dBAcoustics

TECHNICAL SPECIFICATIONS UPGRADE TO THE MODDERFONTEIN WIND ENERGY FACILITY BEAUFORT WEST REDZ 11

Part 2 Amendment Application

ENVIRONMENTAL NOISE IMPACT REPORT

BJB van der Merwe

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Date: 5 July 2021

DECLARATION OF INDEPENDENCE

I, **Barend J B van der Merwe** as duly authorised representative of **dBAcoustics**, hereby confirm my independence and declare that I have no interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which **Terramanzi Group (Pty)Ltd** was appointed as environmental assessment practitioner in terms of the National Environmental Management Act (NEMA), 1998 as amended (Act No. 107 of 1998), other than fair remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, No 43110 of 20 March 2020 for the **compilation of a professional opinion in terms of a Part 2 Amendment application for the Modderfontein Wind Energy Facility (WEF) – Noise Impact Assessment**. I further declare that I am confident in the results of the studies undertaken and conclusions drawn because of it. I have disclosed, to the environmental assessment practitioner, in writing, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2020. I have further provided the environmental assessment practitioner with written access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not. I am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2020 and any other specific and relevant legislation (national and provincial), policies, guidelines, and best practice.

Signature: 

Full Name: Barend Jacobus Barnardt van der Merwe

Date: 5 July 2021

Title / Position: Environmental noise specialist

Qualification(s): MSc Environmental Management

Experience (years): 19 years

Registration(s): SAAI, NACA, SAAG and IAIAsa

Details of specialist and expertise

I, Barend JB van der Merwe of 43 6th Street, Linden Johannesburg have been an environmental noise and ground vibration specialist for the last 18 years. I have been instrumental in the pre-feasibility studies of proposed projects which may have an impact on the environment and noise receptors. I am also involved with the noise and ground vibration impact assessments and the environmental management plans compilation of large projects such as wind farms, mining, roads, trains (primarily the Gautrain) and various point noise sources. As a post-graduate student in Environmental Management at the University of Johannesburg, I obtained an MSc degree with the research project concentrating on the impact of noise and ground vibration on a village close to a new underground mine. I have played a major role in the identification, evaluation and control of physical factors such as noise and ground vibration in the following projects – wind farms, various platinum and coal mines and the quarterly noise evaluation of the Gautrain, construction of the N2 near Butterworth, design of the Musina by-pass, noise mitigatory measures at the N17 road near Trichardt, establishment of the weigh bridge along the N3 near Pietermaritzburg, George Western by-pass. The following large environmental companies are amongst my clients: Chameleon Environmental, Gibb, Royal Haskoning DHV, Coffey Environmental, Golder Associates Africa (Pty) Ltd, GCS Environmental (Pty) Ltd, Hatch, Knight Piesold Environmental (Pty) Ltd and SRK Engineering (Pty) Ltd, WOOD Environmental.

Qualifications

1. MSc – Environmental Management – University of Johannesburg;
2. BSc - Honors in Geography and Environmental Management – University of Johannesburg;
3. National Higher Diploma in Environmental Health - Witwatersrand Technikon;
4. National Diploma in Public Health - Cape Town Technikon;
5. National Certificate in Noise Pollution - Technikon SA;
6. National Certificate in Air Pollution - Technikon SA;
7. National Certificate in Water Pollution - Technikon SA;
8. Management Development Diploma - Damelin Management School; and
9. Advanced Business Management Diploma - Rand Afrikaans University.

Membership

- South African Institute of Acoustics (SAAI);
- International Association of Impact Assessment (IAIA);
- National Association of Clean Air (NACA);
- South African Association of Geographers (SAAG).

Experience

- Noise impact assessment of different mine establishments;
- Noise Control Officer i.t.o. Noise Control Regulations;

- Compilation of noise management plans;
- Annual and quarterly baseline noise surveys;
- Moderator Wits Technikon – Environmental Pollution III.
- Various road projects for SANRAL.
- Compilation of the Integrated Pollution strategy for Ekurhuleni Town Council.
- Represent clients at Town Planning Tribunals.
- Represent clients at Housing Board tribunals.
- Determine residual noise levels in certain areas as required by clients.
- Noise attenuation at places of entertainment.
- Design and implementation of sound attenuators.
- Noise projections and contouring.
- Advisory capacity regarding noise related cases to local authorities: - Sandton, Roodepoort, Randburg, Krugersdorp, Alberton, Centurion, Vereeniging. Due to my previous experience in Local Government I provide a service to these Local government departments on the implementation of the Noise Control Regulations and SANS 10103

  of 2008 – The measurement and rating of environmental noise with respect to land use, health annoyance and to speech communication.
- Identification, Evaluation and Control of noise sources in industry.

I was involved in the following noise impact assessments during the Environmental Impact Assessment process (Noise and/or Vibration):

- Airlink BID for landing in Kruger National Park;
- Coal gasification plant in Theunissen;
- Langhoogte and Wolseley wind farms;
- Widening of N3 at Howick, KZN;
- Tulu Kapi Mine, Ethiopia;
- Boabab Iron Ore Mine, Mozambique;
- N11 Decommissioning Mokopane;
- Baseline noise survey for NuCoal Mines, Woestalleen, Vuna and Mooiplaats Collieries;
- Baseline noise monitoring Mooinooi mine;
- Leeuwpan coal mine;
- N17 Road at Trichardt for KV3 Engineers;
- N17 Road in Soweto;
- Proposed new by-pass road at Musina;
- George Western By-pass road between George Airport and Outeniqua Pass;
- Gautrain baseline monitoring;
- Upgrade of Delmas Road extensions in Moreletta Park, Pretoria;
- Proposed weigh bridge, N3, Pietermaritzburg:
- Tonkolili Manganese mine, Sierra Leone;

- Proposed wind turbines in the Western Cape – Caledon, Wolseley, Swellendam;
- Extension of works at the PPC factory in Piketberg;
- Exxaro Arnot Colliery – Mooifontein;
- Hydro power plant – 2 Sites in Durban;
- Coal export terminal in Beira, Mozambique;
- Site selection for new Power Station – Kangra Mine, Piet Retief;
- Gas exploration at Ellisras;
- Noise survey and assessment of future mine shafts at various mines;
- Mining exploration at Potgietersrus – Lonmin Akani;
- New coal mines in Witbank – Dorstfontein Expansion Project;
- New coal mines in Middelburg and Ermelo;
- New Vanadium Manganese mine in Potgietersrus;
- Xolobeni mining project in Transkei;

- Glynn mines in Sabie;
- Rezoning of properties for housing at Burgersfort, Shosanguve, Hammanskraal;
- Various noise impact assessment for clients in and around Centurion;
- Relocation of night races from Newmarket racecourse to Turfontein racecourse;
- Rezoning applications for private clients

Indemnity and Conditions Relating to this Report

The findings, results, observations, conclusions, and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information supplied by Terramanzi Group (Pty)Ltd. The accuracy of the results and conclusions are entirely reliant on the accuracy and completeness of the supplied data. dBAcoustics does not accept responsibility for any errors or omissions in the supplied data and information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions and the findings apply to the site conditions as they existed at the time of the field survey. These opinions do not necessarily apply to conditions that may arise after the date of the field survey and subsequent noise impact assessment report. The report is based on scientific and recommended survey and assessment techniques. This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must refer to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

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EXECUTIVE SUMMARY

Introduction

Environmental authorisation was granted for the Modderfontein Wind Farm Facility, Western Cape (DEA & DP Reference Number 12/12/20/1993/3) for a windfarm with 67 wind turbines with a total generating capacity of 201MW. The authorisation was granted during February 2012.

It is the intention of the owners of the wind farm South African Renewable Green Energy (Pty)Ltd to change the number of wind turbines to 34 WTG's wind turbines with a total generating capacity of 140MW (cluster 1) and 50.4MW (cluster 2) with a total generating capacity of 190.4MW. Turbines with a generating capacity of up to 5.6MW each will be used. The hub height will be 119m and the rotor diameter will be 162m. The wind farm boundaries and infra-structure remain unchanged, and the number of wind turbines will be 50% of the original application. The locations of the wind turbines will be further than 500m from the residential areas as per Requirement 7 of the authorisation granted for the establishment of a wind farm. The proposed change in the generating capacity will fall in line within the guidelines of the South African Energy Policy (1998) to meet one of the objectives to make optimal use of available energy resources.

South African Renewable Green Energy (Pty)Ltd therefore commissioned dBAcoustics to assess the proposed changes to the generating capacity of the wind turbines in terms of the noise impact into the receiving environment within the boundaries and beyond the boundaries of the wind farm.

The following methodology was employed to determine if the projected noise intrusions levels for the original noise report have changed:

- Noise modeling will be done to determine the potential noise increase at the noise receptors within and beyond the boundaries of the Modderfontein WEF;
- Determine if there were any changes to the living environment since 2011 when the initial environmental noise survey was done; and
- The updated noise data will be used to assess the potential noise intrusion levels at the noise receptors inside and in the vicinity of the approved wind farm boundaries.

The noise level from the proposed "new" wind turbines will be 106.4dBA at a height of 119m. The threshold value of 7.0dBA (Western Cape Noise Control Regulations, 2013) will not be exceeded during the day and/or night- time periods.

There will be a shift in the prevailing ambient noise level in the immediate vicinity of the wind turbines but at a distance exceeding 500m from the wind turbine the intrusion level will be minimal

and in line with the Western Cape Noise Control Regulations, 2013. The wind noise will create the predominant ambient noise level at the noise receptors which will mask the noise from the wind turbines. People who may work or visit the wind turbine will experience an increase in the prevailing ambient noise level in the vicinity of the wind turbines. The increase at the residential properties will be insignificant (on the occupants of the farmhouses and animals).

The prevailing ambient noise levels are largely created by emissions from a combination of noise sources of which the main source is wind noise and the wind turbines can only operate when the wind is blowing. The large variations in the meteorological conditions and the geographical relations between the wind turbine positions and the noise sensitive receptors allow for the decrease in the noise as it propagates from the wind turbines.

The conditions as per original authorisation (DEA & DP Reference Number 12/12/20/1993/3) will still be applicable and adhered to

Barend van der Merwe – MSc UJ
Environmental Noise and Vibration Specialist

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ABBREVIATIONS

dBA – A-weighted sound pressure level;

dB – Decibel;

IFC – International Finance Corporation;

Km/h – kilometre per hour;

m – Meters;

MW – megawatt

m/s – meters per second;

N, E, S, W – North, East, West, South

L_{Basic} – Basic noise level in dBA;

NSA – Noise sensitive areas;

MP – Measuring points;

SANS – South African National Standards;

TLB – Tractor loader backhoe

WT – Wind turbine

GLOSSARY

Ambient sound level
Means the reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation.

A-weighted sound pressure level (sound level) (L_{pA}), in decibels
The A-weighted sound pressure level is given by the equation:

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

Where

p_A is the root-mean-square sound pressure, using the frequency weighting network A in pascals; and

p_o is the reference sound pressure (p_o = 20 μPa).

NOTE The internationally accepted symbol for sound level is dBA.

Distant source
A sound source that is situated more than 500 m from the point of observation.

Disturbing noise
A disturbing noise means the following;

- Exceeds the rating level by 7.0dBA;
- Exceeds the residual noise level where the residual noise level is higher than the rating level;
- Exceeds the residual noise level by 3 dBA where the residual noise level is lower than the rating level;
- In the case of a low-frequency noise, exceeds the level specified in Annex B of SANS 10103.

Equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$), in decibels
The value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval T, has the same mean-square sound pressure as a sound under consideration whose level varies with time. It is given by the equation

$$L_{Aeq,T} = 10 \log \left[\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \frac{p_A^2(t)}{p_o^2} dt \right]$$

Where
$L_{Aeq,T}$ is the equivalent continuous A-weighted sound pressure level, in decibels, determined over a time interval T that starts at t_1 and ends at t_2;

p_o is the reference sound pressure (p_o = 20 μPa); and

$p_A(t)$ is the instantaneous A-weighted sound pressure of the sound signal, in pascals.

Impulsive sound
Sound characterised by brief excursions of sound pressure (acoustic impulses) that significantly exceed the residual noise.

Initial noise
The component of the ambient noise present in an initial situation before any change to the existing situation occurs.

Intelligible speech
Speech that can be understood without undue effort.

Low frequency noise
Sound, which predominantly contains frequencies below 100 Hz.

Nearby source
A sound source that is situated at 500 m or less from the point of observation.

Noise nuisance
Means any sound which disturbs or impairs the convenience or peace of any person.

Rating level
Means the applicable outdoor equivalent continuous rating level indicated in Table 2 of SANS 10103 2008.

Residual noise
Means means the all-encompassing sound in a given situation at a given time, measured as the reading on an integrated impulse sound level meter for a total period of at least 10 minutes, excluding noise alleged to be causing a noise nuisance or disturbing noise.

Specific noise
A component of the ambient noise which can be specifically identified by acoustical means and which may be associated with a specific source.

NOTE Complaints about noise usually arise because of one or more specific noises.

1 INTRODUCTION

dBAcoustics was commissioned by South African Renewable Green Energy (Pty)Ltd to investigate the potential noise increase of the new turbine positions and the change in the power generating capacity of 5.6MW per wind turbine. Environmental authorisation was granted for the Modderfontein Windfarm Facility, Western Cape (DEA & DP Reference Number 12/12/20/1993/3) for a windfarm of 67 wind turbines. The authorisation was granted during 2012.

The location of the wind turbines has changed but the wind farm boundaries will still be the same, and the wind farm will still be situated on Modderfontein and Phaisant Kraal which is agricultural land located south west of the R63 – 7 782m, north of the N1 – 3 901m and north-east of Three Sisters – 18 234m.

The prevailing ambient noise level within the study area is created by traffic from the R63 road (intermittent traffic flow), railway activities along the railway corridor and intermittent agricultural activities.

The main noise sources within and beyond the boundaries of the wind farm are:

- Seasonal agricultural activities;
- Traffic noise which can be continuous and/or intermittent at times;
- Railway noise - intermittent;
- Aircraft type noise - intermittent;
- Domestic type noises;
- Animal and bird noises;
- Wind noise.

The topography, ground conditions, prevailing noise sources and prevailing wind direction will be key aspects on the propagation of sound towards the noise receptors in the vicinity of the approved wind farm.

The location of the noise receptors is presented in Table 1.

Table 1: Location of the noise receptors

Receptor	Latitude	Longitude	Land use type
A	31°45.770'S	23°18.046'E	Rural
B	31°44.995'S	23°11.471'E	Rural
C	31°45.111'S	23°11.464'E	Rural
D	31°45.111'S	23°11.464'E	Rural
E	31°47.343'S	23°10.395'E	Rural
F	31°43.951'S	23°15.579'E	Rural
G	31°44.083'S	23°15.693'E	Rural

The location of the 34 wind turbines and noise receptors (A to G) in the vicinity of the wind farm is illustrated in Figure 1.

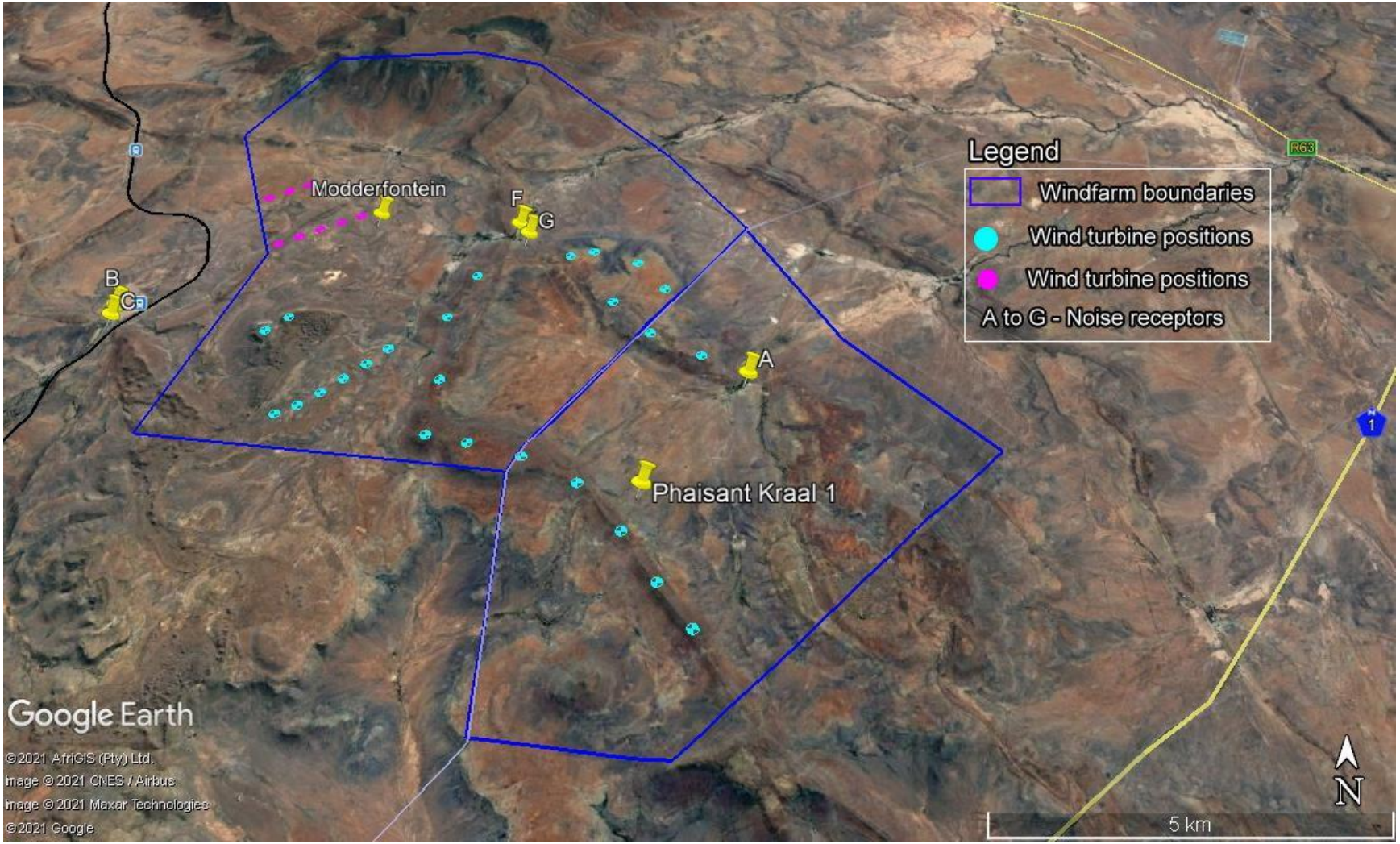

Figure 1: Location of the wind turbines and noise receptors

The recommendations by the Western Cape Provincial Government (Report 6) on the set-back distance between a wind farm and residential area are still applicable whereby the buffer zone between urban areas and the wind turbine may not be closer than 800m and between a residential dwelling and the wind turbines not closer than 400m.

1.1 Conditions of the Environmental Authorisation - Noise

The following conditions as per original authorisation (DEA & DP Reference Number 12/12/20/1993/3) will still be applicable and adhered to:

1. Construction staff must be trained to minimise noise impacts;
2. The holder of this authorisation must ensure that the National Control Regulations and SANS 10103:2008 are adhered to and reasonable measures to limit noise from the work site are implemented;
3. The holder of this authorisation must ensure that the construction staff working in areas where the 8-hour ambient noise levels exceed 75.0dBAmust wear ear protection devices;
4. The holder of this authorisation must ensure that all equipment and machinery are well maintained and equipped with silencers;
5. The holder of this authorisation must provide a warning to the community when noisy activity e.g. blasting is to take place;
6. All noisy construction operations should only occur during daylight hours;
7. All wind turbines must be located at a set-back distance of 500m from any homestead and a day/night noise criteria level at the nearest residents of 45.0dBA should be used to locate the turbines. The 500m setback distance can be relaxed if local factors; such as high ground between the noise source and the receiver, indicates that a noise disturbance will not occur;
8. Positions of turbines jeopardizing compliance with accepted noise levels should be revised during the micro-siting of the units in question and predicted noise levels re-modelled by the noise specialist in order to ensure that the predicted noise levels are less than 45.0dBA.

1.1.1 Background to noise

Sound is a wave motion, which occurs when a sound source sets the nearest particles of air in motion. The movement gradually spreads to air particles further away from the source. Sound propagates in air with a speed of approximately 340 m/s.

The sound pressure level in free field conditions is inversely proportional to the square of the distance from the sound source – Inverse Square Law. Expressed logarithmically as decibels, this means the sound level decrease 6 dB with the doubling of distance. This applies to a point source only. If the sound is uniform and linear then the decrease is only 3 dB per doubling of distance.

The decibel scale is logarithmic therefore decibel levels cannot be added together in the normal arithmetic way, for example, two sound sources of 50 dB each do not produce 100 dB but 53 dB, nor does 50 dB and 30 dB equal 80 dB, but remains 50 dB.

Air absorption is important over large distances at high frequencies and it depends on

the humidity but is typically about 40 dB/km @ 4000 Hz. Traffic noise frequencies are mainly mid/low and will be unaffected below 200m.

When measuring the intensity of a sound, an instrument, which duplicates the ear variable sensitivity to sound of different frequency, is usually used. This is achieved by building a filter into the instrument with a similar frequency response to that of the ear. This is called an A-weighting filter because it conforms to the internationally standardized A-weighting curves. Measurements of sound level made with this filter are called A-weighted sound level measurements, and the unit is dB.

Sound propagation is affected by wind gradient rather than the wind itself. The profile of the ground causes such a gradient. The sound may be propagated during upwind conditions upwards to create a sound shadow. A downwind refracts the sound towards the ground producing a slight increase in sound level over calm isothermal conditions.

The velocity of sound is inversely proportional to the temperature therefore a temperature gradient produces a velocity gradient and a refraction of the sound. Temperature decreases with height and the sound is refracted upwards.

For a source and receiver close to the ground quite large attenuation can be obtained at certain frequencies over absorbing surfaces, noticeably grassland. This attenuation is caused by a change in phase when the reflected wave strikes the absorbing ground and the destructive interference of that wave with the direct wave. The reduction in sound tends to be concentrated between 250 Hz and 600 Hz.

Noise screening can be effective when there is a barrier between the receiver and the source i.e. walls, earth mounds, cuttings, and buildings. The performance of barriers is frequency dependent. To avoid sound transmission through a barrier the superficial mass should be greater than 10 Kg/m^2.

There is a complex relation between subjective loudness and the sound pressure level and again between annoyance due to noise and the sound pressure level. In general, the ear is less sensitive at low frequencies and the ear will only detect a difference in the sound pressure level when the ambient noise level is exceeded by 3-5 dBA.

There are certain effects produced by sound which, if it is not controlled by approved acoustic mitigatory measures, seem to be construed as undesirable by most people and they are:

- Long exposure to high levels of sound, which may damage the hearing or create a temporary threshold shift – in industry or at areas where music is played louder than 95 dBA. This will seldom happen in far-field conditions;
- Interference with speech where important information by the receiver cannot be analysed due to loud noises;
- Excessive loudness;
- Annoyance.

Several factors, for example clarity of speech, age of listener and the presence of noise induced threshold displacement, will influence the comprehensibility of speech

communication. The effect of noise (except for long duration, high level noise) on humans is limited to disturbance and/or annoyance and the accompanying emotional reaction. This reaction is very difficult to predict and is influenced by the emotional state of the complainant, his attitude towards the noisemaker, the time of day or night and the day of the week.

Types of noise exposure:

- Continuous exposure to noise – The level is constant and does not vary with time e.g. traffic on freeway and an extractor fan;
- Intermittent exposure to noise – The noise level is not constant and occurs at times e.g. car alarms and sirens;
- Exposure to impact noise – A sharp burst of sound at intermittent intervals e.g. explosions and low frequency sound.

These time-varying characteristics of environmental noise are described using statistical noise descriptors:

Leq: The Leq is the constant sound level that would contain the same acoustic energy as the varying sound level, during the same period.

L_{Max}: The instantaneous maximum noise level for a specified period.

L_{Min}: The instantaneous minimum noise level for a specified period.

The following relationships occur for increases in A-weighted noise levels:

- The trained healthy human ear can discern changes in sound levels of 1 dBA under controlled conditions in an acoustic laboratory;
- It is widely accepted that the average healthy ear can barely perceive noise level changes of 3 dBA;
- A change in sound level of 5 dBA is a readily perceptible increase in noise level;
- A 10-dBA change in the sound level is perceived as twice as loud as the original source.

The World Bank in the Environmental Health and Safety Regulations has laid down the following noise level guidelines:

- Residential area – 55 dBA for the daytime and 45 dBA for the night-time period;
- Industrial area – 70 dBA for the day- and night-time periods.

The difference between the actual noise and the ambient noise level and the time of the day and the duration of the activity, will determine how people will respond to sound and what the noise impact will be. To evaluate such, there must be uniform guidelines to evaluate each scenario. SANS 10103 of 2008 has laid down sound pressure levels for specific districts and has provided the following continuous noise levels per district as given in Table 2.

Table 2: Recommended noise levels for different types of districts

Type of district	Equivalent continuous rating level $L_{Req,T}$ for ambient noise					
	Outdoors			Indoors, with open windows		
	Day-night	Daytime	Night-time	*Day-night*	Daytime	Night-time
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with some workshops, with business premises and with main roads	60	60	50	50	50	40
e) Central business district	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

The reference time intervals can be specified to cover typical human activities and variations in the operation of noise sources and are for daytime between 6h00 to 22h00 and for night-time between 22h00 and 6h00.

The study area falls within an (a) to (b) type districts because of the type of activities such as main roads, gravel roads, little traffic and major traffic which all have an influence on the prevailing ambient noise level for a specific area.

There is therefore a mixture of activities and higher noise levels as per the above recommended continuous rating levels within i.e. residential, agricultural activities (seasonal) and feeder roads in proximity of each other or to a farmhouse. A farmhouse next to the R63 road will experience higher noise levels than the farmhouse/s some distance from roads. The ambient noise level will therefore differ throughout the study area, depending on the location and the measuring position in relation to areas with existing noise sources such as roads.

People exposed to an increase in the prevailing ambient noise level will react differently to the noise levels and the response is given in Table 3.

Table 3: Estimated community/group response when the ambient noise level is exceeded (Source: SANS 10103 of 2008).

1	2	3
Excess $)L_{Req,T}$[1)]	**Estimated community/group response**	
dB	**Category**	**Description**
0	None	No observed reaction
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

1) Calculate $)L_{Req,T}$ from the appropriate of the following:
a) $)L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS $L_{Req,T}$ of the residual noise (determine the specific noise under investigation).
b) $)L_{Req,T}$ = $L_{req,T}$ of ambient noise under investigation MINUS the maximum rating level for the ambie table 1.
c) $)L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS the typical rating level for the applicab determined from table 2.

The difference between the actual noise and the ambient noise level will determine how people will respond to sound.

1.2 Legislative and Policy Context

There were no changes to the following legislation and policies except for the new Noise Control Regulations for the Western Cape promulgated in 2013.

International Guidelines

- Noise guidelines for wind farms, MOE, 2008 (MOE)[i];
- Environmental, Health and Safety (EHS) Guidelines, World Health Organisation (WHO, 2002)[ii]; and
- The guidelines for the assessment and rating of noise from wind farms, ETSU, 1997 (ETSU, 1997)[iii].

National legislation

- National Environmental Management Act. 2006 Act 62 of 2008 (RSA, 2008)[iv].

Provincial legislation

- Western Cape Noise Regulations No 7141 of 20 June 2013[v].

National Standards

- SANS 10357 of 2004 – The calculation of sound propagation by the concave method (SANS, 2004)[vi];
- SANS 10210 of 2004 – Calculating and predicting road traffic noise (SANS, 2004)[vii];
- SANS 10328 of 2008 – Methods for environmental noise impact assessments (SANS, 2008)[viii]; and
- SANS 10103 of 2008 – The measurement and rating of environmental noise with respect to annoyance and to speech communication (SANS, 2008)[ix].

A disturbing noise according to the Western Cape Noise Regulations, 2013 means a noise, excluding the unamplified human voice:

- Exceeds the rating level by 7.0dBA;
- Exceeds the residual noise level where the residual noise level is higher than the rating level;
- Exceeds the residual noise level by 3 dBA where the residual noise level is lower than the rating level;
- in the case of a low-frequency noise, exceeds the level specified in Annex B of SANS 10103.

Constitution of South the Republic of South Africa (RSA, 1996)[x]

Article 24: Everyone has the right -
(a) to an environment that is not harmful to their health and well-being; and
(b) to have the environment protected for the present and future generations through reasonable legislative and other measures that-
(i) prevent pollution and ecological degradation;
(ii) promote conservation; and
(iii) secure ecological sustainable development and use of natural resources, while promoting justifiable economic and social development.

The potential noise impact by the wind turbines will be evaluated in terms of the above legislation and if the establishment of the turbines will have a negative effect on the people living in the vicinity of the proposed wind farm.

1.2.1 Policy Requirements

Strategic Initiative to Introduce Commercial Land Based Wind Energy Development to the Western Cape – Report 4, Comparative assessment (Western Cape, 2006)[xi]

Set back distance between NSAs and residential areas:

a) 800m between urban edge and wind turbines;
b) 400m between a residential property and a wind turbine

1.3 Assessment Methodology

1.3.1 Instrumentation

The noise survey will be based on the noise data which was used during the 2011 EIA Assessment (M^2 Environmental Connections CC, 2011) as there were little to no changes since 2011, when the noise survey was done. The noise levels in the vicinity of the noise receptors were as follow

1.3.2 Measuring points and results

The noise measuring points, and resultant noise data will be the same as the 2011 noise impact assessment report.

The prevailing noise levels (dBA) are given in Table 4.

Table 4: Prevailing ambient noise levels

Receptor	Day				Night			
	$L_{Aeq,T}$	$L_{A,max}$	$L_{A,min}$	L_{A90}	$L_{Aeq,T}$	$L_{A,max}$	$L_{A,min}$	L_{A90}
A	39.8	56.6	21.8	27.9	51.1	63.7	20.0	23.9
B	47.3	62.1	32.0	36.0	31.3	46.6	20.0	24.8
C	47.3	62.1	32.0	36.0	31.3	46.6	20.0	24.8
D	30.3	51.6	20.7	22.9	26.6	50.3	20.0	20.0
E	30.3	51.6	20.7	22.9	26.6	50.3	20.0	20.0
F	39.8	56.6	21.8	27.9	51.1	63.7	20.0	23.9
G	39.8	56.6	21.8	27.9	51.1	63.7	20.0	23.9

1.3.3 Current noise sources

Traffic noise (2 vehicles over the measuring period), trains (5 trains used the railroad), wind noise, domestic type noise and farming activity noise (seasonal) are the main contributors to the prevailing ambient noise level of the different areas. The prevailing noise level is proportional to the distance from the main noise sources. The wind and the trees play an important role in the change of the pre-vailing ambient noise levels and there is a definite shift in the ambient noise levels at the different wind speeds with an upwards increase of the noise level the higher the wind speed. The ambient noise level increased by 7.0dBA when the wind was blowing at a speed of 5.0m/s description of noise receptors in the vicinity of the wind turbines (1 to 25).

The distance between the noise receptors, the wind noise and other noise sources such as traffic, farming activities and insects all contribute to the prevailing ambient noise level on a continuous to intermittent basis.

The location of the residential properties in terms of the wind turbines are illustrated in Figure 1 on Page 9.

1.4 Noise mapping

1.4.1 Projected noise levels according to a Noise Map software

The cumulative noise projections were done with a Noise Map software program where the height of the tower, noise level at Nacelle, octave band, wind speed, humidity, topography, ground conditions and temperature forms part of the data input. The noise contours were compiled for the 119m high wind turbine with a rotor diameter of 162m with a noise level of 106.4dBA at hub height (see Figure 3). The make of the wind turbine was not available and the information of a Nordex type wind turbine was used for determining the projected noise levels at the different noise receptors.

The predominant average hourly wind direction in Victoria West varies throughout the year.

The wind is most often from the *west* for *3.6 weeks*, from *March 8* to *April 2* and for *1.2 months*, from *August 29* to *October 5*, with a peak percentage of *36%* on *September 9*. The wind is most often from the *north* for *4.9 months*, from *April 2* to *August 29*, with a peak percentage of *52%* on *July 3*. The wind is most often from the *south* for *5.1 months*, from *October 5* to *March 8*, with a peak percentage of *40%* on *January 1*. The wind direction is illustrated in Figure 2.

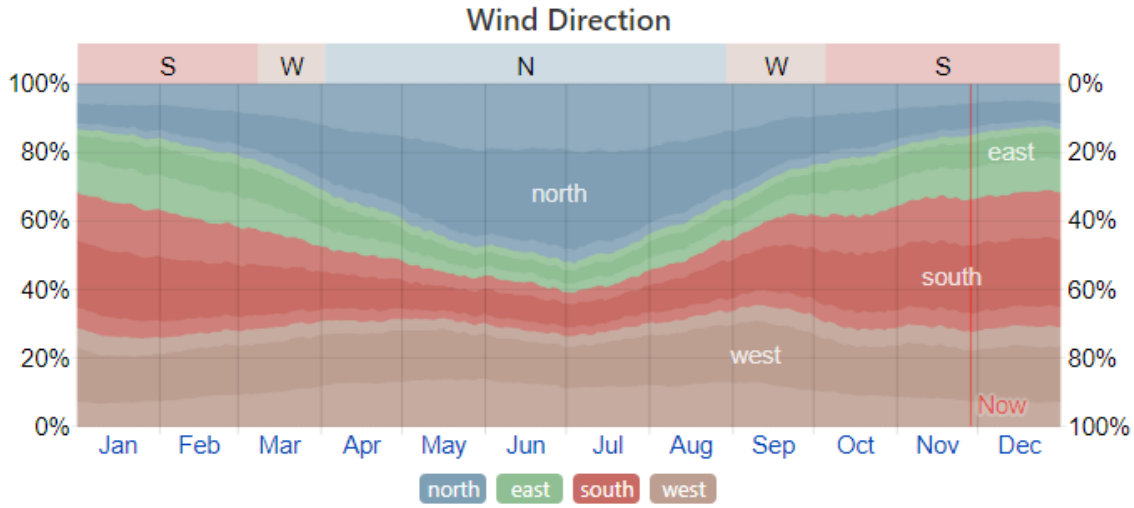

Figure 2: Wind direction[xii]

The noise levels during wind speeds of different magnitude are as follows:

- 1.0m/s – 40.3dBA;
- 2.1m/s – 40.6dBA;
- 3.1m/s – 42.7dBA;
- 4.2m/s – 46.9dBA;
- 5.2dBA – 48.9dBA;
- 6.9dBA – 58.9dBA;
- 7.7m/s – 67.6dBA; and
- 15.2m/s – 70.8dBA.

The measured noise levels in areas where the noise level was above 50.0dBA were from traffic and/or agricultural type activities and when it was lower than 40.0dBA there was no wind but distant noise sources such as traffic, fans and/or agricultural activities. The magnitude of the noise intrusion levels during the day and night-time was done according to the following criteria as illustrated in Table 5.

Table 5: Noise level criteria

Increase Δ -dBA	**Assessment of impact magnitude**	**Color code**
0 <Δ≤ 1	Not audible	
1 <Δ≤ 3	Very Low	
3 <Δ≤ 5	Low	
5 <Δ≤ 10	Medium	
10 <Δ≤ 15	High	
15 <Δ	Very high	

The noise contours for the results of the noise survey and the subsequent noise intrusion levels at the different residential areas (A to G) are given in Figure 3 and the noise intrusion levels in Table 6.

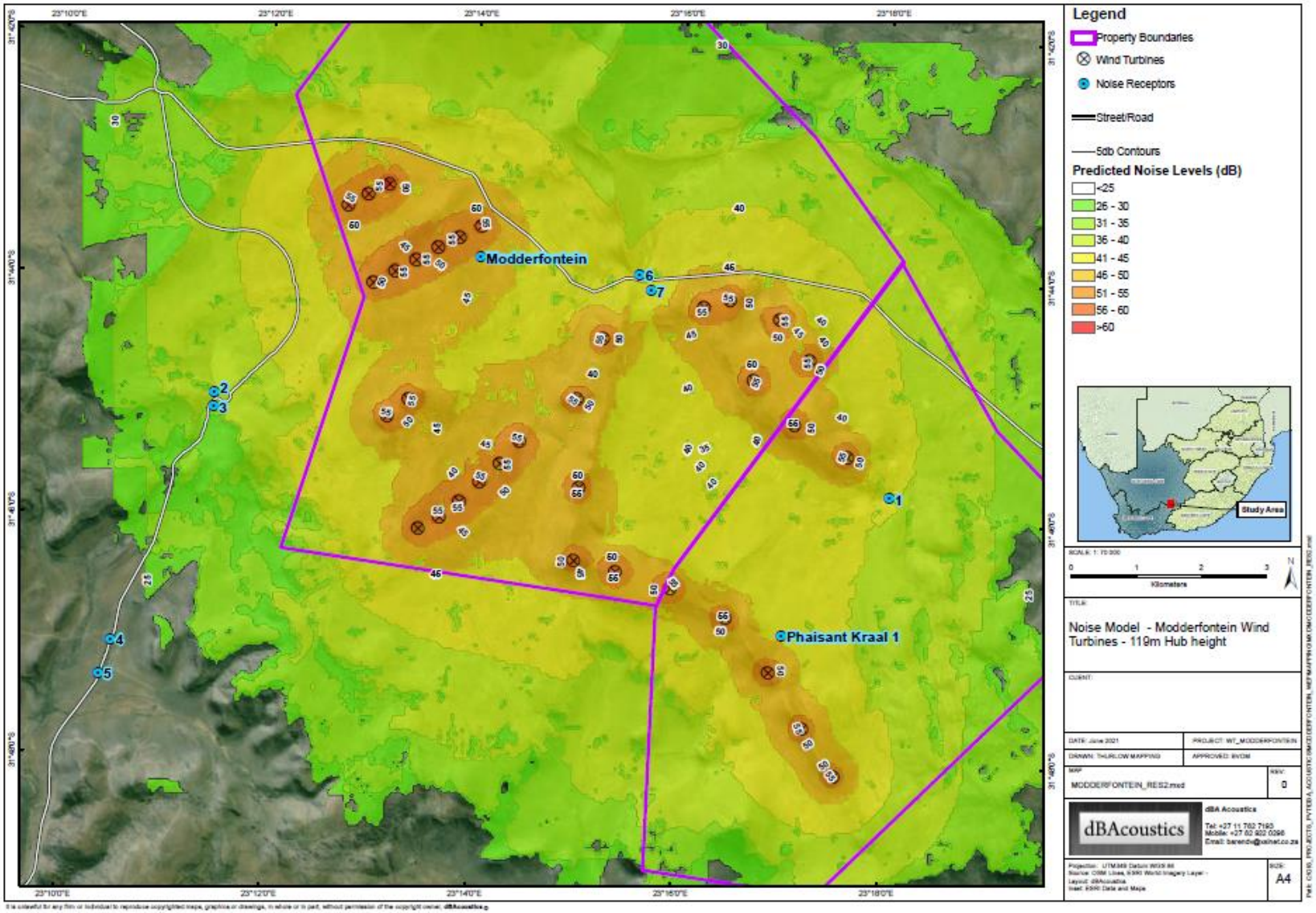

Figure 3: Noise contours

Table 6: Noise intrusion levels at the different noise receptors - projected

NSA	Projected noise level at noise receptor with 119m Wind turbine	Prevailing ambient noise level – daytime	Prevailing ambient noise level - night-time	Prevailing wind speed – m/s	Prevailing wind speed – m/s	Noise intrusion levels –daytime	Noise intrusion levels –night-time
A	40.0	39.8	51.1	3.7	5.7	0.2	-11.1
B	39.0	47.3	31.3	5.6	3.2	-8.3	7.7
C	37.0	47.3	31.3	5.6	3.2	-8.3	7.7
D	37.0	30.3	31.3	2.7	1.8	6.7	--3.7
E	37.0	30.3	31.3	2.7	1.8	6.7	--3.7
F	41.0	39.8	51.1	3.7	5.7	-1.2	-10.1
G	43.0	39.8	51.1	3.7	5.7	-3.2	-10.1

Two aspects are important when considering potential noise impacts of a project namely:

- The increase in the noise level because of the construction and operational phases, and;
- The overall noise level produced by the turbines.

The prevailing ambient noise level may change according to the season of the year when farming activities or wind becomes the pre-dominant contributor to the higher ambient noise levels.

1.4.2 Assumptions and Limitations

The following assumptions were used in the noise impact assessment:

- The noise level of 106.4dBA which was used for the noise mapping procedure was a general noise level and not turbine specific;
- The number of turbines were 25 and should the number be reduced the noise impact will be less;
- The noise mapping was based on the location of the turbines as illustrated in Figure 3.

2 IMPACTS IDENTIFICATION AND ASSESSMENT

2.1 Identification of Impacts

2.1.1 Construction Phase – Environmental Authorisation already issued for this phase. There will be no changes to the construction phase.

- Grading and building of new roads and trenches

  Noise may be generated by the construction activities and the use of construction equipment such as Graders, TLB's and Front-end loaders. The use of this equipment will create an increase in noise levels in the immediate vicinity of the construction activities and in some cases at some distance from the activities.

- Preparation of the footprint, digging of trenches, earthworks, and construction of the base of the wind turbine.

  Noise could be generated by the following activities: earth drilling, generator noise, civil construction and in extreme cases localised blasting.

- Construction of the wind turbines on site

  The construction of the wind turbines could generate localised noise increase in particular the use of cranes and generators during the assembly stage of the wind turbine.

- Construction traffic

  Construction traffic to and from the site would create a temporary linear noise source.

2.1.2 Operational Phase – The increase in the height of the turbines will be the only change as the turbine positions will remain the same.

- Noise generated by the wind turbines

  The blade and the tip speed of the blade may cause an increased noise level in the vicinity of the turbine.

- Wind turbines – mechanical noise

  Mechanical noise generated by the gearbox and generator which is situated at 119m from ground level.

- Wind turbines - normal wear and tear, and the lack of preventative maintenance.

Noise could be generated through the lack of a cyclic maintenance programme to identify normal wear and tear of the essential components such as the gear-box, generator and blades.

- Wind turbine noise

  Mechanical noise - Mechanical noise is associated with the relevant motion between the various parts inside the nacelle.

  Aerodynamic noise

  - Low-frequency noise
  - Turbulent inflow noise
  - Turbulent boundary layer trailing edge noise
  - Laminar boundary layer vortex shedding noise
  - Tip vortex formation noise
  - Trailing edge bluntness vortex shedding noise

- Amplitude modulation

  Amplitude modulation of wind turbine noise is commonly described as swish, or thump sound (downward movement of the blade and vertical wind speed shear) of the blade in the vicinity of a wind turbine. – Amplitude modulation relates to the change in amplitude (loudness) occurring at the blade passing frequency. For a three-blade turbine this will be three times the rational speed of the blades rotating.

- Traffic

  Traffic noise is created by vehicle movement where mechanical noise, rattles, and road surface play an important role on the noise levels along roads or some distance from roads.

- Sub-station and overhead power lines

  A sub-station can generate noise from the blowers and transformers, and corona noise from the overhead power lines. These noise levels are site specific.

- Maintenance activities

  The regular maintenance activities may give rise to site-specific increase in the noise levels.

2.1.3 Decommissioning Phase - Environmental Authorisation already issued for this phase. There will be no changes to the decommissioning phase.

The dismantling of the wind turbines will involve mechanical machinery with associated mechanical type noise which will be a point noise source.

2.2 Impact Assessment Methodology

The possible noise impacts were evaluated in terms of the criteria given below.

ITEM	DEFINITION
EXTENT	
Local	Extending only as far as the boundaries of the activity, limited to the site and its immediate surroundings
Regional	Impact on the broader region
National	Will have an impact on a national scale or across international borders
DURATION	
Short-term	0-5 years
Medium-Term	5-15 years
Long-Term	>15 years, where the impact will cease after the operational life of the activity
Permanent	Where mitigation, either by natural process or human intervention, will not occur in such a way or in such a time span that the impact can be considered transient.
MAGNITUDE OR INTENSITY	
Low	Where the receiving natural, cultural or social function/environment is negligibly affected or where the impact is so low that remedial action is not required.
Medium	Where the affected environment is altered, but not severely and the impact can be mitigated successfully and natural, cultural, or social functions and processes can continue, albeit in a modified way.
High	Where natural, cultural, or social functions or processes are substantially altered to a very large degree. If a negative impact then this could lead to unacceptable consequences for the cultural and/or social functions and/or irreplaceable loss of biodiversity to the extent that natural, cultural, or social functions could temporarily or permanently cease.
PROBABILITY	
Improbable	Where the possibility of the impact materialising is very low, either because of design or historic experience
Probable	Where there is a distinct possibility that the impact will occur
Highly Probable	Where it is most likely that the impact will occur
Definite	Where the impact will undoubtedly occur, regardless of any prevention measures
SIGNIFICANCE	
Low	Where a potential impact will have a negligible effect on natural, cultural, or social environments and the effect on the decision is negligible. This will not require special design considerations for the project
Medium	Where it would have, or there would be a moderate risk to natural, cultural, or social environments and should influence the decision. The project will require modification or mitigation measures to be included in the design

High	Where it would have, or there would be a high risk of, a large effect on natural, cultural, or social environments. These impacts should have a major influence on decision making.
Very High	Where it would have, or there would be a high risk of, an irreversible negative impact on biodiversity and irreplaceable loss of natural capital that could result in the project being environmentally unacceptable, even with mitigation. Alternatively, it could lead to a major positive effect. Impacts of this nature must be a central factor in decision making.
STATUS OF IMPACT	
Whether the impact is positive (a benefit), negative (a cost) or neutral (status quo maintained)	
DEGREE OF CONFIDENCE IN PREDICTIONS	
The degree of confidence in the predictions is based on the availability of information and specialist knowledge (e.g., low, medium, or high)	
MITIGATION	
Mechanisms used to control, minimise and or eliminate negative impacts on the environment and to enhance project benefits Mitigation measures should be considered in terms of the following hierarchy: (1) avoidance, (2) minimisation, (3) restoration and (4) off-sets.	

Scoring system for impact assessment rating

IMPACT PARAMETER	**SCORE**	
Extent (A)	**Rating**	
Local	1	
Regional	2	
National	3	
Duration (B)	**Rating**	
Short term	1	
Medium Term	2	
Long Term	3	
Permanent	4	
Probability (C)	**Rating**	
Improbable	1	
Probable	2	
Highly Probable	3	
Definite	4	
IMPACT PARAMETER	**NEGATIVE IMPACT SCORE**	**POSITIVE IMPACT SCORE**
Magnitude/Intensity (D)	**Rating**	**Rating**
Low	-1	1
Medium	-2	2
High	-3	3
SIGNIFICANCE RATING (F) = (A*B*D)*C	**Rating**	**Rating**
Low	0 to - 40	0 to 40
Medium	- 41 to - 80	41 to 80
High	- 81 to - 120	81 to 120
Very High	> - 120	> 120

2.3 Impact Assessment – Proposed Development

The qualitative impact assessment for the different phases is presented in Tables 7, 8, 9 and 10, this is based on the impact before and after mitigation measures.

2.3.1 Construction phase

Table 7: Impact assessment – Construction phase

IMPACT NATURE	**Impact – Nature of Impact** **Noise from grading and building of new roads**		**STATUS**	**NEGATIVE**
Impact Description	Change in the prevailing ambient noise levels in the vicinity of the construction activities.			
Impact Source(s)	Construction vehicles such as graders, rippers, earthmoving equipment, hauling vehicles.			
Receptor(s)	Farm-houses A, F and G.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	2	Preferred Alternative:	2
	No-Go Alternative:	2	No-Go Alternative:	2
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	3	No-Go Alternative:	2
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	**-4**	Preferred Alternative:	**-4**
	No-Go Alternative:	**-12**	No-Go Alternative:	**-8**
CUMULATIVE IMPACTS	The noise impact during the daytime will be below the threshold value of 7.0dBA.			
CONFIDENCE	High			
MITIGATION MEASURES	Construction of trenches and new roads to take place during daytime only			

IMPACT NATURE	Impact – Nature of Impact Noise from the preparation of the footprint, earthworks, and construction of the base of the wind turbine		STATUS	NEGATIVE
Impact Description	Change in the prevailing ambient noise levels in the vicinity of the construction activities.			
Impact Source(s)	Construction vehicles such as graders, rippers, earthmoving equipment, hauling vehicles.			
Receptor(s)	Farm-houses A, F and G.			
PARAMETER	WITHOUT MITIGATION	SCORE	WITH MITIGATION	SCORE
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	2	Preferred Alternative:	2
	No-Go Alternative:	2	No-Go Alternative:	2
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	3	No-Go Alternative:	2
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	**-4**	Preferred Alternative:	**-4**
	No-Go Alternative:	**-12**	No-Go Alternative:	**-8**
CUMULATIVE IMPACTS	The noise impact during the daytime will be below the threshold value of 7.0dBA.			
CONFIDENCE	High			
MITIGATION MEASURES	Construction activities to take place during daytime only			

IMPACT NATURE	Impact – Nature of Impact Noise from the construction of the wind turbines – off loading of blades, generator, and mast.		STATUS	NEGATIVE
Impact Description	Change in the prevailing ambient noise levels in the vicinity of the construction activities.			
Impact Source(s)	Cranes, generators, heavy-duty motor vehicles.			
Receptor(s)	Farm-houses A, F and G.			
PARAMETER	WITHOUT MITIGATION	SCORE	WITH MITIGATION	SCORE
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	2	Preferred Alternative:	2
	No-Go Alternative:	2	No-Go Alternative:	2
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1

	No-Go Alternative:	3	No-Go Alternative:	2
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	**-4**	Preferred Alternative:	**-4**
	No-Go Alternative:	**-12**	No-Go Alternative:	**-8**
CUMULATIVE IMPACTS	The noise impact during the daytime will be below the threshold value of 7.0dBA.			
CONFIDENCE	High			
MITIGATION MEASURES	Construction activities to take place during daytime only			

IMPACT NATURE	**Impact – Nature of Impact** **Noise from construction vehicles and traffic to and from the wind turbine construction sites.**		**STATUS**	**NEGATIVE**
Impact Description	Change in the prevailing ambient noise levels in the vicinity of the construction activities.			
Impact Source(s)	Low-bed vehicles, generator, construction vehicles.			
Receptor(s)	Farm-houses A, F and G.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	2	Preferred Alternative:	2
	No-Go Alternative:	2	No-Go Alternative:	2
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	3	No-Go Alternative:	2
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	**-4**	Preferred Alternative:	**-4**
	No-Go Alternative:	**-12**	No-Go Alternative:	**-8**
CUMULATIVE IMPACTS	The noise impact during the daytime will be below the threshold value of 7.0dBA.			
CONFIDENCE	High			
MITIGATION MEASURES	Construction activities to take place during daytime only			

2.3.2 Operational phase

Table 8: Impact assessment – Operational phase

IMPACT NATURE	Impact – Nature of Impact Noise generated by the wind turbines.		STATUS	NEGATIVE
Impact Description	Change in the prevailing ambient noise levels in the vicinity of the wind turbine site/s			
Impact Source(s)	Blades, nacelle.			
Receptor(s)	Farm-houses A, F and G.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	4	Preferred Alternative:	4
	No-Go Alternative:	4	No-Go Alternative:	4
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	3	No-Go Alternative:	2
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	**-8**	Preferred Alternative:	**-8**
	No-Go Alternative:	**-24**	No-Go Alternative:	**-16**
CUMULATIVE IMPACTS	The noise impact during the power generation activities will be below the threshold value of 7.0dBA.			
CONFIDENCE	High			
MITIGATION MEASURES	Ensure that all wind turbines have a buffer of 500m between the wind turbine and the noise sensitive areas. Latest technology to be applied to blade design to minimise the noise levels and to take care of the low frequency noise, turbulent inflow noise, turbulent boundary layer trailing edge noise, boundary layer vortex shedding noise, tip vortex formation noise and the trailing edge bluntness vortex noise			

IMPACT NATURE	**Impact – Nature of Impact** **Noise from mechanical noise generated by the gearbox and generator (nacelle) which is situated at 119m from ground level.**		**STATUS**	**NEGATIVE**
Impact Description	Change in the prevailing ambient noise levels in the vicinity of the turbines during the operational phase.			
Impact Source(s)	Generator and nacelle.			
Receptor(s)	Farm-houses A, F and G.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	4	Preferred Alternative:	4
	No-Go Alternative:	4	No-Go Alternative:	4
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	3	No-Go Alternative:	2
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	**-8**	Preferred Alternative:	**-8**
	No-Go Alternative:	**-24**	No-Go Alternative:	**-16**
CUMULATIVE IMPACTS	The noise impact during the power generation activities will be below the threshold value of 7.0dBA.			
CONFIDENCE	High			
MITIGATION MEASURES	Acoustic insulation on the inside of the Nacelle turbine housing; Acoustic insulation curtains; Anti-vibration support footing.			

IMPACT NATURE	**Impact – Nature of Impact** **Noise from normal wear and tear of the essential components such as gear-box, generator and blades.**		**STATUS**	**NEGATIVE**
Impact Description	Change in the prevailing ambient noise levels in the vicinity of the wind turbines.			
Impact Source(s)	Low-bed vehicles, generator, construction vehicles.			
Receptor(s)	Farm-houses A, F and G.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	4	Preferred Alternative:	4
	No-Go Alternative:	4	No-Go Alternative:	4
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1

	No-Go Alternative:	3	No-Go Alternative:	2
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	**-8**	Preferred Alternative:	**-8**
	No-Go Alternative:	**-24**	No-Go Alternative:	**-16**
CUMULATIVE IMPACTS	The noise impact during the power generation activities will be below the threshold value of 7.0dBA.			
CONFIDENCE	High			
MITIGATION MEASURES	Cyclic maintenance programme of the wind turbines; Withdraw from services should a wind turbine create excessive noise due to wear and tear or poor maintenance.			

IMPACT NATURE	**Impact – Nature of Impact** **Noise from amplitude modulation.**		**STATUS**	**NEGATIVE**
Impact Description	Change in the prevailing ambient noise levels in the vicinity of the wind turbines..			
Impact Source(s)	Blades.			
Receptor(s)	Farm-houses A, F and G.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	4	Preferred Alternative:	4
	No-Go Alternative:	4	No-Go Alternative:	4
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	3	No-Go Alternative:	2
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	**-8**	Preferred Alternative:	**-8**
	No-Go Alternative:	**-24**	No-Go Alternative:	**-16**
CUMULATIVE IMPACTS	The noise impact during the power generation activities will be below the threshold value of 7.0dBA.			
CONFIDENCE	High			
MITIGATION MEASURES	Ensure that all wind turbines have a buffer of 500m between the wind turbine and the noise sensitive areas. Latest technology to be applied to blade design to minimise the noise levels and to take care of the low frequency noise, turbulent inflow noise, turbulent boundary layer trailing edge noise, boundary layer vortex shedding noise, tip vortex formation noise and the trailing edge bluntness vortex noise.			

IMPACT NATURE	Impact – Nature of Impact Noise from traffic to and from the wind turbine sites.		STATUS	NEGATIVE
Impact Description	Change in the prevailing ambient noise levels in the vicinity of the traffic along the access roads to the turbines.			
Impact Source(s)	Motor-vehicles			
Receptor(s)	Farm-houses A, F and G.			
PARAMETER	WITHOUT MITIGATION	SCORE	WITH MITIGATION	SCORE
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	4	Preferred Alternative:	4
	No-Go Alternative:	4	No-Go Alternative:	4
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	3	No-Go Alternative:	2
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	**-8**	Preferred Alternative:	**-8**
	No-Go Alternative:	**-24**	No-Go Alternative:	**-16**
CUMULATIVE IMPACTS	The noise impact during the power generation activities will be below the threshold value of 7.0dBA.			
CONFIDENCE	High			
MITIGATION MEASURES	Internal roads to be always kept in a good condition and free from potholes.			

IMPACT NATURE	Impact – Nature of Impact Noise from sub-station and overhead power lines.		STATUS	NEGATIVE
Impact Description	Change in the prevailing ambient noise levels in the vicinity of the sub-station and the overhead power lines.			
Impact Source(s)	Sub-station and overhead power lines.			
Receptor(s)	Farm-houses A, F and G.			
PARAMETER	WITHOUT MITIGATION	SCORE	WITH MITIGATION	SCORE
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	4	Preferred Alternative:	2
	No-Go Alternative:	4	No-Go Alternative:	2
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	3	No-Go Alternative:	2
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1	Preferred Alternative:	-1

	No-Go Alternative:	-2	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	**-8**	Preferred Alternative:	**-4**
	No-Go Alternative:	**-24**	No-Go Alternative:	**-8**
CUMULATIVE IMPACTS	The noise impact during the power generation activities will be below the threshold value of 7.0dBA.			
CONFIDENCE	High			
MITIGATION MEASURES	Overhead power lines to be erected some distance from the residential properties.			

IMPACT NATURE	**Impact – Nature of Impact** **Noise from cyclic and/or emergency maintenance activities.**		**STATUS**	**NEGATIVE**
Impact Description	Change in the prevailing ambient noise levels in the vicinity of the maintenance activities.			
Impact Source(s)	Power tools and emergency generator (if required)			
Receptor(s)	Farm-houses A, F and G.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	4	Preferred Alternative:	4
	No-Go Alternative:	4	No-Go Alternative:	4
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	3	No-Go Alternative:	2
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	**-8**	Preferred Alternative:	**-8**
	No-Go Alternative:	**-24**	No-Go Alternative:	**-16**
CUMULATIVE IMPACTS	The noise impact during the power generation activities will be below the threshold value of 7.0dBA.			
CONFIDENCE	High			
MITIGATION MEASURES	Maintenance and/or emergency repairs to be done in such a manner that the prevailing ambient noise will not be exceeded by more than 7.0dBA.			

2.3.3 Rehabilitation phase

Table 9: Impact assessment – Rehabilitation phase.

IMPACT NATURE	Impact – Nature of Impact Noise from removal of wind turbines and the rehabilitation of the wind turbine sites.		STATUS	NEGATIVE
Impact Description	Change in the prevailing ambient noise levels in the vicinity of the rehabilitation sites.			
Impact Source(s)	Earthmoving machinery, rehabilitation machinery/tools.			
Receptor(s)	Farm-houses A, F and G.			
PARAMETER	**WITHOUT MITIGATION**	**SCORE**	**WITH MITIGATION**	**SCORE**
EXTENT (A)	Preferred Alternative:	1	Preferred Alternative:	1
	No-Go Alternative:	1	No-Go Alternative:	1
DURATION (B)	Preferred Alternative:	2	Preferred Alternative:	2
	No-Go Alternative:	2	No-Go Alternative:	2
PROBABILITY (C)	Preferred Alternative:	2	Preferred Alternative:	1
	No-Go Alternative:	3	No-Go Alternative:	2
INTENSITY OR MAGNITUDE (D)	Preferred Alternative:	-1	Preferred Alternative:	-1
	No-Go Alternative:	-2	No-Go Alternative:	-2
SIGNIFICANCE RATING (F) = (A*B*D)*C	Preferred Alternative:	**-4**	Preferred Alternative:	**-4**
	No-Go Alternative:	**-12**	No-Go Alternative:	**-8**
CUMULATIVE IMPACTS	The noise impact during the daytime will be below the threshold value of 7.0dBA.			
CONFIDENCE	High			
MITIGATION MEASURES	Construction activities to take place during daytime only			

2.4 Potential Mitigation Measures

Table 11: Mitigation Measures.

Aspect	Mitigation	Responsible person	Activity
Construction phase			
Grading and building of new internal roads	Construction equipment to comply with the standards for construction vehicles as explained in the IFC's Environmental Health & Safety Regulations.	Site engineer	Environmental audits during the construction phase.
Preparation of the footprint area, earthworks & construction	Construction equipment to comply with the standards for construction vehicles as explained in the IFC's Environmental Health & Safety Regulations.	Site engineer	Environmental audits during the construction phase.
Construction of the wind turbines	Construction of wind turbines to take place during daytime only.	Site engineer	Environmental audits during the construction phase.

	Construction equipment to comply with the standards for construction vehicles as explained in the IFC's Environmental Health & Safety Regulations.		
Additional traffic	Roads to be always kept in a good state of repair and all potholes to be repaired.	Site engineer	Environmental audits during the construction phase.
Operational phase			
Noise generated by the wind turbines	The wind turbines are situated more than the 500m buffer.	Site engineer	Site establishment at the time of the site preparation by the site engineer.
Wind turbine - mechanical noise	Acoustic insulation on the inside of the turbine housing; Acoustic insulation curtains; Anti-vibration support footing.	Design phase of the turbine – Design engineers	Engineering drawings to be provided and acoustic compliance certificate to be issued.
Wind turbine – Normal wear and tear, poor component design, lack of preventative maintenance	Cyclic maintenance programme of the wind turbines; Withdraw from services should a wind turbine create excessive noise due to wear and tear or poor maintenance.	Site Engineer; Acoustic noise specialist	Regular noise monitoring to take place to identify noisy wind turbines.
Wind Turbine - Aerodynamic noise	Ensure that all wind turbines have a buffer of 500m between the wind turbine and the noise sensitive areas. Latest technology to be applied to blade design to minimise the noise levels and to take care of the low frequency noise, turbulent inflow noise, turbulent boundary layer trailing edge noise, boundary layer vortex shedding noise, tip vortex formation noise and the trailing edge bluntness vortex noise and amplitude modulation.	Manufacturers to provide information on the results of the blade noise	Noise monitoring and adjust mints during the testing phase of the wind turbine.
Traffic	Vehicles to maintain the speed limit always; Roads to be maintained and pot-holes to be removed.	Site engineer	Environmental audits.
Sub-station	A bund wall to be erected around the sub-station with screen walls on top of the berm.	Environmental acoustic specialist	Noise monitoring at specific locations.
Maintenance of the wind turbines and sub-station	Maintenance Equipment to comply with the IFCs Health and safety requirements.	Site engineer	Environmental audits.
Decommissioning phase			
Removal of infra-structure	Construction equipment to comply with the standards as for construction vehicles as explained in the IFC's Environmental Health & Safety Regulations.	Site engineer	Noise monitoring.
Rehabilitation of wind turbine areas	Construction equipment to comply with the standards as for construction vehicles as explained in the IFC's Environmental Health & Safety Regulations.	Site engineer	Noise monitoring.
Cumulative impact			
Cumulative impact of abutting wind farms	Audits of expansion of Record of Decisions.	Site engineer	Environmental audits.

2.5 Impact Assessment - Alternatives

2.5.1 No Go Option

67 Wind turbines with a total generating capacity of 201MW using turbines with a generating capacity of up to 3MW approved during 2012.

3 NOISE MONITORING PROGRAMME

This is part of the environmental authorisation granted.

The noise monitoring programme will need to be a pro-active programme to manage the noise levels within the boundaries of the wind farm boundaries. The monitoring programme must consist out of the following phases:

Pre-construction phase – Measuring points to be registered along the boundary of the wind farm, noise sensitive area and at each wind turbine site. A noise survey to be done during the winter and the summer periods and all information to be kept on record.

Construction phase – A winter and summer period noise survey to be done.

Operational phase – Noise surveys must be done monthly to start off with and as soon as the results are stable a quarterly noise survey to be carried out.

The following noise results must be kept on record:

- Leq – values of each measuring point in dBA;
- Spectrum analysis of the results;
- Any physical characteristics in and next to the measuring points which may change the noise regime of the area;
- Any other details such as the instrument, competent person etc. will be compiled and made available.

4 CONCLUSION

The noise level from the proposed “new” wind turbines will be 106.4dBA at a height of 119m. The threshold value of 7.0dBA (Western Cape Noise Control Regulations, 2013) will not be exceeded during the day and/or night- time periods.

There will be a shift in the prevailing ambient noise level in the immediate vicinity of the wind turbines but at a distance exceeding 500m from the wind turbine the intrusion level will be minimal and in line with the Western Cape Noise Control Regulations, 2013. The wind noise will create the predominant ambient noise level at the noise receptors which will mask the noise from the wind turbines. People who may work or visit the wind turbine will experience an increase in the prevailing ambient noise level in the vicinity of the wind turbines. The increase at the residential properties will be insignificant (on the occupants of the farmhouses and animals).

The prevailing ambient noise levels are largely created by emissions from a combination of noise sources of which the main source is wind noise and the wind turbines can only operate when the wind is blowing. The large variations in the meteorological conditions and the geographical relations between the wind turbine positions and the noise sensitive receptors allow for the decrease in the noise as it propagates from the wind turbines.

The following conditions as per original authorisation (DEA & DP Reference Number 12/12/20/1993/3) will still be applicable and adhered to:

1. Construction staff must be trained to minimise noise impacts;
2. The holder of this authorisation must ensure that the National Control Regulations and SANS 10103:2008 are adhered to and reasonable measures to limit noise from the work site are implemented;
3. The holder of this authorisation must ensure that the construction staff working in areas where the 8-hour ambient noise levels exceed 75.0dBAmust wear ear protection devices;
4. The holder of this authorisation must ensure that all equipment and machinery are well maintained and equipped with silencers;
5. The holder of this authorisation must provide a warning to the community when noisy activity e.g. blasting is to take place;
6. All noisy construction operations should only occur during daylight hours;
7. All wind turbines must be located at a set-back distance of 500m from any homestead and a day/night noise criteria level at the nearest residents of 45.0dBA should be used to locate the turbines. The 500m setback distance can be relaxed if local factors; such as high ground between the noise source and the receiver, indicates that a noise disturbance will not occur;

8. Positions of turbines jeopardizing compliance with accepted noise levels should be revised during the micro-siting of the units in question and predicted noise levels re-modelled by the noise specialist in order to ensure that the predicted noise levels are less than 45.0dBA.

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