South African National Standard SANS 10210 (SABS 0210), *Calculating and Predicting Road Traffic Noise*.
3. South African Bureau of Standards Code of Practice SANS 10328 (SABS 0328), *Methods for Environmental Noise Impact Assessments*.
4. South African National Standard SANS 10357 (SABS 0357), *The Calculation of Sound Propagation by the Concawe Method*.
5. National Noise Control Regulations.

APPENDIX A

GLOSSARY OF TERMS

AND

NOISE IMPACT CRITERIA

APPENDIX A: GLOSSARY OF TERMS AND NOISE IMPACT CRITERIA

A1. GLOSSARY OF TERMS

In order to ensure that there is a clear interpretation of this report the following meanings should be applied to the acoustic terminology:

- **Ambient sound level** or **ambient noise** means the totally encompassing sound in a given situation at a given time, and usually composed of sound from many sources, both near and far. Note that ambient noise includes the noise from the noise source under investigation. The use of the word *ambient* should however always be clearly defined (compare with *residual noise*).
- **A-weighted sound pressure, in Pascals**: The root-mean-square sound pressure determined by use of frequency-weighting network A.
- **A-weighted sound pressure level (SPL) (noise level) (L_{pA}), in decibels**: The sound pressure level of A-weighted sound pressure is given by the equation:

  $L_{pA} = 10 \log (p_A/p_o)^2$ where:

  p_A is the A-weighted sound pressure, in Pascals; and

  p_o is the reference sound pressure (p_o = 20 micro Pascals (μPa))

  Note: The internationally accepted symbol for sound pressure level, dB(A), is used.
- **Controlled areas** as specified by the National Noise Control Regulations are areas where certain noise criteria are exceeded and actions to mitigate the noise are required to be taken. Controlled areas as related to roads, airports and factory areas are defined. These Regulations presently exclude the creation of *controlled areas* in relation to railway noise.
- **dB(A)** means the value of the sound pressure level in decibels, determined using a frequency weighting network A. (The "A"-weighted noise levels/ranges of noise levels that can be expected in some typical environments are given in Table A2 at the end of this appendix).
- **Disturbing noise** means a noise level that exceeds the outdoor equivalent continuous rating level for the time period and neighbourhood as given in Table 2 of SANS 10103:2004. For convenience, the latter table is reproduced in this appendix as Table A1.
- **Equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$)** means the value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, has the same mean-square sound pressure as a sound under consideration whose level varies with time.

- **Equivalent continuous rating level ($L_{Req,T}$)** means the equivalent continuous A-weighted sound pressure level during a specified time interval, plus specified adjustments for tonal character and impulsiveness of the sound and the time of day.
- **Equivalent continuous day/night rating level ($L_{R,dn}$)** means the equivalent continuous A-weighted sound pressure level during a reference time interval of 24-hours, plus specified adjustments for tonal character and impulsiveness of the sound and the time of day. (An adjustment of +10dB is added to the night-time rating level).
- **Integrating sound level meter** means a device that integrates a function of the root mean square value of sound pressure over a period of time and indicates the result in dBA.
- **Noise** means any acoustic phenomenon producing any aural sensation perceived as disagreeable or disturbing by an individual or group. Noise may therefore be defined as any *unwanted* sound or sound that is *loud, unpleasant or unexpected*.
- **Noise climate** is a term used to describe the general character of the environment with regard to sound. As well as the ambient noise level (quantitative aspect), it includes the qualitative aspect and the character of the fluctuating noise component.
- **Noise Control Regulations** means the regulations as promulgated by the National Department of Environmental Affairs.
- **Noise impact criteria** means the standards applied for assessing noise impact.
- **Noise level** means the reading on an integrating impulse sound level meter taken at a measuring point in the presence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation, and, if the alleged disturbing noise has a discernible pitch, for example, a whistle, buzz, drone or music, to which 5dBA has been added. (The "A"-weighted noise levels/ranges of noise levels that can be expected in some typical environments are given in Table A2 at the end of this appendix).
- **Noise nuisance** means any sound which disturbs or impairs or may disturb or impair the convenience or peace of any reasonable person considering the location and time of day. This applies to a disturbance which is not quantitatively measurable such as barking dogs, etc. (compared with disturbing noise which is measurable).
- **Residual sound level** means the ambient noise that remains at a position in a given situation when one or more specific noises are suppressed (compare with *ambient noise*).
- **Sound exposure level or SEL** means the level of sound accumulated over a given time interval or event. Technically the sound exposure level is the level of the time-integrated mean square A-weighted sound for stated time or event, with a reference time of one second.
- **Sound (pressure) level** means the reading on a sound level meter taken at a measuring point.

- **SANS 10103** means the latest edition of the South African National Standard SANS 10103 titled *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and to Speech Communication*.
- **SANS 10210** means the latest edition of the South African National Standard SANS 10210 titled *Calculating and Predicting Road Traffic Noise*.
- **SANS 10328** means the latest edition of the South African National Standard SANS 10328 titled *Methods for Environmental Noise Impact Assessments*.
- **SANS 10357** means the latest edition of the South African National Standard SANS 10357 titled *The Calculation of Sound Propagation by the Concawe Method*.
- **Sound** means the aural sensation caused by rapid, but very small, pressure variations in the air. In quantifying the subjective aural sensation, "loudness", the letters dBA after a numeral denote two separate phenomena:
    - "dB", short for *decibel*, is related to the human's subjective response to the change in amplitude (or largeness) of the pressure variations.
    - The "A" denotes the ear's different sensitivity to sounds at different frequencies. The ear is very much less sensitive to low (bass) frequency pressure variations compared to mid-frequencies.

  The level of environmental sound usually varies continuously with time. A human's subjective response to varying sounds is primarily governed by the total sound energy received. The total sound energy is the average level of the fluctuating sound, occurring during a period of time, multiplied by the total time period. In order to compare the effects of different fluctuating sounds, one compares the average sound level over the time period with the constant level of a steady, non-varying sound that will produce the same energy during the same time period. The average energy of sound varying in amplitude is thus equivalent to the continuous, non-varying sound. The two energies are equivalent.

- Refer also to the various South African National Standards referenced above and the Noise Control Regulations for additional and, in some instances, more detailed definitions.

TABLE A1: TYPICAL NOISE RATING LEVELS FOR AMBIENT NOISE IN DISTRICTS (NOISE ZONES)

Type of District	**Equivalent Continuous Rating Level for Noise ($L_{Req,T}$) (dBA)**					
	Outdoors			***Indoors with open windows***		
	Day-night ($L_{R,dn}$)	**Daytime ($L_{Req,d}$)**	**Night-time ($L_{Req,n}$)**	**Day-night ($L_{R,dn}$)**	**Daytime ($L_{Req,d}$)**	**Night-time ($L_{Req,n}$)**
RESIDENTIAL DISTRICTS						
a) Rural districts	45	45	35	35	35	25
b) Suburban districts (little road traffic)	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
NON RESIDENTIAL DISTRICTS						
d) Urban districts (some 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 A2: NOISE LEVELS/RANGES OF NOISE LEVELS THAT MAY BE EXPECTED IN SOME TYPICAL ENVIRONMENTS

Noise Level dB(A)	Typical Environment	Subjective Description
140	30m from jet aircraft during take-off	
130	Pneumatic chipping and riveting (operator's position)	Unbearable
>120	Hearing damage possible even for short exposure	
120	Large diesel power generator	
105-120	Low level military aircraft flight	
110-120	100 m from jet aircraft during take-off	
110	Metal workshop (grinding work), circular saw	
105-110	High speed train at 300 km/h (peak pass-by level at 7,5m)	
90-100	Printing press room	Very noisy
95-100	Passenger train at 200km/h (peak pass-by level at 7,5m).	Very noisy
95-100	Freight train at 100 km/h (peak pass-by level at 7,5 m)	Very noisy
90-100	Discotheque (indoors)	
75-100	7,5 m from passing motorcycle (50 km/h)	
75-80	10 m from edge of busy freeway (traffic travelling at 120 km/h)	
80-95	7,5 m from passing truck (50 km/h)	
80	Kerbside of busy street	
70	Blaring radio	Noisy
70	3 m from vacuum cleaner	Noisy
60-80	7,5 m from passing passenger car (50 km/h)	
65	Normal conversation	
65	Large busy office	
60	Supermarket/small office	
50	Average suburban home (day conditions)	Quiet
40	Library	
40-45	Average suburban home (night-time)	
30-35	Average rural home (night-time)	
25-30	Slight rustling of leaves	
20	Background in professional recording studio	Very quite
20	Forest (no wind)	
0-20	Experienced as complete quietness	
0	Threshold of hearing at 1000 Hz	

A2. NOISE IMPACT CRITERIA

The international tendency is to express noise exposure guidelines in terms of absolute noise levels. 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 environmental guidelines of the World Bank and World Health Organisation, which specify 55dBA during the day (06:00 to 22:00) and 45dBA during the night (22:00 to 06:00) for residential purposes, determined over any hour. SANS 10103 conforms to the described international tendency. The recommended standards to be applied are summarised in Table A1.

Communities generally respond to a change in the ambient noise levels in their environment, and the guidelines set out in SANS 10103 provide a good indication for estimating their response to given increases in noise. The suggested severity criteria for the noise impacts are summarised in terms of the above guidelines in Table A3.

TABLE A3: CATEGORIES OF COMMUNITY/GROUP RESPONSE (CRITERIA FOR THE ASSESSMENT OF THE SEVERITY OF NOISE IMPACT)

Increase in Ambient Noise Level (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
Greater than 15dBA	Very strong	Vigorous community/group action

Changes in noise level are perceived as follows:

- *3dBA:* For a person with average hearing acuity, an increase in the general ambient noise level of 3dBA will be just detectable.
- *5dBA:* For a person with average hearing acuity an increase of 5dBA in the general ambient noise level 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 5dBA will be 'little' with 'sporadic complaints'. For an increase of equal or more than 5dBA the response changes to 'medium' with 'widespread complaints'.
- *10dBA:* A person with average hearing will subjectively judge an increase of 10dBA as a doubling in the loudness of the noise. According to SANS 10103 the estimated

community reaction will change from ‘medium’ with ‘widespread complaints’ to ‘strong’ with ‘threats of community action’.

In the National Noise Control Regulations which are applicable in Mpumalanga Province, an intruding noise is defined as ‘disturbing’ if it causes the ambient noise level to rise by 7dBA or more.

APPENDIX B:

DETAILS OF THE NOISE MEASUREMENT SURVEY AND EXISTING NOISE CLIMATE CONDITION ASSESSMENT

APPENDIX B: DETAILS OF THE NOISE MEASUREMENT SURVEY AND EXISTING NOISE CLIMATE CONDITION ASSESSMENT

B1. GENERAL

The technical details of the noise measurement survey and general *noise climate* investigation related to the potential noise impact of the proposed Majuba CCGT Power Station which is to be developed in the area of the existing Majuba Power Station approximately 10km south-west of Amersfoort in the Mpumalanga Province are dealt with in this Appendix.

The noise impact assessment was undertaken in accordance with the requirements of the South African National Standard SANS 10328 (SABS 0328) *Methods for Environmental Noise Impact Assessments*. Daytime period noise measurements were taken at four main monitoring sites at appropriate locations in the study area in order to establish the residual (existing) *noise climate*.

B2. STANDARDS AND MEASUREMENT EQUIPMENT

The sound pressure level (SPL) (noise) measurements were taken in accordance with the requirements of the South African National Standard SANS 10103:2004, *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and Speech Communication*. Two Type 1 Integrating Sound Level Meters, a Bruël and Kjaer Model 2230 meter and a Rion NA-28 were used for the noise measurements. Both meters were calibrated at an accredited acoustical laboratory within the last 12 months. The calibration status of the meters was also checked before and after completion of the total measurement period of the day. A calibrated signal with a sound pressure level of 94,0dB at 1 kHz and 114,0dB at 1 kHz were applied to the Bruël and Kjaer meter and the Rion meter respectively. A Rion Sound Calibrator NC-74 was used.

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. The frequency weighting setting was set on "A" and the time weighting setting of the meters were set on *Impulse* (I). Measurement periods of a minimum of 10 minutes were used. Note that due to the rainy weather conditions, some of the measurement times were reduced from 10 minutes. In addition, the variation in instantaneous sound pressure level (SPL) over a short period was also measured at some of the Sites. For these latter measurements the time weighting setting of the meter was also set on *Impulse* (I).

At all the measurement sites, the meters were set up with the microphone height at 1,3 metres above ground level and well clear of any reflecting surfaces (a minimum of 3 metres clearance). For all measurements, a standard windshield cover (as supplied by the manufacturers) was placed on the microphone of each meter.

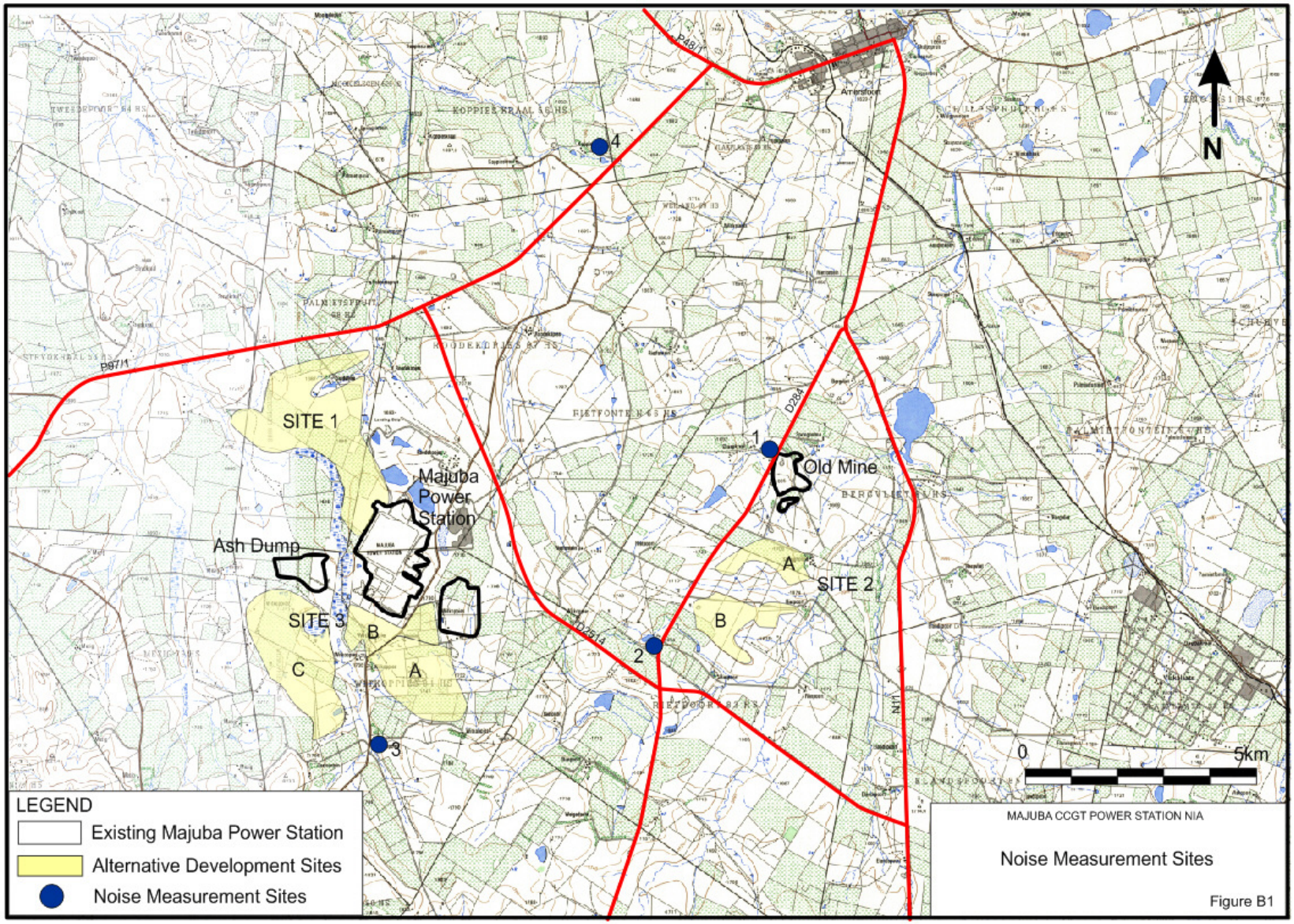
At the same time as each individual measurement was being taken, the qualitative nature of the *noise climate* in the area of the measurement site was assessed and recorded. This comprised an appraisal of the general prevailing acoustic conditions based on the subjective response to the sounds as perceived by the listener (i.e. *auditory observation* by the surveyor), as well as identifying those noise incidents, which influenced the noise meter readings during that measurement period. This procedure is essential in order to ensure that that there is a *human* correlation between the noise as perceived by the human ear and the noise, which is measured by the meter, as well as to establish any anomalies in the general ambient noise conditions.

B3. MEASUREMENT SITES

"Observations" of the noise climate and noise measurements to establish current ambient noise conditions were taken at four (4) main locations in the study area, as indicated in Figure B1. These are:

Site No	Site Description	GPS Co-ordinates
1	On the western side of Road D284 at entrance to Farm Skaapkraal opposite entrance to Majuba Colliery (Farm Bergvliet).	S27º05.088' E029º51.034'
2	On the western side of Road D284 just south of entrance to farm school and just north of intersection with Road D2514.	S27º07.142' E029º49.623'
3	On farm road between potential development areas 3A and 3B, just north of Majuba coal railway line (area south of Majuba Power Station).	S27º08.550' E029º45.839'
4	Just south of the farmhouse on Portion 54 of the farm Koppieskraal 56-HS. The site is 550 metres west of Provincial Road P97/1.	S27º01.570 E029º48.730

Although inclement weather, namely intermittent light rain, on the day of survey prevented measurements being taken at more sites, observations of the noise climate were made at several other locations in the study area. These adequately covered all of the alternative development sites for the power station to enable a sufficiently thorough appreciation of the local noise conditions for purposes of this Scoping study.


SITE 1
Majuba
Power
Station
Ash Dump
SITE 3
B
C
A
SITE 2
A
B
Old Mine
1
2
3
4
N
0
5km
LEGEND
Existing Majuba Power Station
Alternative Development Sites
Noise Measurement Sites
MAJUBA CCGT POWER STATION NIA
Noise Measurement Sites
Figure B1

B4. MEASUREMENT DATES/TIMES

General observation of the noise conditions in the study area as well as the site specific sound pressure level (noise) measurements and observations were taken on Tuesday 22 January 2008 from 12h00 to 17h00.

B5. NOISE MEASUREMENT DETAILS

B5.1. Summary of the Residual Sound Pressure Level Measurements

The results of the residual noise condition measurement survey are summarised in Table B1. The equivalent sound pressure (noise) level (L_{Aeq}), the maximum sound pressure level (L_{Amax}) and the minimum sound pressure level (L_{Amin}) are indicated. Note that the equivalent sound pressure (noise) level may, in layman's terms, be taken to be the average noise level over the given period. This "average" is also referred to as the residual noise level (excluding the impacting noise under investigation) or the ambient noise level (if the impacting noise under investigation is included).

TABLE B1: MEASURED CURRENT NOISE LEVELS IN THE MAJUBA POWER STATION STUDY AREA (YEAR 2008)

Measurement Site	Measured Sound Pressure Level (dBA)					
	Daytime Period			Evening Period		
	L_{Aeq}	L_{max}	L_{min}	L_{Aeq}	L_{max}	L_{min}
Site 1	37.9	45.7	25.3	30*	-	-
Site 2	42.2	55.7	26.1	30*	-	-
Site 3	44.2	50.3	31.7	30*	-	-
Site 4	43,6	56,6	28,5	46,9	61,9	35,5
Note: * Based on the minimum day-time levels, it is estimated that the night-time ambient noise levels will tend to a level of about 30dBA.						

Although the weather conditions on the day of survey were mostly rainy, it was still possible to take the measurements indicated above during breaks in the rain. The measurements to establish the ambient noise levels were not adversely affected by the weather and no specific corrective adjustments needed to be made.

B5.3. Noise Climate Related to the 24 hour Road Traffic

In order to complement the short-term noise measurements the main roads in the area, the existing 24-hour residual noise levels related to the average daily traffic (ADT) flows on National Road N11, Road P28/1, Road P97/1, Road D2514 and Road D284 were also calculated. These data provide an accurate base for the SANS 10103 descriptors. The noise levels generated from the traffic on these roads were calculated using the South African National Standard SANS 10210 (SABS 0210), *Calculating and Predicting Road Traffic Noise*. Typical situations were used for the calculation site. The Year 2007 traffic data were used as the baseline for the calculations. The traffic data were obtained from the Mpumalanga Provincial Department of Roads and Transport.

The noise levels at various offsets from the relevant road centrelines were established and are summarised in Table B2. The noise descriptors used are those prescribed in SANS 10103:2004, namely:

i) Daytime equivalent continuous rating (noise) level ($L_{Req,d}$) (L_d used in Table), namely for the period from 06h00 to 22h00).

ii) Night-time equivalent continuous rating (noise) level ($L_{Req,n}$) (L_n used in Table), namely for the period from 22h00 to 06h00).

iii) Day-night equivalent continuous rating (noise) level ($L_{R,dn}$) (L_{dn} used in Table), namely for the 24 hour period from 06h00 to 06h00).

The noise levels given are for generalised and the unmitigated conditions. There will be greater attenuation than shown with distance where there are houses, other buildings and terrain restraints in the intervening ground between the source and the receiver point.

TABLE B2: EXISTING NOISE CLIMATE ADJACENT TO THE MAIN ROADS IN THE MAJUBA POWER STATION STUDY AREA (YEAR 2007 TRAFFIC)

Road	Noise Climate Alongside the Main Roads at Given Offset from Centreline (SANS 10103 Indicator) (dBA)																	
	25m Offset			50m Offset			100m Offset			250m Offset			500m Offset			1000m Offset		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
N11	60.9	51.3	61.0	57.9	48.3	58.0	54.9	45.3	55.0	50.9	41.3	51.0	47.9	38.3	48.0	44.9	35.3	45.0
P48/1	58.8	48.5	58.7	55.8	45.5	55.7	52.8	42.5	52.7	48.8	38.5	48.7	45.8	35.5	45.7	42.8	32.5	42.7
P97/1 (N)	62.2	52.0	62.1	59.2	49.0	59.1	56.2	46.0	56.1	52.2	42.0	52.1	49.2	39.0	49.1	46.2	36.0	46.1
P97/1 (S)	58.8	48.5	58.7	55.8	45.5	55.7	52.8	42.5	52.7	48.8	38.5	48.7	45.8	35.5	45.7	42.8	32.5	42.7
D2514 (W)	59.3	49.0	59.2	56.3	46.0	56.2	53.3	43.0	53.2	49.3	39.0	49.2	46.3	36.0	46.2	43.3	33.0	43.2
D2514 (E)	58.6	38.3	48.5	55.6	35.3	45.5	52.6	32.3	42.5	48.6	28.3	38.5	45.6	25.3	35.5	42.6	22.3	32.5
D284	43.5	33.2	43.4	40.5	30.2	40.4	37.5	27.2	37.4	33.5	23.2	33.4	30.5	20.2	30.4	27.5	17.2	27.4

B5.3. Prevailing Noise Climate

In overview, the existing situation with respect to the existing *noise climate* in the study area was found to be as follows:

v) The main sources of noise in the area are from:
   a) Traffic on National Road N11, Road P48/1, Road P97/1, Road D2514 and Road D284.
   b) The existing Majuba Power Station.

vi) The existing *noise climate* alongside the main roads is degraded with regard to suburban residential living. In some areas residences are negatively impacted from traffic noise (particularly at night) for up to the following distances from these roads:

a)	National Road N11	-	350m
b)	Road P48/1	-	180m
c)	Road P97/1 (N)	-	400m
d)	Road P97/1 (S)	-	180m
e)	Road D2514 (W)	-	200m
f)	Road D2514 (E)	-	Road reserve boundary
g)	Road D284	-	Road reserve boundary

vii) The residual (existing background) noise levels are relatively low (quiet) in the sections of the study area that are not close to and that are relatively shielded by the terrain from the main roads. Daytime ambient conditions range from about 38dBA to 44dBA. These are typical of the ambient noise conditions in a rural (farming) area. The late evening and night-time conditions fall to about 30dBA.

viii) The area at the school (measurement Site 2) on the farm Rietfontein (just west of Road D284 and about 700 metres north of Road D2514) is quiet with ambient noise levels within the limits appropriate for educational facilities.

APPENDIX C

ASSESSMENT OF NOISE IMPACT

APPENDIX C: ASSESSMENT OF NOISE IMPACT

C1. GENERAL

Eskom is planning the construction of a 2100MW Combined Cycle Gas Turbine (CCGT) Power Station in the Amersfoort area in Mpumalanga Province. Three candidate sites (areas) are being evaluated. Two of these are divided into subareas for investigation. Refer to Figure 1. The CCGT Power Station will be constructed on one of these. The likely position for the Power Station at these sites (the Power Station "footprint") has not yet been determined. The areas are:

iv) Site 1 (Portions 1, 3 and 7 of the farm Palmietspruit 68 HS; Portion 6 of the farm Strydkraal 53 HS; Portion 1 of the farm Roodekopjes 67 HS)

v) Site 2
   - Site 2a (Portion 7 of the farm Bergvliet 65 HS; Portion 4 of the farm Rietpoort 83 HS; Werda 116 HS)
   - Site 2b (Portions 3 and 4 of the farm Rietpoort 83 HS and Werda 116 HS)

vi) Site 3
   - Site 3a (Portions 1, 2, 6, 10 and 11 of the farm Witkoppies 81 HS)
   - Site 3b (Portions 1, 5 and 6 of the farm Witkoppies 81 HS)
   - Site 3c (Portions 4, 5, 8, 9, 12, 13 and 14 of the farm Witkoppies HS).

The assessment of the noise impact was guided by the requirements of the South African National Standard SANS 10328 (SABS 0328) titled *Methods for Environmental Noise Impact Assessments* and the Noise Control Regulations. A comprehensive assessment using the appropriate noise impact decriptors (standards) has been undertaken. The noise impact criteria used in this investigation specifically take into account those as specified in the South African National Standard SANS 10103:2003, *The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and Speech Communication,* as well as those in the National Noise Control Regulations. Relevant aspects of these Regulations and SANS 10103:2004 are provided in Appendix A.

For this study the position of houses/dwellings on the farms was taken off the following 1:50 000 topographical cadastral maps. Even though the latest editions were used, the mapping is 20 years out of date.

- SOUTH AFRICA 1:50 000 Sheet 2729BA PERDEKOP Second Edition, 1987.
- SOUTH AFRICA 1:50 000 Sheet 2729BB AMERSFOORT Second Edition, 1987.

C2. ASSESSMENT OF THE PRE-CONSTRUCTION PHASE

Activities during the planning and design stages that have possible impact implications in the study area are related to field surveys (such as seismic testing and geological test borehole drilling for large building/structure foundation investigations). As these survey activities will be of short duration and take place during the day, they are unlikely to cause any noise impact.

C3. ASSESSMENT OF THE CONSTRUCTION PHASE

C3.1. General

The potential noise climate was established in general for the construction of the CCGT Power Station inclusive of appurtenant works.

Although many of the details of the planned Power Station have not yet been finalised, general concepts have been used in the noise impact evaluation and these are adequate for the Scoping to provide a sound basis for the analysis of typical noise conditions and impacts that are likely to prevail on the project. Data related to construction have been sourced from various consultants and the experience that JKA has had working on similar sites.

C3.2. Construction Noise Conditions

Construction will likely be carried out during the daytime only (07h00 to 18h00 or 20h00). It should however be noted that certain activities may occasionally extend into the late evening period, while others such as de-watering operations may need to take place over a 24-hour period. Some of the activities such as the construction of the chimney stacks could take place continuously (24-hours a day) over a number of weeks if a continuous sliding shutter concreting operation is used. It is estimated that the development of the project will take place over a period of 3 to 4 years.

C3.2.1. ***Sources of Noise***

The following are likely to be the main construction related sources of noise for the CCGT Power Station and its infrastructure:

i) Construction camp establishment. This will be for the site offices, workshops and possibly the accommodation camp for the workers on site.

ii) Activities related to the relocation of services.

iii) Excavation of building basements and service trenches. Blasting may be required in places but in general pneumatic breakers will be used where rock is encountered.

iv) Piling operations for large buildings.

v) Erection of shuttering for concrete.

vi) Fixing of steel reinforcing.

vii) Placing and vibration of concrete. Poker vibrators will be used.

viii) Stripping of shuttering after concrete pour.

ix) Erection of structural steelwork.

x) Finishing operations on buildings. Cladding, services installation, etc.

xi) Installation of generating plant and ancillary plant.

xii) General movement of heavy vehicles such as concrete delivery vehicles, mobile cranes, mechanical dumpers and water trucks (dust suppression) around the site.

xiii) De-watering pumps. A 24-hour operation may sometimes be necessary.

xiv) Road construction equipment: scrapers, dozers, compactors, etc. (Construction of the internal road system and access roads.

xv) Operations at construction site fabrication workshops and plant maintenance workshops.

xvi) Construction material and equipment delivery vehicles.

xvii) Concrete batching plant and asphalt batching plant on site.

The level and character of the construction noise will be highly variable as different activities with different plant/equipment take place at different times, over different periods, in different combinations, in different sequences and on different parts of the construction site. Typical noise levels generated by the various construction equipment are given in Table C1.

These noise levels assume that the equipment is maintained in good order. Conservative attenuation conditions (related to intervening ground conditions and screening) have been applied.

C3.2.2. ***Noise Impact***

The nature of the noise impact from the large building construction sites is likely to be as follows:

i) Source noise levels from many of the construction activities will be high. Noise levels from all work areas will vary constantly and in many instances significantly over short periods during any day working period.

ii) Exact daytime period and night-time period continuous equivalent sound pressure levels are not possible to calculate with certainty at this stage as the final construction site layout, work programme, work *modus operandi* and type of equipment have not been finalised. Working on a worst case scenario basis, it is estimated that the maximum noise levels from general construction operations should not exceed 62dBA at a distance of 1500 metres from the activity site.

iii) Ideally the daytime outdoor ambient noise levels should not exceed 45dBA for rural residential areas or 55dBA for urban residential areas (as specified in SANS 10103).

iv) There are likely to be noise disturbance and noise nuisance effects on people living in the area of the construction sites.

v) For all construction work, the construction workers working with or in close proximity to equipment will be exposed to high levels of noise as can be seen from Table C1 (refer to the 5 metre offset noise levels).

TABLE C1. TYPICAL NOISE LEVELS GENERATED BY CONSTRUCTION EQUIPMENT

Plant/Equipment	Typical Operational Noise Level at Given Offset (dBA)							
	5m	10m	25m	50m	100m	250m	500m	1000m
Air compressor	91	85	77	71	65	57	51	46
Compactor	92	86	78	72	66	58	52	46
Concrete mixer	95	89	81	75	69	61	55	49
Concrete vibrator	86	80	72	66	60	52	46	40
Conveyor belt	77	71	63	57	51	43	37	32
Crusher (aggregate)	90	84	76	70	64	56	50	44
Crane (mobile)	93	87	79	73	67	59	53	47
Dozer	95	89	81	75	69	61	55	49
Loader	95	89	81	75	69	61	55	49
Mechanical shovel	98	92	84	78	72	64	58	52
Pile driver	110	104	97	91	85	77	71	65
Pump	86	80	72	66	60	52	46	40
Pneumatic breaker	98	92	84	78	72	64	58	52
Rock drill	108	102	94	88	82	74	68	62
Roller	84	78	70	64	58	50	44	38
Trucks	-	81	73	67	64	60	57	54

Typical ambient noise conditions from a construction site are as indicated in Table C2.

TABLE C2: TYPICAL NOISE LEVELS GENERATED BY A CONSTRUCTION SITE

Noise Source	Typical Operational Noise Level at Given Offset (dBA)							
	100m	250m	500m	800	1000m	1500m	2000m	2500m
Construction site	64	56	49	44	41	36	32	29

The nature of the noise impact from the road construction activities (internal roads and access roads) is likely to be as follows:

i) The level and character of the construction noise will be highly variable as different activities with different plant/equipment take place at different times, over different periods, in different combinations, in different sequences and on different parts of the construction site.

ii) As no specific construction details or possible locations of major ancillary activity sites are available at this stage, the anticipated noise from various types of construction activities cannot be calculated accurately. In general at this stage, it can be said that the typical noise levels of construction equipment at a distance of 15 metres lie in the range of 75 decibels (dBA) to 100dBA. Refer also to Table C1. Based on data from similar "linear" construction sites, a one-hour equivalent noise level of between 75dBA and 78dBA at a point 50 metres from the construction would be typical for the earthmoving phase.

No assessment of the construction traffic has been made at this stage by the Traffic Impact Team. A project of this size will generate significant traffic daily. The noise impact from this source is not expected to be severe but this aspect will need to be investigated in more detail at the EIA Phase once the site of the new power station is finalised.

C4. ASSESSMENT OF THE OPERATIONAL PHASE

C4.1. General

The three alternative sites for the planned CCGT Power Station were evaluated on the following basis:

i) Noise impact from the existing Majuba Power Station operations.

ii) Noise impact from traffic generated by the new Power Station.

iii) Cumulative noise impact effects of both power stations.

iv) Features of acoustical significance.

C4.2. General Noise Conditions Related to the Existing Majuba Power Station

The existing Majuba Power Station is extremely noisy and can be heard 8000m to the east although at this offset the impact is not significant. The noise footprint of this power station is:

Offset from the Plant		Noise Level (dBA)
1000m	-	55
2000m	-	49
3000m	-	44
4000m	-	39
5000m	-	35

The noise levels given are the unmitigated values. A conservative approach has been taken in that a hard intervening ground condition has been modelled. The vegetation in the area will generally result in greater attenuation with distance than shown. There will also be greater attenuation than shown with distance where there are houses, other buildings and terrain restraints in the intervening ground between the source and the receiver point.

C4.3. Noise Conditions Related to the Planned CCGT Power Station

The technical details of the new power station have not yet been finalised. The following have been assumed for the Scoping Analysis. The main noise sources at the CCGT Power Station will be from the cooling fans (is dry cooling is utilised), the compressors and the gas turbines. As the generating units and associated plant are likely to be enclosed in a building, the noise from the cooling fans will be the loudest contributing source that will predominate at areas outside the CCGT Power Station property. It is predicted that the noise levels from the CCGT Power Station could be of the following order at the given offsets from the cooling fan installation:

Offset from the Plant		Noise Level (dBA)
1000m	-	55
2000m	-	49
3000m	-	44
4000m	-	39
5000m	-	35

The noise levels given are the unmitigated values. A conservative approach has been taken in that a hard intervening ground condition has been modelled. There will be greater attenuation than shown with distance where there are houses, other buildings and terrain restraints in the

intervening ground between the source and the receiver point. The sparse vegetation in the area will not assist the attenuation with distance.

Noise sensitive sites within 4000 metres of the new CCGT Power Station are potentially impacted.

C4.4. CCGT Power Station Generated Traffic

No assessment of the construction traffic which will be generated by the CCGT Power Station once it has been commissioned has been made at this stage by the Traffic Impact Team. The total daily traffic that will be generated by the new facility will be relatively small in comparison to the total volume of traffic on the adjacent main roads affecting all of the six potential development sites.

C4.5. Features of Acoustical Significance

C4.5.1. ***Wind***

Analysis of the wind records for the area indicates that the main prevailing winds blow from the east (35% of the time) and the west (29%). Approximately 0,6% *still* periods are experienced annually. This will result in a slight enhancement of noise levels in the areas to the east and west of the Power Station under the respective windy conditions.

C4.5.2. ***Topography***

The terrain at all three study sites is undulating with some features in the near ground of all the sites that will assist with attenuation.

C4.5.3. ***Vegetation***

The vegetation in all three study areas is sparse and will not contribute to the noise attenuation.

C5. EVALUATION OF THE ALTERNATIVE SITES

The analysis was based on an area of influence lying within 4000m of the potential position of the CCGT Power Station.

C5.1. Site 1 Study Area

The following were the findings regarding the Site 1 study area.

v) Areas to the north and west of the site are quiet (typical of a rural/agricultural area), although the noise climate alongside Road D97/1 is degraded.

vi) There will be significant cumulative effects from the existing Power Station to the south of this site.

vii) There are a significant number (35 identified from the topocadastral map) of noise sensitive sites (mainly farmhouses and farm labourer homes) in the study area that have the potential to be impacted by noise from the new Power Station.

viii) Access to the site is relatively easy from Road D97/1 and minor road construction will be necessary. Traffic noise impact from the new facility is not expected to be significant.

C5.2. Site 2a Study Area

The following were the findings regarding the Site 2a study area.

v) Areas in all directions from the site are quiet (typical of a rural/agricultural area), although the noise climate alongside National Road N11 is degraded. The volumes of traffic on Road D284 and Road D2514(E) are low and presently have little effect on the noise climate.

vi) There will be minor cumulative effects from the existing Power Station to the west of this site.

vii) There are a significant number (50 identified from the topocadastral map) of noise sensitive sites (mainly farmhouses and farm labourer homes) in the study area that have the potential to be impacted by noise from the new Power Station. A farm school will also be significantly affected.

viii) Access to the site is relatively easy from Road D284 and minor road construction will be necessary. Traffic noise impact from the new facility is expected to be high along Road D284 and Road D2514(E) due to existing low traffic volumes on these two facilities. This will be so during construction and operation phases.

C5.3. Site 2b Study Area

The following were the findings regarding the Site 2b study area.

v) Areas in all directions from the site are quiet (typical of a rural/agricultural area), although the noise climate alongside National Road N11 is degraded. The volumes of traffic on Road D284 and Road D2514(E) are low and presently have little effect on the noise climate.

vi) There will be minor cumulative effects from the existing Power Station to the west of this site.

vii) There are a significant number (50 identified from the topocadastral map) of noise sensitive sites (mainly farmhouses and farm labourer homes) in the study area that have the potential to be impacted by noise from the new Power Station. A farm school will also be significantly affected.

viii) Access to the site is relatively easy from Road D284 and minor road construction will be necessary. Traffic noise impact from the new facility is expected to be high along Road

D284 and Road D2514(E) due to existing low traffic volumes on these two facilities. This will be so during construction and operation phases.

C5.4. Site 3a Study Area

The following were the findings regarding the Site 3a study area.

vi) Areas to the south-west, south and east of the site are quiet (typical of a rural/agricultural area). The ash dump lies to the west.

vii) There will be significant cumulative effects from the existing Power Station to the north of this site.

viii) There are a significant number (31 identified from the topocadastral map) of noise sensitive sites (mainly farmhouses and farm labourer homes) in the study area that have the potential to be impacted by noise from the new Power Station.

ix) It is assumed that access to this site will be via a new road linking eastwards to Road D2514. Traffic noise impact from the new road facility is not expected to be significant.

x) The Majuba Coal Train Railway Line is aligned through the southern and central section of this site's area of influence. This facility does not, however, have a major influence on the noise climate of the area.

C5.5. Site 3b Study Area

The following were the findings regarding the Site 3b study area.

v) Areas to the south-west, south and east of the site are quiet (typical of a rural/agricultural area). The ash dump lies to the west.

vi) There will be significant cumulative effects from the existing Power Station to the north of this site.

vii) There are a significant number (31 identified from the topocadastral map) of noise sensitive sites (mainly farmhouses and farm labourer homes) in the study area that have the potential to be impacted by noise from the new Power Station.

viii) It is assumed that access to this site will be via a new road linking eastwards to Road D2514. Traffic noise impact from the new road facility is not expected to be significant.

C5.6. Site 3c Study Area

The following were the findings regarding the Site 3c study area.

vi) Areas to the south-east and west of the site are quiet (typical of a rural/agricultural area). The ash dump lies to the north.

vii) There will be significant cumulative effects from the existing Power Station to the north-east of this site.

viii) There are a significant number (31 identified from the topocadastral map) of noise sensitive sites (mainly farmhouses and farm labourer homes) in the study area that have the potential to be impacted by noise from the new Power Station.

ix) There is no indication from which side the access road to this site will be built. A logical alternative is from the west. If this is the case, there will be some traffic noise impact on the farms to the west of Site 3c.

x) The Majuba Coal Train Railway Line is aligned through the southern and central section of this site's area of influence. This facility does not, however, have a major influence on the noise climate of the area.

C5.7. Criteria Used to Rank Sites

The following criteria were used to rank the alternative development sites:

i) The extent to which the existing noise climate is degraded, thereby reducing the impact of the new Power Station.

ii) Potential for impact from CCGT Power Station construction activities.

iii) Potential for impact from CCGT Power Station construction traffic.

iv) Potential for impact of CCGT Power Station operations on urban areas.

v) Potential for impact of CCGT Power Station operations on settlement areas.

vi) Potential for impact of CCGT Power Station operations on farmhouses and farm labourer houses.

vii) Potential for impact of CCGT Power Station operations on farm school.

viii) Potential for impact of CCGT Power Station operational traffic.

ix) Ease to apply mitigating measures.

C5.8 Site Preference Rating (SPR)

A five point positive rating system was applied to various noise aspects in order to compare the six alternative sites. The details of the rating analysis of the six alternative sites and aspects compared are summarised in Table C3. In this approach, namely that of a positive rating, the higher the rating score, the more preferred the site. The rating scheme applied is as follows:

- 1 = not suitable for development (Impact of very high significance – negative).
- 2 = not preferred (Impact of high significance – negative).
- 3 = acceptable (Impact of moderate significance – negative).
- 4 = preferred (Impact of low or negligible significance – negative).
- 5 = ideal for development or positive impact.

TABLE C3: RATING COMPARISON OF THE SIX ALTERNATIVE SITES FOR THE PLANNED CCGT POWER STATION

Aspect for Rating	Rating for Alternative					
	Site 1	Site 2a	Site 2b	Site 3a	Site 3b	Site 3c
Suitability of existing noise climate	3	2	2	4	4	3
Impact from CCGT PS construction activities	3	2	2	3	3	2
Impact from CCGT PS construction traffic	3	2	2	3	3	2
Impact from CCGT PS operations on urban areas	3	3	3	3	3	3
Impact from CCGT PS operations on settlements	3	2	2	3	3	3
Impact from CCGT PS operations on farmhouses	3	2	2	3	3	3
Impact from CCGT PS operations on farm school	3	1	1	3	3	3
Impact from CCGT PS operational traffic	3	2	2	3	3	2
Cumulative noise effects from existing Majuba PS	3	2	2	3	3	3
Ease to apply mitigating measures	3	3	3	3	3	3
Total	**30**	**21**	**21**	**31**	**31**	**27**