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# PROPOSED BRANDVALLEY WIND ENERGY FACILITY

## IN THE NORTHERN AND WESTERN CAPE PROVINCES SOUTH AFRICA

## DEA REFERENCE: 14/12/16/3/3/2/900

## SPECIALIST STUDY ON NOISE IMPACTS


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DoL Approved Inspection Authority (OH0049-CI-09)

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### Amendment History

| | | |
|---|---|---|
| Version 1 | Original | 23/03/2016 |
| Version 2 | Minor changes to Discussion and Legislation | 31/03/2016 |
| Version 3 | Revisions due to reviewer's comments. Overall impact rating not changed. | 22/04/2016 |
| Version 4 | Modelled the removal of several turbines to reduce noise emissions to meet the SANS 10103:2008 night limit. Only the discussion was updated | 27/04/2016 |

**INFORMATION PAGE**

| | |
|---|---|
| **CLIENT NAME** | EOH Coastal & Environmental Services |
| **PROJECT** | Brandvalley Wind Energy Facility<br>Northern and Western Cape Provinces |
| **CONTACT PERSON** | Ms. B. Huddy |
| **TYPE OF SURVEY** | Noise Specialist Study as part of the Environmental Impact Assessment |
| **DATE OF FIELD SURVEY** | $15^{th}$ & $16^{th}$ February 2016<br>(Conducted by Tarryn Lombard) |
| **REPORT PREPARED BY** | Dr Brett Williams |

**This report only pertains to the conditions found at the above site at the time of the survey. This report may not be copied electronically, physically or otherwise, except in its entirety. If sections of the report are to be copied the approval of the author, in writing, is required.**

..........................................

**Dr B WILLIAMS**

| DECLARATION OF INDEPENDENCE | |
| --- | --- |
| Noise Impact Assessment | I Brett Williams, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed Brandvalley Wind Energy Facility, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.<br><br>**SIGNATURE:** |

## EXECUTIVE SUMMARY

Safetech were appointed to conduct a specialist study for an environmental noise impact assessment for the construction of the Brandvalley Wind Energy Facility in the Northern and Western Cape Provinces. The facility will generate approximately 140MW of electricity.

The noise assessment study considered the site location as described in the Final Scoping Report (EOH Coastal & Environmental Services, March 2016). A literature review and desktop modelling was conducted. Baseline monitoring was done of the ambient noise levels at the site.

The results of the study indicate that the following conclusions can be drawn:

a) There will be a short term increase in noise in the vicinity of the site during the construction phase as the ambient noise level will be exceeded by vehicle operations.
b) The SANS 10103:2008 night limit of 35dB(A) will be exceeded at Noise Sensitive Area 1, although it is highly likely that the wind noise will provide a masking effect. The impact is likely to be very low. Further modelling indicates that if two turbines are removed (WTG 52 & 53), the SANS 10103:2008 night limit will not be exceeded (based on the Vestas V126 turbine).
c) The cumulative effect of both the Brandvalley and Rietkloof projects will only have a marginal effect on two noise sensitive receptors.

The following is recommended:

a) The noise impacts are re-modelled when the final turbine layout and type is determined is determined.
b) Periodic noise measurements are taken during the construction and operational phases.

Dr Brett Williams

## ABBREVIATIONS AND DEFINITIONS

| | |
|---|---|
| Ambient Noise (General meaning) | 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<br>***Authors Note:*** *Ambient noise in layman's terms generally excludes the noise alleged to be causing a noise nuisance or disturbing noise. Ambient noise in this definition is equivalent to* Residual Noise as defined in *the SANS 10103:2008* |
| Ambient Noise (SANS 10103:2008) | Totally encompassing sound in a given situation at a given time, and usually composed of sound from many sources, both near and far<br>*NOTE: Ambient noise includes the noise from the noise source under investigation.* |
| Annoyance | General negative reaction of the community or person to a condition creating displeasure or interference with specific activities. |
| dB(A) | Decibels weighted A scale – Value of the sound pressure level in decibels, determined using a frequency weighting network A (with reference to 20 µPa unless otherwise indicated). |
| Disturbing Noise (Western Cape Noise Control Regulations June 2013) | A noise, excluding the unamplified human voice, which:<br>a) Exceeds the rating level by 7 dBA;<br>b) Exceeds the residual noise level where the residual noise level is higher than the rating level;<br>c) Exceeds the residual noise level by 3 dBA where the residual noise level is lower than the rating level; or<br>d) In the case of a low-frequency noise, exceeds the level specified in Annex B of SANS 10103. |
| Equivalent Continuous Rating Level ($L_{Req,T}$) | The equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$) during a specified time interval, plus specified adjustments for tonal character and impulsiveness of the sound, and derived from the applicable equation.<br>$L_{Aeq,T} + Ci + C_t + kn$<br>where<br>$L_{aeq,T}$ is the equivalent A-weighted sound pressure level in decibels<br>Ci is the impulse correction<br>$C_t$ is the correction for tonal character<br>Kn is the adjustment for day or night (0dB for day and +10dB for night measurements |
| $L_{Aeq,T}$ | The equivalent continuous A-weighted sound pressure level. |
| Low Frequency Noise | Means sound which contains sound energy at frequencies predominantly below 100 Hz. |
| $L_{90}$ | Sound pressure level exceeded for 90 percent of the measurement time |
| m | metres |
| m/s | metres per second |
| Noise Nuisance | Means any sound which impairs or may impair the convenience or peace of a reasonable person. |
| Noise Rating Level | Means the applicable outdoor equivalent continuous rating level indicated in Table 2 of SANS 10103. |
| Residual Noise (SANS 10103) | 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. |

| | |
|---|---|
| SANS 10103:2008 | The South African national standards code of practice for the measurement and rating of environmental noise with respect to annoyance and to speech communication. |
| Sound Level | Means the equivalent continuous rating level as defined in SANS 10103, taking into account impulse, tone and night-time corrections. |
| Western Cape Noise Control Regulations | Department of Environmental Affairs and Development Planning Environment Conservation Act, 1989 - Western Cape Noise Control Regulations. PN 200/2013. 20th June 2013. |

# 1. Introduction

## 1.1. Background to the Study

Brandvalley Wind Farm (Pty) Ltd proposes to construct a Wind Energy Facility (WEF) of up to 140 Megawatts (MW) installed capacity on a number of farms situated near Laingsburg in the Western Cape and Northern Cape. The project is situated on the border of the Northern Cape Province and the Western Cape Province. The wind farm will host up to 70 turbines, each with a capacity of between 1.5MW and 4MW. Safetech was appointed to undertake the Noise Impact Assessment (NIA) to inform the Environmental Impact Assessment (EIA) process for the proposed WEF.

## 1.2. Technical Objectives/Scope of the Noise Impact Assessment

The NIA for the EIA phase is to be conducted in accordance with Section 8 of SANS 10328: Methods for environmental noise impact assessments. The scope of the project is described below:

- Determine the land use zoning on surrounding land and identify noise sensitive receptors that could be impacted upon by activities relating to the construction, operation and decommissioning of the wind farm.
- Determine the existing ambient levels of noise within the study area.
- Determine the typical rating level for noise on surrounding land at identified noise sensitive receptors.
- Identify all noise sources, relating to the establishment and operation of the proposed wind farm that could potentially result in a noise impact on surrounding land and at the identified noise sensitive receptors.
- Determine the sound power emission levels and nature of the sound emission from the identified noise sources.
- Calculate the expected rating level of noise on surrounding land and at the identified noise sensitive receptors from the combined sound power levels emanating from identified noise sources in accordance with procedures contained in SANS 10357 or similar.
- Calculate and assess the noise impact on surrounding land and at the identified noise sensitive receptors in terms of SANS 10103; the Environment Conservation Act: National Noise Control Regulations (GNR 154 - 1992; and the Western Cape Noise Control Regulations. There are no noise control provincial regulations for the Northern Cape.

- Investigate alternative noise mitigation procedures, if required, in collaboration with the design engineers of the facility and estimate the impact of noise upon implementation of such procedures.
- Prepare and submit an environmental noise impact report containing the procedures and findings of the investigation.
- Prepare and submit recommended noise mitigation procedures as part of a separate environmental noise management plan, if relevant.

### 1.3. Structure of the report

This volume presents the findings of the noise impact assessment specialist study undertaken to inform the detailed EIA phase of the proposed development and the structure of the report is therefore as follows:

**Chapter 1- Introduction:** Provides brief background information on the proposed project as well as the objectives of thies specialist study. This Chapter also provides details on the structure of this report and list the assumptions and limitations of the assessment.

**Chapter 2 – Project Description:** Provides a detailed description of the proposed project based on the latest project plans provided by EOH Coastal and Environmental Services.

**Chapter 3 – Introduction to Noise:** Provides a primer in order to understand the technical aspects of the report.

**Chapter 4 – Methodology and Approach:** The methodology to conduct the field study as well as the desktop study is discussed.

**Chapter 5 – Applicable Legislation and Standards:** The noise rating limits and the minimum setback distances are discussed.

**Chapter 6 – Impacts during the Construction Phase:** The noise impacts for the construction phase are suggested and calculated.

**Chapter 7 – Impacts during the Operational Phase:** The noise impacts for the operational phase are modelled.

**Chapter 8 – Conclusion and Recommendation:** The conclusion and recommendations are presented.

### 1.4. Assumptions and Limitations

The following assumptions and limitations are applicable to this study:

- The turbine positions were supplied by the developer and are accepted as an accurate layout for the purposes of the environmental impact assessment.
- The worst case scenario impacts were modelled i.e. wind from any direction, not only the prevailing wind, maximum turbine size as required for the site and the worst case meteorological conditions.
- No wind noise masking effect is taken into account. The noise levels at the identified noise sensitive areas could thus be lower if the wind noise masks the turbine noise emissions.

## 2. PROJECT DESCRIPTION

### 2.1. Location and Site Description of the Proposed Development

The location and position of the various wind turbine generators (WTG) are contained in the table and figures below. The project is located in a rural area and is situated on farmland. A total of 70 WTG's were modelled in the report, although this may be reduced in the final layout, depending on the outcomes of the EIA and other specialists' recommendations for impact mitigation . A full project description of the planned infrastructure is contained in Appendix D to this report.

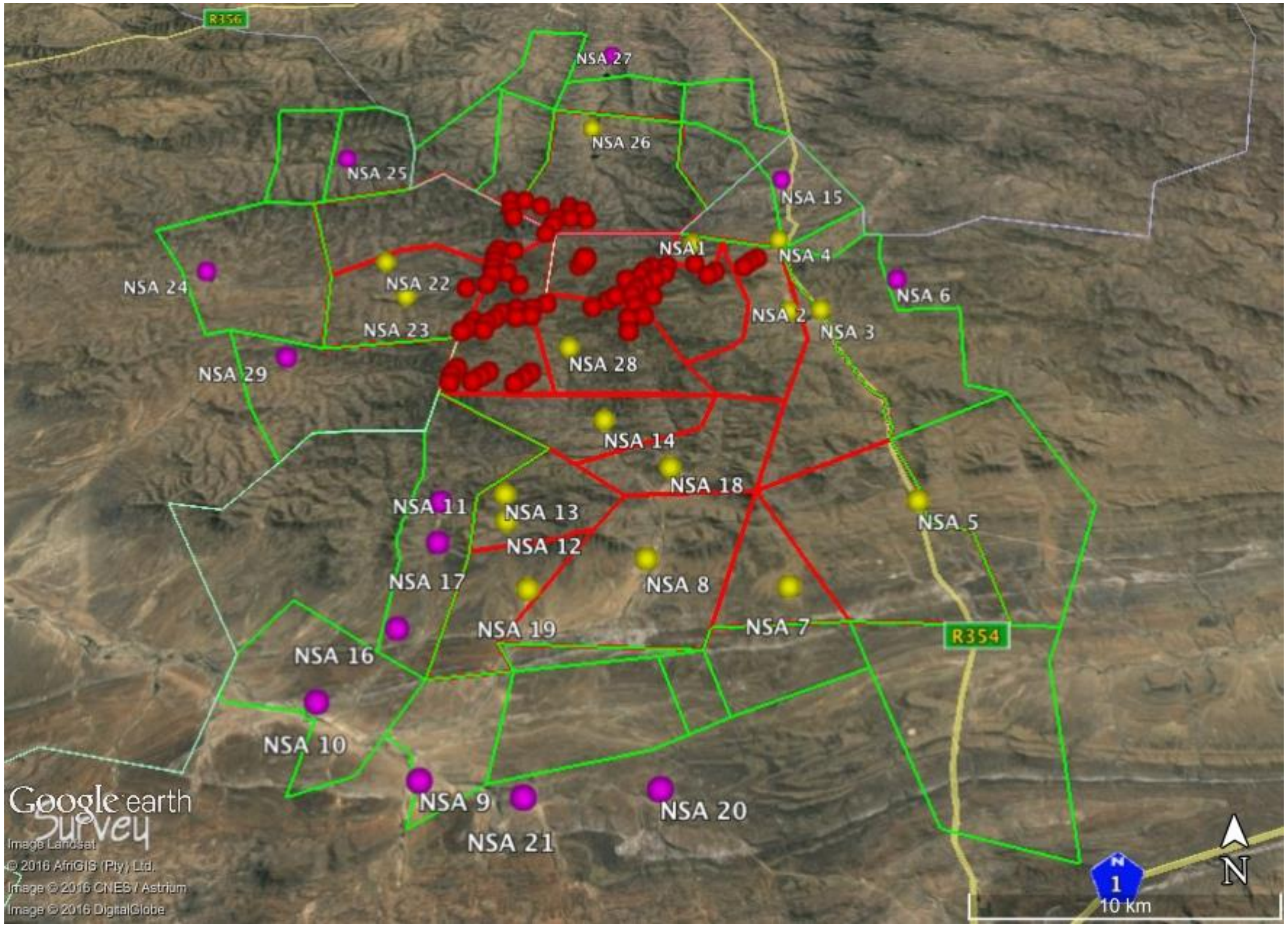
Table 1 - WTG Co-Ordinates

| Turbine Number | East | South |
|---|---|---|
| 1 | 20°25'44.81" | 33°00'55.98" |
| 2 | 20°25'33.16" | 33°01'04.82" |
| 3 | 20°25'19.73" | 33°01'12.66" |
| 4 | 20°24'36.78" | 33°00'53.25" |
| 5 | 20°24'24.80" | 33°01'01.30" |
| 6 | 20°24'11.92" | 33°01'09.10" |
| 7 | 20°23'36.21" | 33°01'11.15" |
| 8 | 20°23'37.78" | 33°00'58.28" |
| 9 | 20°23'45.80" | 33°00'47.18" |
| 10 | 20°27'01.77" | 32°57'47.47" |
| 11 | 20°27'11.57" | 32°57'37.56" |
| 12 | 20°23'48.04" | 32°59'42.95" |
| 13 | 20°24'00.40" | 32°59'35.41" |
| 14 | 20°24'06.84" | 32°59'23.74" |
| 15 | 20°24'24.72" | 32°59'41.14" |
| 16 | 20°24'29.36" | 32°59'28.88" |
| 17 | 20°24'41.90" | 32°59'21.58" |
| 18 | 20°24'53.55" | 32°59'11.12" |
| 19 | 20°25'17.85" | 32°59'04.76" |
| 20 | 20°25'44.09" | 32°59'03.37" |
| 21 | 20°25'17.71" | 32°59'19.59" |
| 22 | 20°25'42.36" | 32°59'16.72" |
| 23 | 20°26'07.88" | 32°58'55.52" |
| 24 | 20°25'19.88" | 32°58'21.09" |
| 25 | 20°24'25.29" | 32°58'16.83" |
| 26 | 20°23'50.43" | 32°58'20.62" |
| 27 | 20°24'59.14" | 32°57'58.22" |
| 28 | 20°24'33.35" | 32°57'59.97" |
| 29 | 20°24'33.89" | 32°57'47.07" |
| 30 | 20°24'37.06" | 32°57'34.45" |
| 31 | 20°24'35.09" | 32°57'21.62" |
| 32 | 20°24'42.24" | 32°57'10.21" |
| 33 | 20°25'08.51" | 32°57'14.93" |
| 34 | 20°26'03.30" | 32°56'42.76" |
| 35 | 20°26'15.75" | 32°56'24.47" |
| 36 | 20°26'21.84" | 32°56'10.31" |
| 37 | 20°26'46.11" | 32°56'11.33" |
| 38 | Removed | Removed |
| 39 | 20°26'40.99" | 32°55'56.94" |
| 40 | 20°27'06.35" | 32°55'54.68" |
| 41 | 20°26'43.06" | 32°55'44.03" |
| 42 | Removed | Removed |
| 43 | 20°25'04.48" | 32°56'05.22" |
| 44 | 20°24'58.24" | 32°55'49.02" |
| 45 | 20°24'57.22" | 32°55'29.63" |
| 46 | 20°25'23.27" | 32°55'31.53" |

| Turbine Number | East | South |
|---|---|---|
| 47 | 20°32'08.82" | 32°57'39.50" |
| 48 | 20°31'56.30" | 32°57'46.88" |
| 49 | 20°31'44.47" | 32°57'55.11" |
| 50 | 20°30'54.17" | 32°58'03.60" |
| 51 | 20°30'41.47" | 32°58'10.74" |
| 52 | 20°30'20.45" | 32°57'48.82" |
| 53 | 20°29'32.89" | 32°57'53.95" |
| 54 | 20°29'06.70" | 32°57'54.32" |
| 55 | 20°28'54.42" | 32°58'01.94" |
| 56 | 20°28'46.68" | 32°58'13.03" |
| 57 | 20°28'21.74" | 32°58'17.36" |
| 58 | 20°29'27.68" | 32°58'08.38" |
| 59 | 20°29'11.38" | 32°58'17.92" |
| 60 | 20°28'51.76" | 32°58'29.68" |
| 61 | 20°28'39.12" | 32°58'36.92" |
| 62 | 20°28'30.56" | 32°58'47.68" |
| 63 | 20°28'03.52" | 32°58'48.59" |
| 64 | 20°27'50.94" | 32°58'56.00" |
| 65 | 20°27'24.86" | 32°59'06.19" |
| 66 | 20°29'05.59" | 32°58'50.49" |
| 67 | 20°28'36.43" | 32°59'06.61" |
| 68 | 20°28'50.00" | 32°59'24.75" |
| 69 | 20°28'24.32" | 32°59'27.90" |
| 70 | 20°28'24.13" | 32°59'49.79" |

(Note: Turbines WTG56 and WTG57 have been removed due to ecological impacts.)

Figure 1 - WTG Positions




**WTG** = Red dot **Noise Sensitive Area** = Purple Dot (outside Project Area) and Yellow Dot (Inside Project Area)

The project site is zoned for agricultural land use. The site is hilly with sparse vegetation. A full description of the project is contained in the Final Scoping Report as well as Appendix D to this report. The potential sensitive receptors are discussed below. The main noise sensitive receptors that could be impacted by noise pollution are the terrestrial fauna, the avifauna and human receptors. This report only deals with the human receptors as separate ecology and avifauna impact assessments will be undertaken.

### 2.2. Sensitive Receptors

#### 2.2.1 Human Noise Sensitive Areas

Northern Portion – Operational Phase

The project area is situated in a rural farming community. Twenty-nine homesteads are located in the vicinity where the turbines will be erected. The locations of the various noise sensitive areas (NSA's) are indicated in the table below and the figure above. The NSA's were identified through a site visit and Google Earth images.

The NSA's to the south are located on and around the proposed Rietkloof Wind Energy Project and are included here for cumulative effect purposes.

The location of the noise sensitive areas is shown in Table 2 below. A detailed description of the NSA's is contained in Appendix E.

Table 2 - Location of NSA's

| Description | East | South | Within Project Boundary | Type |
| --- | --- | --- | --- | --- |
| NSA 1 | 20°30'17.97" | 32°57'10.38" | Yes | Farmhouse |
| NSA 2 | 20°32'52.95" | 32°59'17.08" | Yes | Farmhouse |
| NSA 3 | 20°33'46.34" | 32°59'14.38" | Yes | Farmhouse |
| NSA 4 | 20°32'50.34" | 32°57'02.30" | Yes | Farmhouse |
| NSA 5 | 20°35'33.01" | 33°04'25.20" | Yes | Farmhouse |
| NSA 6 | 20°36'03.35" | 32°58'22.40" | No | Farmhouse |
| NSA 7 | 20°32'05.40" | 33°06'21.24" | Yes | Farmhouse |
| NSA 8 | 20°28'42.36" | 33°05'39.20" | Yes | Farmhouse |
| NSA 9 | 20°23'38.49" | 33°10'03.50" | No | Farmhouse |
| NSA 10 | 20°21'09.92" | 33°08'30.25" | No | Farmhouse |
| NSA 11 | 20°23'36.36" | 33°04'12.19" | No | Farmhouse |
| NSA 12 | 20°25'16.19" | 33°04'42.76" | Yes | Farmhouse |
| NSA 13 | 20°25'12.35" | 33°04'05.63" | Yes | Farmhouse |
| NSA 14 | 20°27'42.38" | 33°02'14.53" | Yes | Farmhouse |

| Description | East | South | Within Project Boundary | Type |
|---|---|---|---|---|
| NSA 15 | 20°33'09.67" | 32°54'52.62" | No | Farmhouse |
| NSA 16 | 20°22'49.18" | 33°07'02.68" | No | Farmhouse |
| NSA 17 | 20°23'36.67" | 33°05'09.53" | No | Farmhouse |
| NSA 18 | 20°29'22.71" | 33°03'29.96" | Yes | Farmhouse |
| NSA 19 | 20°25'51.24" | 33°06'16.52" | Yes | Farmhouse |
| NSA 20 | 20°28'51.51" | 33°10'20.42" | No | Farmhouse |
| NSA 21 | 20°25'54.65" | 33°10'25.14" | No | Farmhouse |
| NSA 22 | 20°21'25.27" | 32°57'21.98" | Yes | Farmhouse |
| NSA 23 | 20°22'07.76" | 32°58'30.41" | Yes | Farmhouse |
| NSA 24 | 20°16'15.80" | 32°57'29.92" | No | Farmhouse |
| NSA 25 | 20°19'48.45" | 32°53'44.68" | No | Farmhouse |
| NSA 26 | 20°27'23.34" | 32°52'42.16" | Yes | Farmhouse |
| NSA 27 | 20°28'03.60" | 32°49'35.62" | No | Farmhouse |
| NSA 28 | 20°26'46.16" | 33°00'14.10" | Yes | Farmhouse |
| NSA 29 | 20°19'04.31" | 33°00'15.87" | No | Farmhouse |

#### 2.2.2 Natural Environment Receptors

The fauna on the site includes bats, birds, commercial livestock and a variety of buck, leopard, reptiles etc. The noise impacts on the natural environment receptors are dealt with in separate specialist studies of this EIA (Ecological Impact Assessment – Flora and Fauna).

## 3. Introduction to Noise

### 3.1. Sound Propagation

Noise is defined as any unwanted sound and is measured in decibels. Sounds are characterized by their magnitude (loudness) and frequency. There can be loud low frequency sounds, soft high frequency sounds and loud sounds that include a range of frequencies. The human ear can detect a very wide range of both sound levels and frequencies, but it is more sensitive to some frequencies than others.

Sound frequency denotes the "pitch" of the sound and, in many cases, corresponds to notes on the musical scale (Middle C is 262 Hz). An octave is a frequency range between a sound with one frequency and one with twice that frequency, a concept often used to define ranges of sound frequency values. The frequency range of human hearing is quite wide, generally ranging from about 20 Hz to 20 kHz (about 10 octaves). Sounds experienced in daily life are usually not a single frequency, but are formed from a mixture of numerous frequencies, from numerous sources (See Appendix C).

Concerns about environmental noise depend on:

- The level of intensity, frequency, frequency distribution and patterns of the noise source;
- Background sound levels;
- The terrain between the emitter and receptor;
- The nature of the receptor; and
- The attitude of the receptor about the emitter.

In general, the effects of noise on people can be classified into three general categories:

- Subjective effects including annoyance, nuisance, dissatisfaction
- Interference with activities such as speech, sleep, and learning
- Physiological effects such as anxiety, tinnitus, or hearing loss.

It is important to distinguish between the various measures of the magnitude of sounds, namely sound power level and sound pressure level. Sound power level is the power per unit area of the sound pressure wave; it is a property of the source of the sound and it gives the total acoustic power emitted by the source. Sound pressure is a property of sound at a given observer location and can be measured there by a microphone.

In order to predict the sound pressure level at a distance from source with a known power level, one must determine how the sound waves propagate. In general, as sound propagates without obstruction from a point source, the sound pressure level decreases. The initial energy in the sound is distributed over a larger and larger area as the distance from the source increases. Thus, assuming spherical propagation, the same energy that is distributed over a square meter at a distance of one meter from a source is distributed over 10,000 $m^2$ at a distance of 100 meters away from the source. With spherical propagation, the sound pressure level is reduced by 6 dB per doubling of distance.

This simple model of spherical propagation must be modified in the presence of reflective surfaces and other disruptive effects. For example, if the source is on a perfectly flat and reflecting surface, then hemispherical spreading has to be assumed, which also leads to a 6 dB reduction per doubling of distance, but the sound level would be 3 dB higher at a given distance than with spherical spreading.

Sound propagation is generally influenced by the following factors:

- Source characteristics (e.g., directivity, height, etc.)
- Distance of the source from the observer
- Air absorption, which depends on frequency
- Ground effects (i.e., reflection and absorption of sound on the ground, dependent on source height, terrain cover, ground properties, frequency, etc.)
- Blocking of sound by obstructions and uneven terrain
- Weather effects (i.e., wind speed, change of wind speed or temperature with height). The prevailing wind direction can cause differences in sound pressure levels between upwind and downwind positions.
- Shape of the land; certain land forms can also focus sound

### 3.2. Sources of Wind Turbine Noise

The sources of sounds emitted from operating wind turbines can be divided into two categories, firstly mechanical sounds, from the interaction of turbine components, and secondly aerodynamic sounds, produced by the flow of air over the blades.

### 3.3. Mechanical Sounds

Mechanical sounds originate from the relative motion of mechanical components and the dynamic response among them. Sources of such sounds include:

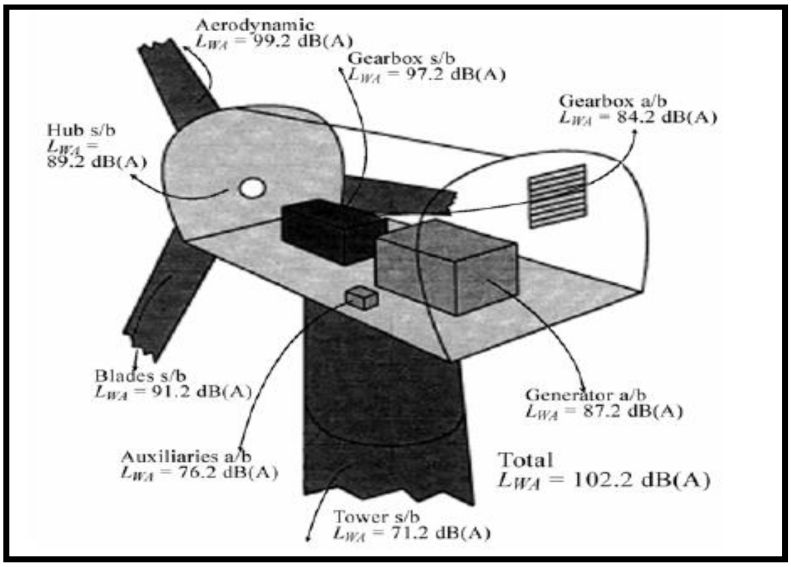
- Gearbox
- Generator
- Yaw Drives
- Cooling Fans
- Auxiliary Equipment (e.g. hydraulic systems, transformers etc.)

Since the emitted sound is associated with the rotation of mechanical and electrical equipment, it tends to be tonal (of a common frequency), although it may have a broadband component. For example, pure tones can be emitted at the rotational frequencies of shafts and generators, and the meshing frequencies of the gears.

In addition, the hub, rotor, and tower may act as loudspeakers, transmitting the mechanical sound and radiating it. The transmission path of the sound can be air-borne or structure-borne. Air-borne means that the sound is directly propagated from the component surface or interior into the air. Structure-borne sound is transmitted along other structural components before it is radiated into the air.

The figure below shows the type of transmission path and the sound power levels for the individual components for a typical 2 MW wind turbine. The important information in the picture is not the sound power levels, but rather the various sources of noise from the whole assembly. The highest sound power level that was modelled for this project is 107.5 dB using the 3.6MW turbine.

Figure 2 - Typical Sound Power Levels of a 2MW Turbine



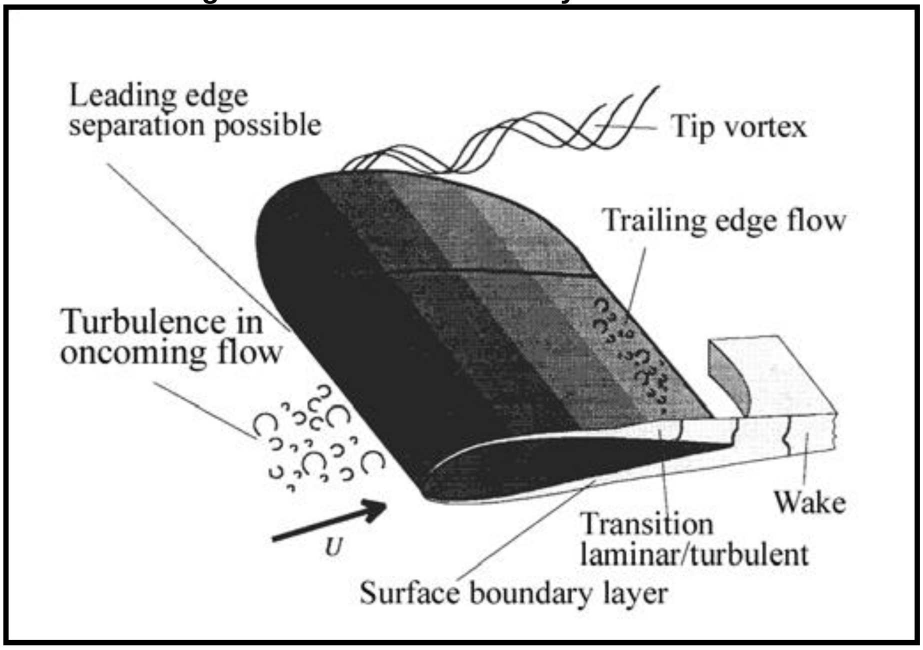

### 3.4. Aerodynamic Sound

Aerodynamic broadband sound is typically the largest component of wind turbine acoustic emissions. It originates from the flow of air around the blades. As shown in Figure 3, a large number of complex flow phenomena occur, each of which might generate some sound. Aerodynamic sound generally increases with rotor speed. The various aerodynamic sound generation mechanisms that have to be considered are divided into three groups:

- *Low Frequency Sound:* Sound in the low frequency part of the sound spectrum is generated when the rotating blade encounters localized flow deficiencies due to the flow around a tower, wind speed changes, or wakes shed from other blades.

- *Inflow Turbulence Sound:* Depends on the amount of atmospheric turbulence. The atmospheric turbulence results in local force or local pressure fluctuations around the blade.
- *Airfoil Self Noise:* This group includes the sound generated by the air flow right along the surface of the airfoil. This type of sound is typically of a broadband nature, but tonal components may occur due to blunt trailing edges, or flow over slits and holes.

**Figure 3 - Sources of Aerodynamic Noise**




Modern airfoil design takes all of the above factors into account and is generally much quieter than the first generation of bade design.

### 3.5. Ambient Sound & Wind Speed

The ability to hear a wind turbine in a given installation depends on the ambient sound level. When the background sounds and wind turbine sounds are of the same magnitude, the wind turbine sound gets lost in the background. Both the wind turbine sound power level and the ambient sound pressure level will be functions of wind speed. Thus whether a wind turbine exceeds the background sound level will depend on how each of these varies with wind speed.

The most likely sources of wind-generated sounds are interactions between wind and vegetation. A number of factors affect the sound generated by wind flowing over vegetation. For example, the total magnitude of wind-generated sound depends more on the size of the windward surface of the vegetation than the foliage density or volume.

The sound level and frequency content of wind generated sound also depends on the type of vegetation. For example, sounds from deciduous trees tend to be slightly lower and more broadband than that from conifers, which generate more sounds at specific frequencies. The equivalent A-weighted broadband sound pressure generated by wind in foliage has been shown to be approximately proportional to the base 10 logarithm of wind speed.

Sound levels from large modern wind turbines during constant speed operation tend to increase more slowly with increasing wind speed than ambient wind generated sound. As a result, wind turbine noise is more commonly a concern at lower wind speeds and it is often difficult to measure sound from modern wind turbines above wind speeds of 8 m/s because the background wind-generated sound generally masks the wind turbine sound above 8 m/s.

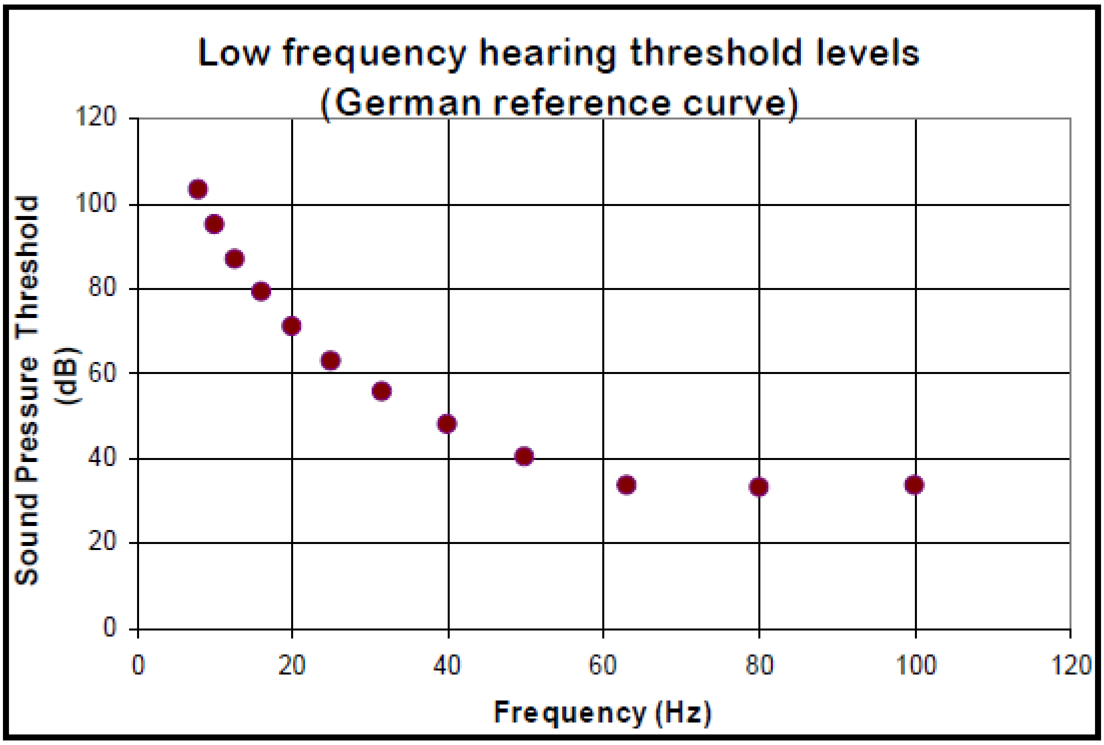
It should be remembered that average sound pressure measurements might not indicate when a sound is detectable by a listener. Just as a dog's barking can be heard through other sounds, sounds with particular frequencies or an identifiable pattern may be heard through background sounds that is otherwise loud enough to mask those sounds. Sound emissions from wind turbines will also vary as the turbulence in the wind through the rotor changes. Turbulence in the ground level winds will also affect a listener's ability to hear other sounds. Because fluctuations in ground level wind speeds will not exactly correlate with those at the height of the turbine, a listener might find moments when the wind turbine could be heard over the ambient sound.

### 3.6. Low Frequency Noise and Infrasound

Infrasound was a characteristic of some wind turbine models that has been attributed to early designs in which turbine blades were downwind of the main tower. The effect was generated as the blades cut through the turbulence generated around the downwind side of the tower. Modern designs generally have the blades upwind of the tower. Wind conditions around the blades and improved blade design minimize the generation of the effect.

Low frequency pressure vibrations are typically categorized as low frequency sound when they can be heard near the bottom of human perception (10-200 Hz), and infrasound when they are below the common limit of human perception. Sound below 20 Hz is generally considered infrasound, even though there may be some human perception in that range. Because these ranges overlap in these ranges, it is important to understand how the terms are intended in a given context.

**Figure 4 - Low frequency Hearing Threshold Levels**




Infrasound is always present in the environment and stems from many sources including ambient air turbulence, ventilation units, waves on the seashore, distant explosions, traffic, aircraft, and other machinery. Infrasound propagates farther (i.e. with lower levels of dissipation) than higher frequencies. To place infrasound in perspective, when a child is swinging high on a swing, the pressure change on its ears, from top to bottom of the swing, is nearly 120 dB at a frequency of around 1 Hz. Some characteristics of the human perception of infrasound and low frequency sound are:

- Low frequency sound and infrasound (2-100 Hz) are perceived as a mixture of auditory and tactile sensations.
- Lower frequencies must be of a higher magnitude (dB) to be perceived, e.g. the threshold of hearing at 10 Hz is around 100 dB; see Figure 4 above.
- Tonality cannot be perceived below around 18 Hz
- Infrasound may not appear to be coming from a specific location, because of its long wavelengths.

The primary human response to perceived infrasound is annoyance, with resulting secondary effects. Annoyance levels typically depend on other characteristics of the infrasound, including intensity, variations with time, such as impulses, loudest sound, periodicity, etc. Infrasound has three annoyance mechanisms:

- A feeling of static pressure
- Periodic masking effects in medium and higher frequencies
- Rattling of doors, windows, etc. from strong low frequency components

Human effects vary by the intensity of the perceived infrasound, which can be grouped into these approximate ranges:

- 90 dB and below: No evidence of adverse effects
- 115 dB: Fatigue, apathy, abdominal symptoms, hypertension in some humans
- 120 dB: Approximate threshold of pain at 10 Hz
- 120 – 130 dB and above: Exposure for 24 hours causes physiological damage

There is no reliable evidence that infrasound below the perception threshold produces physiological or psychological effects.

The typical range of sound power level for wind turbine generators is in the range of 100 to 105dBA – a much lower sound power level (10dB or more) than the majority of construction machinery such as dozers. In order for infrasound to be audible even to a person with the most sensitive hearing at a distance of, say, 300m would require a sound power level of at least 140dB at 10Hz and even higher emission levels than this at lower frequencies and at greater distances. There is no information available to indicate that wind turbine generators emit infrasound anywhere near this intensity(2).

Several studies have confirmed that there are no physiological effects from low frequency or infrasound from wind turbines (2),(4),(5),(9),(15),(16),(17).

## 4. METHODOLOGY & APPROACH

The methodology used in the study consisted of two approaches to determine the noise impact from the proposed project and associated infrastructure:

- A desktop study to model the likely noise emissions from the site;
- Field measurements of the existing ambient noise at different locations in the vicinity of the project.

### 4.1. Desktop study methodology

The desktop study was conducted using the available literature on noise impacts as well as numerical calculations using EMD WindPro Software Version 2.9 which is specifically developed for modelling wind turbine noise. The method described in SANS 10357:2004 version 2.1 (The calculation of sound propagation by the Concawe method) was used as a reference for further calculations where required. WindPro uses the methods described in ISO 9613-2 (Acoustics – Attenuation of sound during propagation outdoors. Part 2 – General method of calculation). This method is very comparable to SANS 10357:2004.

The numerical results were then used to produce a noise map that visually indicates the extent of the noise emissions from the site. The noise emissions were modelled for various wind speeds. The direction of the wind is not taken into consideration as the wind could blow from any direction at the speeds that were modelled.

The following data was used for the WTG's that were modeled:

Brandvalley Wind Farm (Pty) Ltd have not yet fully committed to a specific turbine model due to earliness of the development. The noise impact assessment was therefore based on a selection of four possible turbine models that were suggested by the client. The author is limited to the turbines in the officially released wind turbine catalogue in WindPro 2.9. The details of the turbines that were modelled are described in Table 3 below.

Table 3 - Proposed Turbine Specifications

| Manufacturer | **Acciona** | **Siemens** | **Vestas** | **Vestas** |
|---|---|---|---|---|
| Type / Version | **AW 132/3000** | **SWT – 3.3** | **V117** | **V126** |
| Rated Power | 3.0 MW | 3.3 MW | 3.3 MW | 3.3 MW |
| Rotor Diameter | 132m | 130m | 117m | 126m |
| Tower | Tubular | Tubular | Tubular | Tubular |
| Grid Connection | 50 Hz | 50 Hz | 50 Hz | 50 Hz |
| Maximum Sound Power Level | 107.1 dB | 106 dB | 107.0 dB | 107.5 db |
| Hub Height | 85m | 110m | 116.5m | 117m |

Sound Power Level dB(A) reference to 1pW from WindPro 2.9 Catalogue

### 4.2. Field Study

A field study to the project area was conducted on the 15th & 16th February 2016. The field study was conducted by Miss T. Lombard. The ambient monitoring points were chosen based on their proximity to the location of the proposed wind turbines. Ambient noise measurements were taken at the noise sensitive areas that would be impacted during the operational phase. Three NSA's were selected as monitoring points namely, NSA 2, 5 and 18 (see Figure1). These were identified in Section 2.2.1 above. The results are presented in Table 4 & 5 below. The weather conditions during the field study are contained in Appendix F taken from Laingsburg, the nearest town.

Table 4 – Ambient Monitoring Results - Day

**Daytime - Commencing at 09:51 on 16th February 2016**

| NO | AREA | Leq (dBA) | $L_{90}$ (dBA) | Noise Source |
|---|---|---|---|---|
| Position 1 | NSA 18 | 56.3 | 50.7 | • Noise from trees blowing in wind (main noise source).<br>• Tapping noise from windmill.<br>• Noise from leaves blowing across the ground.<br>• Faint noise from activity inside the house.<br>• Noise from birds chirping.<br>• Noise from wind chimes. |
| Position 2 | NSA 5 | 48.9 | 42.0 | • Noise from dogs barking / growling (main noise source).<br>• Noise from trees blowing in the wind.<br>• Noise from people talking nearby.<br>• Noise from people working on farm in distance.<br>• Noise from vehicle activity on R354.<br>• Noise from birds chirping.<br>• Noise from leaves blowing on ground. |
| Position 3 | NSA 2 | 46.4 | 39.1 | • Noise from trees blowing in the wind (main noise source).<br>• Noise from birds chirping.<br>• Noise from people speaking inside house.<br>• Tapping noise from decoration on house.<br>• Noise from rooster crowing.<br>• Noise from gate tapping on wall. |

## Table 5 – Ambient Monitoring Results - Night

**Night-time - Commencing at 22:16 15th February and 19:01 on the 16th February 2016**

| NO | AREA | Leq (dBA) | $L_{90}$ (dBA) | Noise Source |
|---|---|---|---|---|
| **Commencing at 22:16 on 15 February 2016** | | | | |
| Position 1 | NSA 18 (°'"S °'"E) | 54.5 | 50.4 | • Noise from trees blowing in the wind (main noise source).<br>• Noise from wind chimes.<br>• Noise from leaves blowing across the ground.<br>• Noise from birds chirping.<br>• Tapping noise from windmill. |
| Position 2 | NSA 5 | 57.3 | 34.5 | • Noise from dogs barking (main noise source).<br>• Noise from leaves blowing across the ground.<br>• Noise from crickets.<br>• Noise from vehicles driving on the R354. |
| Position 3 | NSA 2 | 36.8 | 33.5 | • Noise from trees blowing in the wind (main noise source).<br>• Noise from vehicle activity in the distance.<br>• Noise from animal rustling the bushes.<br>• Noise from crickets. |
| **Commending at 19:01 on 16 February 2016 (Early evening)** | | | | |
| Position 4 | NSA 18 | 33.8 | 30.7 | • Noise from running water (main noise source).<br>• Noise from trees blowing in breeze.<br>• Tapping noise from windmill.<br>• Noise from animals rustling the bushes. |
| Position 5 | NSA 5 | 34.7 | 31.1 | • Noise from trees blowing in breeze (main noise source).<br>• Noise from dogs barking in the distanced.<br>• Noise from plane flying over.<br>• Noise from crickets.<br>• Noise from 2x vehicles driving by on R354.<br>• Loud banging noise in the distance. |
| Position 6 | NSA 2 | 31.2 | 28.2 | • Noise from trees blowing in breeze (main noise source).<br>• Noise from vehicles driving by in the distance.<br>• Noise from crickets.<br>• Faint tapping noise from decoration on house. |

The measurements were taken by placing the noise meter on a tripod and ensuring that it was at least 1.2 m from ground level and 3.5 m from any large flat reflecting surface. All measurement periods were at least over 10 minutes, except where indicated. The noise meter was calibrated before and after the survey. At no time was the difference more than one decibel (If the difference is more than 1 decibel the meter is not calibrated properly and the measurement is discarded). The weighting used was on the A scale and the meter placed on impulse correction, which is the preferred method as per Section 5 of SANS 10103:2008. No tonal correction was added to the data. Measurements were taken during the day and night-time. The meter was fitted with a windscreen, which is supplied by the manufacturer. The screen is designed so as to reduce wind noise around the microphone and not bias the measurements.

The instrumentation that was used to conduct the study is as follows:

- Rion Precision Sound Level Meter (NL32) with 1/3 Octave Band Analyzer.
- Serial No. 00151075
- Microphone (UC-53A) Serial No. 307806
- Preamplifier (NH-21) Serial No. 13814

All equipment was calibrated by M & N Acoustic Services in November 2015. The sound level meter was calibrated before and after use with a sound level calibrator. Equipment complied with the specifications of Section 8.1 of SANS Code of Practice 10083:2004 Ed 5. Equipment complied with the specifications of Section 8.1 of SANS Code of Practice 10083:2004 Edition 5.

## 5. APPLICABLE LEGISLATION AND STANDARDS

South Africa has noise legislation or standards that could be applicable to the project. The final scoping report has identified that the applicable environmental legislation places a general onus on the developer to ensure that the environment is not affected negatively by the development.

The following legislation and standards have been used to aid the study and guide the decision making process with regards to noise pollution:

***National***

- South Africa - GNR.154 of January 1992: Noise control regulations in terms of section 25 of the Environment Conservation Act (ECA), 1989 (Act No. 73 of 1989).
- South Africa - GNR.155 of 10 January 1992: Application of noise control regulations made under section 25 of the Environment Conservation Act, 1989 (Act No. 73 of 1989).

***Provincial***

- Provincial Government of the Western Cape – PN 200 (2013) Noise Control Regulations

***Local***

- No local legislation identified as applicable to the noise impact study.

***National Standards***

- South Africa - SANS 10103:2008 Version 6 - The measurement and rating of environmental noise with respect to annoyance and to speech communication.
- South Africa - SANS 10210:2004 Edition 2.2 – Calculating and predicting road traffic noise.
- South Africa - SANS 10357:2004 Version 2.1 - The calculation of sound propagation by the Concawe method.

### 5.1. National & Provincial Legislation

The South African Noise Control Regulations (National) describe a *disturbing noise* as **any** noise that exceeds the ambient noise by more than 7dB. This difference is usually measured at the complainant's location should a noise complaint arise. Therefore, if a new noise source is introduced into the environment, irrespective of the current noise levels, and the new source is louder than the existing ambient environmental noise by more than 7dB, the complainant will have a legitimate complaint. A noise *disturbance or nuisance* as defined in the national legislation means any sound which disturbs or impairs the convenience of any person. The Western Cape Noise Control Regulations are similar to the National Noise Control Regulations in that the definition of a disturbing noise also refers to **any** noise that exceeds the ambient noise by more than 7dB.

The Western Cape Strategic Wind Initiative Document (May 2006) can be used for guidance. The Western Cape does not prescribe any specific noise limits for wind turbines other than to recommend a setback distance of 400m from residences (including rural dwellings). It is recommended that a setback distance of 500m be used for this project. This is based on this authors experience on similar projects. **The closest turbine to the occupied NSA's is approximately 1180m from NSA 1.**

The Western Cape Noise Control Regulations define a disturbing noise as:

*a noise, excluding the unamplified human voice, which:*

*a) exceeds the rating level by 7 dBA;*

*b) exceeds the residual noise level where the residual noise level is higher than the rating level;*

*c) exceeds the residual noise level by 3 dBA where the residual noise level is lower than the rating level; or*

*d) in the case of a low-frequency noise, exceeds the level specified in Annex B of SANS 10103.*

### 5.2. National Standards

The most applicable standard for planning purposes used in this study is SANS 10103:2008 which provides typical rating levels for noise in various types of districts, as described in Table 6 below. Ideally, in such areas one does not want to experience any anthropogenic noise pollution.

Table 6 - Typical rating levels for noise in various types of districts

| Type of District | Equivalent Continuous Rating Level, LAeq,T for Noise | | | | | |
|---|---|---|---|---|---|---|
| | Outdoors (dB(A)) | | | Indoors, with open windows (dB(A)) | | |
| | Day-night | Daytime | Night-time | Day-night | Daytime | Night-time |
| Rural Districts | 45 | 45 | 35 | 35 | 35 | 25 |
| Suburban districts with little road traffic | 50 | 50 | 40 | 40 | 40 | 30 |
| Urban districts | 55 | 55 | 45 | 45 | 45 | 35 |
| Urban districts with one or more of the following: Workshops; business premises and main roads | 60 | 60 | 50 | 50 | 50 | 40 |
| Central business districts | 65 | 65 | 55 | 55 | 55 | 45 |

| Type of District | Equivalent Continuous Rating Level, LAeq,T for Noise | | | | | |
|---|---|---|---|---|---|---|
| | Outdoors (dB(A)) | | | Indoors, with open windows (dB(A)) | | |
| | Day-night | Daytime | Night-time | Day-night | Daytime | Night-time |
| Industrial districts | 70 | 70 | 60 | 60 | 60 | 50 |

SANS 10103:2008 defines Daytime as 06:00 to 22:00 hours and night time as 22:00 to 06:00 hours. The rating levels in the table above indicate that in rural districts the ambient noise should not exceed the **guideline** 35 dB(A) (outdoors) and 25 dB (A) (indoors) at night and 45 dB(A) (outdoors) and 35 dB(A) (indoors) during the day. The day / night (24hour) rating limit is 45 dB(A) (outdoors) and 35 dB(A) (indoors). These levels can thus be seen as the maximum target levels for any noise pollution sources. If the current ambient (residual) noise exceeds the rating limit, then actual ambient (residual) limit will be used when a noise complaint arises in terms of the Environment Conservation Act - Noise Control Regulations and the Western Cape Noise Control Regulations.

SANS 10103: 2004 also provides a guideline for expected community responses to excess environmental noise above the ambient (residual) noise. These are reflected in the table below.

Table 7 - Categories of environmental community / group response (SANS 10103:2008)

| EXCESS Lr dB (A) | ESTIMATED COMMUNITY/GROUP RESPONSE | |
|---|---|---|
| | CATEGORY | DESCRIPTION |
| 0 - 10 | Little | Sporadic complaints |
| 5 - 15 | Medium | Widespread complaints |
| 10 - 20 | Strong | Threats of community / group action |
| > 15 | Very Strong | Vigorous community / group action |

### 5.3. International Standards

There are various international criteria levels for ambient sound from wind turbines. These are listed below:

- New Zealand – 40dB(A)
- Denmark – 42dB(A) (dwellings in open country)

- United Kingdom ($L_{A90}$) 35 - 40dB(A)

Australia has set the following limits that wind turbine noise should not exceed:

- 35dB(A) at relevant receivers in localities which are primarily intended for rural living, or
- 40dB(A) at relevant receivers in localities in other zones, or the background noise (*LA90*) by more than 5dB(A)

Germany has set the following standards

- Purely residential areas with no commercial developments 50 dBA (Day) and 35 dBA (Night)
- Areas with hospitals, health resorts, etc. 45 dBA (Day) 35 dBA (Night)

The rationale behind the criteria levels is that the design limit should be 5 dB below the ambient (residual) limit. This corresponds well with the South African guideline limit of 45 dB(A) (day/night limit) for rural districts.

## 6. IMPACTS DURING THE CONSTRUCTION PHASE

### 6.1. Potential Construction Noise Sources (General Equipment and Vehicles)

Noise pollution will be generated during the construction phase as well as the operational phase and decommissioning phase. The decommissioning noise impacts will be the same as for the construction phase.

The construction phase could generate noise during different activities such as:

- Site preparation and earthworks to gain access using bulldozers, trucks etc.
- Foundation construction using mobile equipment, cranes, concrete mixing and pile driving equipment (if needed).
- Limited blasting.
- Heavy vehicle used to deliver construction material and the turbines.
- Operating of a batch plant

The number and frequency of use of the various types of vehicles has not been determined but an indication of the type and level of noise generated is presented below.

Table 8 – Typical types of vehicles and equipment to be used on site (Construction Phase)

| Type | Description | Typical Sound Power Level (dB) |
|---|---|---|
| Passenger Vehicle | Passenger vehicle or light delivery vehicle such as bakkies | 85 |
| Trucks | 10 ton capacity | 95 |
| Cranes | Overhead and mobile | 109 |
| Mobile Construction Vehicles | Front end loaders | 100 |
| Mobile Construction Vehicles | Excavators | 108 |
| Mobile Construction Vehicles | Bull Dozer | 111 |
| Mobile Construction Vehicles | Dump Truck | 107 |
| Mobile Construction Vehicles | Grader | 98 |
| Mobile Construction Vehicles | Water Tanker | 95 |
| Stationary Construction Equipment | Concrete mixers | 110 |
| Compressor | Air compressor | 100 |
| Compactor | Vibratory compactor | 110 |

| Type | Description | Typical Sound Power Level (dB) |
|---|---|---|
| Pile Driver | Piling machine (mobile) | 115 |

Source: GCDA 2006

### 6.2. Predicted Noise Levels for the Construction Phase

The construction noise at the various sites will have a local impact. Safetech has conducted noise tests at various construction sites in South Africa and have recorded the noise emissions of various pieces of construction equipment. The results are presented in the Table below.

Table 9 - Typical Construction Noise

| Type of Equipment | $L_{Aeq,T}$ dB(A) |
|---|---|
| CAT 320D Excavator measured at approximately 50 m. | 67.9 |
| Mobile crane measured at approximately 70 m | 69.6 |
| Drilling rig measured at approximately 70 m | 72.6 |

The impact of the construction noise that can be expected at the proposed site can be extrapolated from Table 8. As an example, if a number of pieces of equipment are used simultaneously, the noise levels can be added logarithmically and then calculated at various distances from the site to determine the distance at which the ambient level will be reached.

Table 10 - Combining Different Construction Noise Sources – High Impacts ( Equipment with the highest sound power emissions i.e. worst case)

| Description | Typical Sound Power Level (dB) |
|---|---|
| Overhead and mobile cranes | 109 |
| Front end loaders | 100 |
| Excavators | 108 |
| Bull Dozer | 111 |
| Piling machine (mobile) | 115 |
| Total* | 117 |

*The total is a logarithmic total and not a sum of the values.

Table 11 - Combining Different Construction Noise Sources – Low Impacts - Equipment with the lowest sound power emissions

| Description | Typical Sound Power Level (dB) |
|---|---|
| Front end loaders | 100 |
| Excavators | 108 |
| Truck | 95 |
| Total | 111 |

The information in the tables above can now be used to calculate the attenuation by distance. Noise will also be attenuated by topography and atmospheric conditions such as temperature, humidity, wind speed and direction etc. but this is ignored for this purpose. Therefore, the distance calculated below would be representative of maximum distances to reach ambient noise levels.

The table below gives an illustration of attenuation by distance from a noise of 117dB measured from the source.

Table 12 – Attenuation by distance for the construction phase (worst case)

| Distance from noise source (metres) | Sound Pressure Level dB(A) |
|---|---|
| 10 | 89 |
| 20 | 83 |
| 40 | 77 |
| 80 | 71 |
| 160 | 65 |
| 320 | 59 |
| 640 | 53 |
| 1280 | 47 |

What can be inferred from the above table is that if the ambient noise level is at 45dB(A) during the day, the construction noise will be similar to the ambient level at approximately 1280m from the noise source, if the noise characteristics are similar. Beyond this distance, the noise level will be below the ambient noise and will therefore have little impact. The above only applies to the construction noise and light wind conditions.  High wind conditions will have a masking effect on the construction noise. In all likelihood, the construction noise will have little impact on the surrounding community as it will most likely occur during the day when the ambient noise is louder and there are unstable atmospheric conditions. Furthermore, none of the turbines are located closer than 1200m from the receptors. The construction of the access roads is a linear activity and will be of a short duration at each receptor. The construction of the roads is thus not significant as it is conducted mostly with mobile plant and equipment.

### 6.3. Significance Statement – Construction Activities

The EOH

EOH Coastal & Environmental Services

impact rating methodology as described in the Final Scoping Report is used to determine the construction significance ratings.

**Construction Impact Mitigation Measures**

- Construction operations should occur during daylight hours as far as possible.
- No construction piling should occur at night where possible. Piling should only occur during the day to take advantage of unstable atmospheric conditions.
- Construction staff should receive "noise sensitivity" training such as switching off vehicles when not in use, location of NSA's etc.
- One ambient noise survey should be conducted at the noise sensitive receptors during the construction phase

Table 13 – Construction Impact Significance Statement Table

| Nature of impact | Temporal Scale | Spatial Scale | Severity of Impact | Risk or Likelihood | Overall Significance |
|---|---|---|---|---|---|
| **WITHOUT MITIGATION** | | | | | |
| Impact of the construction noise on the surrounding environment | Short Term (1) | Local (1) | Moderate (2) | Probable (3) | **Low (7)** |
| **WITH MITIGATION** | | | | | |
| Impact of the construction noise on the surrounding environment | Short Term (1) | Local (1) | Moderate (2) | Probable (3) | **Low (7)** |

## 7. IMPACTS DURING THE OPERATIONAL PHASE

The potential effects of low frequency noise on humans include sleep disturbance, nausea, vertigo etc. These effects are unlikely to impact upon residents due to the distance between the turbines and the nearest communities. Sources of low frequency noise also include wind noise and vehicular traffic, which are all sources that currently also impact on the receptors.

### 7.1. Predicted noise levels for the Wind Turbines Generators (Brandvalley)

The tables and figures below indicate the noise generated by the turbines at wind speeds from 3m/s to 12m/s. The predicted noise levels in the Table 14 and 15 are ONLY the noise generated by the turbines and do not take any masking effect of the ambient noise into account. The wind speeds where the night time SANS 10103:2008 limit of 35dB(A) is exceeded is indicated in red font in Tables 14 and 15.

Table 14 - Predicted noise levels at the NSA's during the operational phase

| SANS10103:2008 Night Limit = 35dB(A) | | Vestas V117 | Vestas V126 | Acciona | Siemens | Vestas V126 |
|---|---|---|---|---|---|---|
| Name | Wind speed | From WTGs | From WTGs | From WTGs | From WTGs | WTG 52 & 53 Removed |
| | [m/s] | [dB(A)] | [dB(A)] | [dB(A)] | [dB(A)] | |
| **NSA1** | 3 | 23.2 | 22.2 | 37.2 | 22.2 | 21.6 |
| | 4 | 27.5 | 26.5 | 37.0 | 26.5 | 25.5 |
| | 5 | 32.0 | 31.7 | 36.8 | 31.7 | 29.9 |
| | 6 | 35.5 | 35.0 | 36.6 | 35.0 | 33.6 |
| | 7 | 36.4 | 35.8 | 36.4 | 35.8 | 34.3 |
| | 8 | 36.8 | 34.8 | 36.0 | 34.8 | 34.4 |
| | 9 | 36.8 | 35.8 | 35.9 | 35.8 | 34.4 |
| | 10 | 36.8 | 35.8 | 36.2 | 35.8 | 34.4 |
| | 11 | 36.8 | 35.8 | 36.5 | 35.8 | 34.4 |
| | 12 | 36.8 | 35.8 | 36.8 | 35.8 | 34.4 |
| **NSA 2** | 3 | 12.7 | 11.7 | 26.9 | 11.7 | 13.8 |
| | 4 | 17.0 | 16.0 | 26.7 | 16.0 | 17.7 |
| | 5 | 21.5 | 21.2 | 26.5 | 21.2 | 22.1 |
| | 6 | 25.0 | 25.8 | 26.3 | 25.8 | 25.8 |
| | 7 | 25.9 | 25.3 | 26.1 | 25.3 | 26.5 |
| | 8 | 26.3 | 25.4 | 25.7 | 25.4 | 26.6 |
| | 9 | 26.3 | 25.3 | 25.6 | 25.3 | 26.6 |
| | 10 | 26.3 | 25.3 | 25.9 | 25.3 | 26.6 |
| | 11 | 26.3 | 25.3 | 26.2 | 25.3 | 26.6 |
| | 12 | 26.3 | 25.3 | 26.5 | 25.3 | 26.6 |
| **NSA 3** | 3 | 8.8 | 7.8 | 23.0 | 7.8 | 9.9 |
| | 4 | 13.1 | 12.1 | 22.8 | 12.1 | 13.8 |
| | 5 | 17.6 | 17.3 | 22.6 | 17.3 | 18.2 |

| SANS10103:2008 Night Limit = 35dB(A) | | Vestas V117 | Vestas V126 | Acciona | Siemens | Vestas V126 |
|---|---|---|---|---|---|---|
| Name | Wind speed | From WTGs | From WTGs | From WTGs | From WTGs | WTG 52 & 53 Removed |
| | [m/s] | [dB(A)] | [dB(A)] | [dB(A)] | [dB(A)] | |
| | 6 | 21.1 | 22.8 | 22.4 | 22.8 | 21.9 |
| | 7 | 22.0 | 21.4 | 22.2 | 21.4 | 22.6 |
| | 8 | 22.4 | 22.3 | 21.8 | 22.3 | 22.7 |
| | 9 | 22.4 | 21.4 | 21.7 | 21.4 | 22.7 |
| | 10 | 22.4 | 21.4 | 22.0 | 21.4 | 22.7 |
| | 11 | 22.4 | 21.4 | 22.3 | 21.4 | 22.7 |
| | 12 | 22.4 | 21.4 | 22.6 | 21.4 | 22.7 |
| **NSA 4** | 3 | 18.4 | 17.3 | 32.4 | 17.3 | 19.6 |
| | 4 | 22.7 | 21.6 | 32.2 | 21.6 | 23.5 |
| | 5 | 27.2 | 26.8 | 32.0 | 26.8 | 27.9 |
| | 6 | 30.7 | 30.3 | 31.8 | 30.3 | 31.6 |
| | 7 | 31.6 | 30.9 | 31.6 | 30.9 | 32.3 |
| | 8 | 32.0 | 30.1 | 31.2 | 30.1 | 32.4 |
| | 9 | 32.0 | 30.9 | 31.1 | 30.9 | 32.4 |
| | 10 | 32.0 | 30.9 | 31.4 | 30.9 | 32.4 |
| | 11 | 32.0 | 30.9 | 31.7 | 30.9 | 32.4 |
| | 12 | 32.0 | 30.9 | 32.0 | 30.9 | 32.4 |
| **NSA 5** | 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 6 | 0.0 | 10.5 | 0.0 | 10.5 | 0.0 |
| | 7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 8 | 0.0 | 10.7 | 0.0 | 10.7 | 0.0 |
| | 9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 10 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 11 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 12 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **NSA 6** | 3 | 0.0 | 0.0 | 12.9 | 0.0 | 0.0 |
| | 4 | 2.9 | 1.9 | 12.7 | 1.9 | 3.6 |
| | 5 | 7.4 | 7.1 | 12.5 | 7.1 | 8.0 |
| | 6 | 10.9 | 16.1 | 12.3 | 16.1 | 11.7 |
| | 7 | 11.8 | 11.2 | 12.1 | 11.2 | 12.4 |
| | 8 | 12.2 | 15.9 | 11.7 | 15.9 | 12.5 |
| | 9 | 12.2 | 11.2 | 11.6 | 11.2 | 12.5 |
| | 10 | 12.2 | 11.2 | 11.9 | 11.2 | 12.5 |
| | 11 | 12.2 | 11.2 | 12.2 | 11.2 | 12.5 |
| | 12 | 12.2 | 11.2 | 12.5 | 11.2 | 12.5 |
| **NSA 7** | 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 6 | 0.0 | 10.9 | 0.0 | 10.9 | 0.0 |
| | 7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 8 | 0.0 | 11.1 | 0.0 | 11.1 | 0.0 |
| | 9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 10 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 11 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

| SANS10103:2008 Night Limit = 35dB(A) | | Vestas V117 | Vestas V126 | Acciona | Siemens | Vestas V126 |
|---|---|---|---|---|---|---|
| Name | Wind speed | From WTGs | From WTGs | From WTGs | From WTGs | WTG 52 & 53 Removed |
| | [m/s] | [dB(A)] | [dB(A)] | [dB(A)] | [dB(A)] | |
| | 12 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **NSA 8** | 3 | 0.0 | 0.0 | 6.9 | 0.0 | 0.0 |
| | 4 | 0.0 | 0.0 | 6.7 | 0.0 | 0.0 |
| | 5 | 1.4 | 1.1 | 6.5 | 1.1 | 2.1 |
| | 6 | 4.9 | 14.4 | 6.3 | 14.4 | 5.8 |
| | 7 | 5.8 | 5.2 | 6.1 | 5.2 | 6.5 |
| | 8 | 6.2 | 14.3 | 5.7 | 14.3 | 6.6 |
| | 9 | 6.2 | 5.2 | 5.6 | 5.2 | 6.6 |
| | 10 | 6.2 | 5.2 | 5.9 | 5.2 | 6.6 |
| | 11 | 6.2 | 5.2 | 6.2 | 5.2 | 6.6 |
| | 12 | 6.2 | 5.2 | 6.5 | 5.2 | 6.6 |
| **NSA 9** | 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 6 | 0.0 | 7.2 | 0.0 | 7.2 | 0.0 |
| | 7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 8 | 0.0 | 7.5 | 0.0 | 7.5 | 0.0 |
| | 9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 10 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 11 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 12 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **NSA 10** | 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 6 | 0.0 | 8.5 | 0.0 | 8.5 | 0.0 |
| | 7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 8 | 0.0 | 8.8 | 0.0 | 8.8 | 0.0 |
| | 9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 10 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 11 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 12 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **NSA 11** | 3 | 3.6 | 2.6 | 18.0 | 2.6 | 4.9 |
| | 4 | 7.9 | 6.9 | 17.8 | 6.9 | 8.8 |
| | 5 | 12.4 | 12.1 | 17.6 | 12.1 | 13.2 |
| | 6 | 15.9 | 19.6 | 17.4 | 19.6 | 16.9 |
| | 7 | 16.8 | 16.2 | 17.2 | 16.2 | 17.6 |
| | 8 | 17.2 | 19.2 | 16.8 | 19.2 | 17.7 |
| | 9 | 17.2 | 16.2 | 16.7 | 16.2 | 17.7 |
| | 10 | 17.2 | 16.2 | 17.0 | 16.2 | 17.7 |
| | 11 | 17.2 | 16.2 | 17.3 | 16.2 | 17.7 |
| | 12 | 17.2 | 16.2 | 17.6 | 16.2 | 17.7 |
| **NSA 12** | 3 | 1.1 | 0.1 | 15.4 | 0.1 | 2.4 |
| | 4 | 5.4 | 4.4 | 15.2 | 4.4 | 6.3 |
| | 5 | 9.9 | 9.6 | 15.0 | 9.6 | 10.7 |
| | 6 | 13.4 | 18.3 | 14.8 | 18.3 | 14.4 |

| SANS10103:2008 Night Limit = 35dB(A) | | Vestas V117 | Vestas V126 | Acciona | Siemens | Vestas V126 |
|---|---|---|---|---|---|---|
| Name | Wind speed | From WTGs | From WTGs | From WTGs | From WTGs | WTG 52 & 53 Removed |
| | [m/s] | [dB(A)] | [dB(A)] | [dB(A)] | [dB(A)] | |
| | 7 | 14.3 | 13.7 | 14.6 | 13.7 | 15.1 |
| | 8 | 14.7 | 18.0 | 14.2 | 18.0 | 15.2 |
| | 9 | 14.7 | 13.7 | 14.1 | 13.7 | 15.2 |
| | 10 | 14.7 | 13.7 | 14.4 | 13.7 | 15.2 |
| | 11 | 14.7 | 13.7 | 14.7 | 13.7 | 15.2 |
| | 12 | 14.7 | 13.7 | 15.0 | 13.7 | 15.2 |
| **NSA 13** | 3 | 4.7 | 3.7 | 19.0 | 3.7 | 6.0 |
| | 4 | 9.0 | 8.0 | 18.8 | 8.0 | 9.9 |
| | 5 | 13.5 | 13.2 | 18.6 | 13.2 | 14.3 |
| | 6 | 17.0 | 20.4 | 18.4 | 20.4 | 18.0 |
| | 7 | 17.9 | 17.3 | 18.2 | 17.3 | 18.7 |
| | 8 | 18.3 | 20.0 | 17.8 | 20.0 | 18.8 |
| | 9 | 18.3 | 17.3 | 17.7 | 17.3 | 18.8 |
| | 10 | 18.3 | 17.3 | 18.0 | 17.3 | 18.8 |
| | 11 | 18.3 | 17.3 | 18.3 | 17.3 | 18.8 |
| | 12 | 18.3 | 17.3 | 18.6 | 17.3 | 18.8 |
| **NSA 14** | 3 | 10.0 | 9.0 | 24.4 | 9.0 | 11.3 |
| | 4 | 14.3 | 13.3 | 24.2 | 13.3 | 15.2 |
| | 5 | 18.8 | 18.5 | 24.0 | 18.5 | 19.6 |
| | 6 | 22.3 | 24.5 | 23.8 | 24.5 | 23.3 |
| | 7 | 23.2 | 22.6 | 23.6 | 22.6 | 24.0 |
| | 8 | 23.6 | 24.0 | 23.2 | 24.0 | 24.1 |
| | 9 | 23.6 | 22.6 | 23.1 | 22.6 | 24.1 |
| | 10 | 23.6 | 22.6 | 23.4 | 22.6 | 24.1 |
| | 11 | 23.6 | 22.6 | 23.7 | 22.6 | 24.1 |
| | 12 | 23.6 | 22.6 | 24.0 | 22.6 | 24.1 |
| **NSA 15** | 3 | 2.3 | 1.3 | 16.6 | 1.3 | 3.2 |
| | 4 | 6.6 | 5.6 | 16.4 | 5.6 | 7.1 |
| | 5 | 11.1 | 10.8 | 16.2 | 10.8 | 11.5 |
| | 6 | 14.6 | 18.8 | 16.0 | 18.8 | 15.2 |
| | 7 | 15.5 | 14.9 | 15.8 | 14.9 | 15.9 |
| | 8 | 15.9 | 18.4 | 15.4 | 18.4 | 16.0 |
| | 9 | 15.9 | 14.9 | 15.3 | 14.9 | 16.0 |
| | 10 | 15.9 | 14.9 | 15.6 | 14.9 | 16.0 |
| | 11 | 15.9 | 14.9 | 15.9 | 14.9 | 16.0 |
| | 12 | 15.9 | 14.9 | 16.2 | 14.9 | 16.0 |
| **NSA 16** | 3 | 0.0 | 0.0 | 2.9 | 0.0 | 0.0 |
| | 4 | 0.0 | 0.0 | 2.7 | 0.0 | 0.0 |
| | 5 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 |
| | 6 | 1.0 | 12.0 | 2.3 | 12.0 | 1.9 |
| | 7 | 1.9 | 1.2 | 2.1 | 1.2 | 2.6 |
| | 8 | 2.3 | 12.0 | 1.7 | 12.0 | 2.7 |
| | 9 | 2.3 | 1.2 | 1.6 | 1.2 | 2.7 |
| | 10 | 2.3 | 1.2 | 1.9 | 1.2 | 2.7 |
| | 11 | 2.3 | 1.2 | 2.2 | 1.2 | 2.7 |
| | 12 | 2.3 | 1.2 | 2.5 | 1.2 | 2.7 |

| SANS10103:2008 Night Limit = 35dB(A) | | Vestas V117 | Vestas V126 | Acciona | Siemens | Vestas V126 |
|---|---|---|---|---|---|---|
| Name | Wind speed | From WTGs | From WTGs | From WTGs | From WTGs | WTG 52 & 53 Removed |
| | [m/s] | [dB(A)] | [dB(A)] | [dB(A)] | [dB(A)] | |
| NSA 17 | 3 | 0.0 | 0.0 | 12.7 | 0.0 | 0.0 |
| | 4 | 2.7 | 1.7 | 12.5 | 1.7 | 3.6 |
| | 5 | 7.2 | 6.9 | 12.3 | 6.9 | 8.0 |
| | 6 | 10.7 | 16.6 | 12.1 | 16.6 | 11.7 |
| | 7 | 11.6 | 11.0 | 11.9 | 11.0 | 12.4 |
| | 8 | 12.0 | 16.4 | 11.5 | 16.4 | 12.5 |
| | 9 | 12.0 | 11.0 | 11.4 | 11.0 | 12.5 |
| | 10 | 12.0 | 11.0 | 11.7 | 11.0 | 12.5 |
| | 11 | 12.0 | 11.0 | 12.0 | 11.0 | 12.5 |
| | 12 | 12.0 | 11.0 | 12.3 | 11.0 | 12.5 |
| NSA 18 | 3 | 0.8 | 0.0 | 15.2 | 0.0 | 2.1 |
| | 4 | 5.1 | 4.1 | 15.0 | 4.1 | 6.0 |
| | 5 | 9.6 | 9.3 | 14.8 | 9.3 | 10.4 |
| | 6 | 13.1 | 18.8 | 14.6 | 18.8 | 14.1 |
| | 7 | 14.0 | 13.4 | 14.4 | 13.4 | 14.8 |
| | 8 | 14.4 | 18.5 | 14.0 | 18.5 | 14.9 |
| | 9 | 14.4 | 13.4 | 13.9 | 13.4 | 14.9 |
| | 10 | 14.4 | 13.4 | 14.2 | 13.4 | 14.9 |
| | 11 | 14.4 | 13.4 | 14.5 | 13.4 | 14.9 |
| | 12 | 14.4 | 13.4 | 14.8 | 13.4 | 14.9 |
| NSA 19 | 3 | 0.0 | 0.0 | 7.2 | 0.0 | 0.0 |
| | 4 | 0.0 | 0.0 | 7.0 | 0.0 | 0.0 |
| | 5 | 1.7 | 1.4 | 6.8 | 1.4 | 2.5 |
| | 6 | 5.2 | 14.2 | 6.6 | 14.2 | 6.2 |
| | 7 | 6.1 | 5.5 | 6.4 | 5.5 | 6.9 |
| | 8 | 6.5 | 14.1 | 6.0 | 14.1 | 7.0 |
| | 9 | 6.5 | 5.5 | 5.9 | 5.5 | 7.0 |
| | 10 | 6.5 | 5.5 | 6.2 | 5.5 | 7.0 |
| | 11 | 6.5 | 5.5 | 6.5 | 5.5 | 7.0 |
| | 12 | 6.5 | 5.5 | 6.8 | 5.5 | 7.0 |
| NSA 20 | 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 6 | 0.0 | 6.7 | 0.0 | 6.7 | 0.0 |
| | 7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 8 | 0.0 | 7.0 | 0.0 | 7.0 | 0.0 |
| | 9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 10 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 11 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 12 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| NSA 21 | 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 6 | 0.0 | 6.8 | 0.0 | 6.8 | 0.0 |
| | 7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 8 | 0.0 | 7.1 | 0.0 | 7.1 | 0.0 |

| SANS10103:2008 Night Limit = 35dB(A) | | Vestas V117 | Vestas V126 | Acciona | Siemens | Vestas V126 |
|---|---|---|---|---|---|---|
| **Name** | **Wind speed** | **From WTGs** | **From WTGs** | **From WTGs** | **From WTGs** | **WTG 52 & 53 Removed** |
| | **[m/s]** | **[dB(A)]** | **[dB(A)]** | **[dB(A)]** | **[dB(A)]** | |
| | 9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 10 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 11 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 12 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **NSA 22** | 3 | 10.0 | 9.0 | 24.2 | 9.0 | 11.3 |
| | 4 | 14.3 | 13.3 | 24.0 | 13.3 | 15.2 |
| | 5 | 18.8 | 18.5 | 23.8 | 18.5 | 19.6 |
| | 6 | 22.3 | 24.5 | 23.6 | 24.5 | 23.3 |
| | 7 | 23.2 | 22.6 | 23.4 | 22.6 | 24.0 |
| | 8 | 23.6 | 24.0 | 23.0 | 24.0 | 24.1 |
| | 9 | 23.6 | 22.6 | 22.9 | 22.6 | 24.1 |
| | 10 | 23.6 | 22.6 | 23.2 | 22.6 | 24.1 |
| | 11 | 23.6 | 22.6 | 23.5 | 22.6 | 24.1 |
| | 12 | 23.6 | 22.6 | 23.8 | 22.6 | 24.1 |
| **NSA 23** | 3 | 15.4 | 14.4 | 29.5 | 14.4 | 16.7 |
| | 4 | 19.7 | 18.7 | 29.3 | 18.7 | 20.6 |
| | 5 | 24.2 | 23.9 | 29.1 | 23.9 | 25.0 |
| | 6 | 27.7 | 28.4 | 28.9 | 28.4 | 28.7 |
| | 7 | 28.6 | 28.0 | 28.7 | 28.0 | 29.4 |
| | 8 | 29.0 | 27.9 | 28.3 | 27.9 | 29.5 |
| | 9 | 29.0 | 28.0 | 28.2 | 28.0 | 29.5 |
| | 10 | 29.0 | 28.0 | 28.5 | 28.0 | 29.5 |
| | 11 | 29.0 | 28.0 | 28.8 | 28.0 | 29.5 |
| | 12 | 29.0 | 28.0 | 29.1 | 28.0 | 29.5 |
| **NSA 24** | 3 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 |
| | 4 | 0.0 | 0.0 | 2.3 | 0.0 | 0.0 |
| | 5 | 0.0 | 0.0 | 2.1 | 0.0 | 0.0 |
| | 6 | 0.6 | 12.5 | 1.9 | 12.5 | 1.6 |
| | 7 | 1.5 | 0.9 | 1.7 | 0.9 | 2.3 |
| | 8 | 1.9 | 12.6 | 1.3 | 12.6 | 2.4 |
| | 9 | 1.9 | 0.9 | 1.2 | 0.9 | 2.4 |
| | 10 | 1.9 | 0.9 | 1.5 | 0.9 | 2.4 |
| | 11 | 1.9 | 0.9 | 1.8 | 0.9 | 2.4 |
| | 12 | 1.9 | 0.9 | 2.1 | 0.9 | 2.4 |
| **NSA 25** | 3 | 0.0 | 0.0 | 9.0 | 0.0 | 0.0 |
| | 4 | 0.0 | 0.0 | 8.8 | 0.0 | 0.0 |
| | 5 | 3.5 | 3.2 | 8.6 | 3.2 | 4.2 |
| | 6 | 7.0 | 15.1 | 8.4 | 15.1 | 7.9 |
| | 7 | 7.9 | 7.3 | 8.2 | 7.3 | 8.6 |
| | 8 | 8.3 | 15.0 | 7.8 | 15.0 | 8.7 |
| | 9 | 8.3 | 7.3 | 7.7 | 7.3 | 8.7 |
| | 10 | 8.3 | 7.3 | 8.0 | 7.3 | 8.7 |
| | 11 | 8.3 | 7.3 | 8.3 | 7.3 | 8.7 |
| | 12 | 8.3 | 7.3 | 8.6 | 7.3 | 8.7 |
| **NSA 26** | 3 | 4.0 | 3.0 | 18.2 | 3.0 | 5.3 |
| | 4 | 8.3 | 7.3 | 18.0 | 7.3 | 9.2 |

| SANS10103:2008 Night Limit = 35dB(A) | | Vestas V117 | Vestas V126 | Acciona | Siemens | Vestas V126 |
|---|---|---|---|---|---|---|
| Name | Wind speed | From WTGs | From WTGs | From WTGs | From WTGs | WTG 52 & 53 Removed |
| | [m/s] | [dB(A)] | [dB(A)] | [dB(A)] | [dB(A)] | |
| | 5 | 12.8 | 12.5 | 17.8 | 12.5 | 13.6 |
| | 6 | 16.3 | 20.2 | 17.6 | 20.2 | 17.3 |
| | 7 | 17.2 | 16.6 | 17.4 | 16.6 | 18.0 |
| | 8 | 17.6 | 19.8 | 17.0 | 19.8 | 18.1 |
| | 9 | 17.6 | 16.6 | 16.9 | 16.6 | 18.1 |
| | 10 | 17.6 | 16.6 | 17.2 | 16.6 | 18.1 |
| | 11 | 17.6 | 16.6 | 17.5 | 16.6 | 18.1 |
| | 12 | 17.6 | 16.6 | 17.8 | 16.6 | 18.1 |
| **NSA 27** | 3 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 |
| | 4 | 0.0 | 0.0 | 1.8 | 0.0 | 0.0 |
| | 5 | 0.0 | 0.0 | 1.6 | 0.0 | 0.0 |
| | 6 | 0.0 | 11.9 | 1.4 | 11.9 | 0.9 |
| | 7 | 0.9 | 0.3 | 1.2 | 0.3 | 1.6 |
| | 8 | 1.3 | 12.0 | 0.8 | 12.0 | 1.7 |
| | 9 | 1.3 | 0.3 | 0.7 | 0.3 | 1.7 |
| | 10 | 1.3 | 0.3 | 1.0 | 0.3 | 1.7 |
| | 11 | 1.3 | 0.3 | 1.3 | 0.3 | 1.7 |
| | 12 | 1.3 | 0.3 | 1.6 | 0.3 | 1.7 |
| **NSA 28** | 3 | 20.7 | 19.7 | 34.8 | 19.7 | 22.0 |
| | 4 | 25.0 | 24.0 | 34.6 | 24.0 | 25.9 |
| | 5 | 29.5 | 29.2 | 34.4 | 29.2 | 30.3 |
| | 6 | 33.0 | 33.0 | 34.2 | 33.0 | 34.0 |
| | 7 | 33.9 | 33.3 | 34.0 | 33.3 | 34.7 |
| | 8 | 34.3 | 32.6 | 33.6 | 32.6 | 34.8 |
| | 9 | 34.3 | 33.3 | 33.5 | 33.3 | 34.8 |
| | 10 | 34.3 | 33.3 | 33.8 | 33.3 | 34.8 |
| | 11 | 34.3 | 33.3 | 34.1 | 33.3 | 34.8 |
| | 12 | 34.3 | 33.3 | 34.4 | 33.3 | 34.8 |
| **NSA 29** | 3 | 0.3 | 0.0 | 14.6 | 0.0 | 1.6 |
| | 4 | 4.6 | 3.6 | 14.4 | 3.6 | 5.5 |
| | 5 | 9.1 | 8.8 | 14.2 | 8.8 | 9.9 |
| | 6 | 12.6 | 18.1 | 14.0 | 18.1 | 13.6 |
| | 7 | 13.5 | 12.9 | 13.8 | 12.9 | 14.3 |
| | 8 | 13.9 | 17.8 | 13.4 | 17.8 | 14.4 |
| | 9 | 13.9 | 12.9 | 13.3 | 12.9 | 14.4 |
| | 10 | 13.9 | 12.9 | 13.6 | 12.9 | 14.4 |
| | 11 | 13.9 | 12.9 | 13.9 | 12.9 | 14.4 |
| | 12 | 13.9 | 12.9 | 14.2 | 12.9 | 14.4 |

## 7.2. Predicted noise levels for the Wind Turbines Generators (Cumulative effect of Brandvalley & Rietkloof)

The cumulative effect of developing both the Brandvalley and Rietkloof Wind Energy Projects was modeled using the Vestas V117 turbine. The results are presented in Table 15 below.

Table 15 – Cumulative predicted noise levels at the NSA's during the operational phase (Brandvalley and Rietkloof)

| | | Cumulative Effect Brandvalley and Rietkloof |
|---|---|---|
| Name | Wind speed | From WTGs |
| | [m/s] | [dB(A)] |
| NSA1 | 3 | 23.3 |
| | 4 | 27.6 |
| | 5 | 32.1 |
| | 6 | 35.6 |
| | 7 | 36.5 |
| | 8 | 36.9 |
| | 9 | 36.9 |
| | 10 | 36.9 |
| | 11 | 36.9 |
| | 12 | 36.9 |
| NSA 2 | 3 | 18.9 |
| | 4 | 23.2 |
| | 5 | 27.7 |
| | 6 | 31.2 |
| | 7 | 32.1 |
| | 8 | 32.5 |
| | 9 | 32.5 |
| | 10 | 32.5 |
| | 11 | 32.5 |
| | 12 | 32.5 |
| NSA 3 | 3 | 16.2 |
| | 4 | 20.5 |
| | 5 | 25.0 |
| | 6 | 28.5 |
| | 7 | 29.4 |
| | 8 | 29.8 |
| | 9 | 29.8 |
| | 10 | 29.8 |
| | 11 | 29.8 |
| | 12 | 29.8 |
| NSA 4 | 3 | 18.5 |
| | 4 | 22.8 |
| | 5 | 27.3 |
| | 6 | 30.8 |

| | | Cumulative Effect Brandvalley and Rietkloof |
|---|---|---|
| **Name** | **Wind speed** | **From WTGs** |
| | **[m/s]** | **[dB(A)]** |
| | 7 | 31.7 |
| | 8 | 32.1 |
| | 9 | 32.1 |
| | 10 | 32.1 |
| | 11 | 32.1 |
| | 12 | 32.1 |
| **NSA 5** | 3 | 9.0 |
| | 4 | 13.3 |
| | 5 | 17.8 |
| | 6 | 21.3 |
| | 7 | 22.2 |
| | 8 | 22.6 |
| | 9 | 22.6 |
| | 10 | 22.6 |
| | 11 | 22.6 |
| | 12 | 22.6 |
| **NSA 6** | 3 | 5.1 |
| | 4 | 9.4 |
| | 5 | 13.9 |
| | 6 | 17.4 |
| | 7 | 18.3 |
| | 8 | 18.7 |
| | 9 | 18.7 |
| | 10 | 18.7 |
| | 11 | 18.7 |
| | 12 | 18.7 |
| **NSA 7** | 3 | 13.7 |
| | 4 | 18.0 |
| | 5 | 22.5 |
| | 6 | 26.0 |
| | 7 | 26.9 |
| | 8 | 27.3 |
| | 9 | 27.3 |
| | 10 | 27.3 |
| | 11 | 27.3 |
| | 12 | 27.3 |
| **NSA 8** | 3 | 20.0 |
| | 4 | 24.3 |
| | 5 | 28.8 |
| | 6 | 32.3 |
| | 7 | 33.2 |
| | 8 | 33.6 |
| | 9 | 33.6 |
| | 10 | 33.6 |
| | 11 | 33.6 |
| | 12 | 33.6 |
| **NSA 9** | 3 | 0.0 |
| | 4 | 0.0 |

| | | Cumulative Effect Brandvalley and Rietkloof |
|---|---|---|
| Name | Wind speed | From WTGs |
| | [m/s] | [dB(A)] |
| | 5 | 0.0 |
| | 6 | 1.7 |
| | 7 | 2.6 |
| | 8 | 3.0 |
| | 9 | 3.0 |
| | 10 | 3.0 |
| | 11 | 3.0 |
| | 12 | 3.0 |
| **NSA 10** | 3 | 0.0 |
| | 4 | 0.0 |
| | 5 | 0.0 |
| | 6 | 0.9 |
| | 7 | 1.8 |
| | 8 | 2.2 |
| | 9 | 2.2 |
| | 10 | 2.2 |
| | 11 | 2.2 |
| | 12 | 2.2 |
| **NSA 11** | 3 | 9.3 |
| | 4 | 13.6 |
| | 5 | 18.1 |
| | 6 | 21.6 |
| | 7 | 22.5 |
| | 8 | 22.9 |
| | 9 | 22.9 |
| | 10 | 22.9 |
| | 11 | 22.9 |
| | 12 | 22.9 |
| **NSA 12** | 3 | 18.8 |
| | 4 | 23.1 |
| | 5 | 27.6 |
| | 6 | 31.1 |
| | 7 | 32.0 |
| | 8 | 32.4 |
| | 9 | 32.4 |
| | 10 | 32.4 |
| | 11 | 32.4 |
| | 12 | 32.4 |
| **NSA 13** | 3 | 19.3 |
| | 4 | 23.6 |
| | 5 | 28.1 |
| | 6 | 31.6 |
| | 7 | 32.5 |
| | 8 | 32.9 |
| | 9 | 32.9 |
| | 10 | 32.9 |
| | 11 | 32.9 |
| | 12 | 32.9 |

| | | Cumulative Effect Brandvalley and Rietkloof |
|---|---|---|
| Name | Wind speed | From WTGs |
| | [m/s] | [dB(A)] |
| **NSA 14** | 3 | 20.7 |
| | 4 | 25.0 |
| | 5 | 29.5 |
| | 6 | 33.0 |
| | 7 | 33.9 |
| | 8 | 34.3 |
| | 9 | 34.3 |
| | 10 | 34.3 |
| | 11 | 34.3 |
| | 12 | 34.3 |
| **NSA 15** | 3 | 2.8 |
| | 4 | 7.1 |
| | 5 | 11.6 |
| | 6 | 15.1 |
| | 7 | 16.0 |
| | 8 | 16.4 |
| | 9 | 16.4 |
| | 10 | 16.4 |
| | 11 | 16.4 |
| | 12 | 16.4 |
| **NSA 16** | 3 | 0.0 |
| | 4 | 3.4 |
| | 5 | 7.9 |
| | 6 | 11.4 |
| | 7 | 12.3 |
| | 8 | 12.7 |
| | 9 | 12.7 |
| | 10 | 12.7 |
| | 11 | 12.7 |
| | 12 | 12.7 |
| **NSA 17** | 3 | 7.3 |
| | 4 | 11.6 |
| | 5 | 16.1 |
| | 6 | 19.6 |
| | 7 | 20.5 |
| | 8 | 20.9 |
| | 9 | 20.9 |
| | 10 | 20.9 |
| | 11 | 20.9 |
| | 12 | 20.9 |
| **NSA 18** | 3 | 21.4 |
| | 4 | 25.7 |
| | 5 | 30.2 |
| | 6 | 33.7 |
| | 7 | 34.6 |
| | 8 | 35.0 |
| | 9 | 35.0 |
| | 10 | 35.0 |

| | | Cumulative Effect Brandvalley and Rietkloof |
|---|---|---|
| **Name** | **Wind speed** | **From WTGs** |
| | **[m/s]** | **[dB(A)]** |
| | 11 | 35.0 |
| | 12 | 35.0 |
| **NSA 19** | 3 | 14.1 |
| | 4 | 18.4 |
| | 5 | 22.9 |
| | 6 | 26.4 |
| | 7 | 27.3 |
| | 8 | 27.7 |
| | 9 | 27.7 |
| | 10 | 27.7 |
| | 11 | 27.7 |
| | 12 | 27.7 |
| **NSA 20** | 3 | 0.0 |
| | 4 | 0.0 |
| | 5 | 2.1 |
| | 6 | 5.6 |
| | 7 | 6.5 |
| | 8 | 6.9 |
| | 9 | 6.9 |
| | 10 | 6.9 |
| | 11 | 6.9 |
| | 12 | 6.9 |
| **NSA 21** | 3 | 0.0 |
| | 4 | 0.0 |
| | 5 | 0.0 |
| | 6 | 3.0 |
| | 7 | 3.9 |
| | 8 | 4.3 |
| | 9 | 4.3 |
| | 10 | 4.3 |
| | 11 | 4.3 |
| | 12 | 4.3 |
| **NSA 22** | 3 | 10.0 |
| | 4 | 14.3 |
| | 5 | 18.8 |
| | 6 | 22.3 |
| | 7 | 23.2 |
| | 8 | 23.6 |
| | 9 | 23.6 |
| | 10 | 23.6 |
| | 11 | 23.6 |
| | 12 | 23.6 |
| **NSA 23** | 3 | 15.4 |
| | 4 | 19.7 |
| | 5 | 24.2 |
| | 6 | 27.7 |
| | 7 | 28.6 |
| | 8 | 29.0 |

| | | Cumulative Effect Brandvalley and Rietkloof |
|---|---|---|
| **Name** | **Wind speed** | **From WTGs** |
| | **[m/s]** | **[dB(A)]** |
| | 9 | 29.0 |
| | 10 | 29.0 |
| | 11 | 29.0 |
| | 12 | 29.0 |
| **NSA 24** | 3 | 0.0 |
| | 4 | 0.0 |
| | 5 | 0.0 |
| | 6 | 0.6 |
| | 7 | 1.5 |
| | 8 | 1.9 |
| | 9 | 1.9 |
| | 10 | 1.9 |
| | 11 | 1.9 |
| | 12 | 1.9 |
| **NSA 25** | 3 | 0.0 |
| | 4 | 0.0 |
| | 5 | 3.5 |
| | 6 | 7.0 |
| | 7 | 7.9 |
| | 8 | 8.3 |
| | 9 | 8.3 |
| | 10 | 8.3 |
| | 11 | 8.3 |
| | 12 | 8.3 |
| **NSA 26** | 3 | 4.0 |
| | 4 | 8.3 |
| | 5 | 12.8 |
| | 6 | 16.3 |
| | 7 | 17.2 |
| | 8 | 17.6 |
| | 9 | 17.6 |
| | 10 | 17.6 |
| | 11 | 17.6 |
| | 12 | 17.6 |
| **NSA 27** | 3 | 0.0 |
| | 4 | 0.0 |
| | 5 | 0.0 |
| | 6 | 0.1 |
| | 7 | 1.0 |
| | 8 | 1.4 |
| | 9 | 1.4 |
| | 10 | 1.4 |
| | 11 | 1.4 |
| | 12 | 1.4 |
| **NSA 28** | 3 | 21.9 |
| | 4 | 26.2 |
| | 5 | 30.7 |
| | 6 | 34.2 |

| | | Cumulative Effect Brandvalley and Rietkloof |
|---|---|---|
| Name | Wind speed | From WTGs |
| | [m/s] | [dB(A)] |
| | 7 | 35.1 |
| | 8 | 35.5 |
| | 9 | 35.5 |
| | 10 | 35.5 |
| | 11 | 35.5 |
| | 12 | 35.5 |
| NSA 29 | 3 | 0.4 |
| | 4 | 4.7 |
| | 5 | 9.2 |
| | 6 | 12.7 |
| | 7 | 13.6 |
| | 8 | 14.0 |
| | 9 | 14.0 |
| | 10 | 14.0 |
| | 11 | 14.0 |
| | 12 | 14.0 |

## 7.3. Discussion of predicted noise levels

### 7.3.1 All Brandvalley NSA's

The results above indicate that the 24 hour 45 dB(A) limit for **day/night** operations will not be exceeded at any of the noise sensitive areas.

The results above indicate that the 35 dB(A) limit for **night** operations will be exceeded at NSA 1 from 6m/s wind speed for the Vestas and Siemens turbines. The Acciona turbine will exceed the night limit from 3m/s. It is highly likely that the wind noise will provide a masking effect at NSA 1 as the rating limit is only exceeded at 6m/s. The WTG noise emissions are thus unlikely to impact the receptors at NSA 1.

Table 14 shows the modelling results in the last column when two turbines (WTG 52 & 53) are removed that are in close proximity to NSA 1. The results indicate that with the removal of these two turbines, the 35dB(A) night limit is not exceeded. The additional modelling was based on the Vestas V126 turbine.

### 7.3.2 Cumulative Effect (Brandvalley and Rietkloof)

The 35 dB(A) **night** guideline limit will be exceeded at NSA 18 and NSA 28 if both the Brandvalley and Rietkloof Wind Energy Farms are developed. It is highly likely that the wind noise will provide a masking effect at NSA 18 as the rating limit is only exceeded at 8m/s and 7m/s at NSA 28. The WTG noise emissions are thus unlikely to impact the receptors at NSA 18 and 28.

If a noise impact survey during operations indicates that a noise disturbance is present i.e. (the turbine noise exceeds the actual ambient (residual) noise by more than 7dB(A), then the turbines can be placed in a lower operational noise mode, when the surface wind speeds are low and the hub height wind speed has reached the cut-in speed (3m/s).

The cumulative impact table (Table 15) indicated that the night rating limit of 35dB(A) is also exceeded at NSA 1. These exceedances can be ignored as they are not due to the cumulative effect, but rather from the individual effect of the Brandvalley project.

#### 7.2.3 Significance Statement Operational Phase

The EOH Coastal & Environmental Services impact rating methodology as described in the Final Scoping Report is used to determine the operational phase significance ratings.

**Operational Phase Impact Mitigation Measures**

- The noise impact from the wind turbine generators should be measured during the operational phase, to ensure that the impact is within the required legal limit.
- Wind turbine generators should be maintained to ensure the noise emissions are within the legal and design specifications.
- An ambient noise survey should be conducted at the noise sensitive receptors closest to the turbines during the operational phase

Table 16 – Construction Impact Significance Statement Table

| Nature of impact | Temporal Scale | Spatial Scale | Severity of Impact | Risk or Likelihood | Overall Significance |
|---|---|---|---|---|---|
| **WITHOUT MITIGATION** | | | | | |
| Impact of the operational noise on the surrounding environment | Short Term (1) | Local (1) | Moderate (2) | Probable (3) | **Low (7)** |
| **WITH MITIGATION** | | | | | |

| Nature of impact | Temporal Scale | Spatial Scale | Severity of Impact | Risk or Likelihood | Overall Significance |
|---|---|---|---|---|---|
| Impact of the operational noise on the surrounding environment | Short Term (1) | Local (1) | Moderate (2) | Probable (3) | **Low (7)** |

## 8. CONCLUSION AND RECOMMENDATIONS

### 8.1. Conclusion

The impact of the noise pollution that can be expected from the site during the construction and operational phase will largely depend on the climatic conditions at the site. The ambient (residual) noise increases as the wind speed increases. The above modeling does not take into account any masking effect of the wind at the receiver, therefore it is a worst case scenario with respect to noise pollution.

#### 8.1.1 Construction Phase

There will be a low impact on the residents at the noise sensitive areas from the construction activities, especially if pile driving is to be done. This however will only occur if the underlying geological structure requires this.

a) The area surrounding the construction sites will be affected for short periods of time in all directions, should numerous construction equipment be used simultaneously.
b) The number of construction vehicles that will be used in the project will add to the existing ambient levels and will most likely cause a disturbing noise for a limited time. The exact number of construction vehicles is not known at present. The duration of impact will however be of short duration.

#### 8.1.2 Operational Phase

The impacts from the operational phase are summarized as follows:

a) The day/night time SANS 10103:2008 noise limit of 45dBA will be not be exceeded at any of the noise sensitive areas.
b) The night time guideline noise limit of 35dBA will only be exceeded at NSA 1 (a maximum of 2.3dB, although this is unlikely due to the wind masking effect.

c) If a complaint is received it should be evaluated against the actual ambient (residual) noise at the complainants location. If the increase is more than 7dB(A) above the ambient noise, a noise disturbance will be present in terms of the Environment Conservation Act – Noise Control Regulations and the Western Cape Noise Control Regulations. This is however unlikely due to the masking effect of the wind.

#### 8.1.3 Decommissioning

The decommissioning noise impacts will be the same as for the construction phase.

### 8.2. Recommendations

The following is recommended:

#### 8.2.1 Construction Activities

- Construction operations should only occur during daylight hours as far as possible.
- No construction piling should occur at night where possible. Piling should only occur during the day to take advantage of unstable atmospheric conditions.
- Construction staff should receive “noise sensitivity” training.
- An ambient noise survey should be conducted during the construction phase.

#### 8.2.2 Operational Activities

The following general recommendation is made for the operational phase:

- Re-modelling of the noise impacts will need to conducted on the final layout (when the final turbine is selected should the layout change).
- The noise impact from the wind turbine generators should be measured during the operational phase, to ensure that the impact is within the required legal limits.

Based on the information that has been supplied to me, the turbine locations, access road alternatives, construction camp alternatives and substation alternatives can proceed as the facility as a whole will result in low (-) noise impacts throughout the project lifecycle regardless of where infrastructure is located.

Dr Brett Williams

## 9. REFERENCES


| | |
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| 5) | DTI – United Kingdom The measurement of low frequency noise at 3 UK Wind Farms. Hayes Mackenzie. 2006 |
| 6) | Gold Coast Desalination Alliance (GCDA) – 2006 Environmental Impact Assessment Queensland Desalination Plant (Chapter 11). |
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# APPENDICES

## APPENDIX A - AIA Certificate

DEPARTMENT
OF LABOUR

Certificate

This is to certify that

SAFETRAIN CC
TRADING AS T\A SAFETECH

has been approved as an

APPROVED INSPECTION AUTHORITY

in terms of the Occupational Health and Safety Act, 1993,
for the monitoring of

Physical Stress Factors and Chemical Stress Factors (including Lead and Asbestos, Ergonomic hazards and Ventilation Installation) and Biological Factors

2009-08-27
DATE

CI 049 OH
CERTIFICATE NUMBER

CHIEF INSPECTOR

## APPENDIX B – Calibration Certificate

sanas
Calibration Laboratory
148 1302


M AND N ACOUSTIC SERVICES (Pty) Ltd
Co. Reg. No: 2012/123298/07 VAT NO: 4300256876 BEE Status: Level 4
P.O. Box 61713, Pierre van Ryneveld, 0045
Shop 13, Ryneveld Corner Shopping Centre,
cnr Fouche & Van Ryneveld Sts, Pierre van Ryneveld, 0045
Tel: 012 689 2007/8 • Fax: 086 211 4690
E-mail: calservice@mweb.co.za


# CERTIFICATE OF CALIBRATION

| | |
|---|---|
| CERTIFICATE NUMBER | 2015-2431 |
| ORGANISATION | SAFETRAIN T/A SAFETECH |
| ORGANISATION ADDRESS | P.O. BOX 27697, GREENACRES, 6057 |
| CALIBRATION OF | INTEGRATING SOUND LEVEL METER complete with ½" MICROPHONES and ⅓- OCTAVE/OCTAVE RTA CARD |
| CALIBRATED BY | ELECTRICAL TESTS: C. DE CLERCQ<br>½" MICROPHONE: W.S. SIBANYONI |
| MANUFACTURERS | RION |
| MODEL NUMBERS | NL-32, UC-53A and NX-22RT |
| SERIAL NUMBERS | 00151075, 319366 and 00150957 V2.2 |
| DATE OF CALIBRATION | 24 NOVEMBER 2015 |
| RECOMMENDED DUE DATE | NOVEMBER 2016 |
| PAGE NUMBER | PAGE 1 OF 4 |

*This certificate is issued in accordance with the conditions of approval granted by the South African National Accreditation System (SANAS). This Certificate may not be reproduced without the written approval of SANAS and M and N Acoustic Services.*

*The measurement results recorded in this certificate were correct at the time of calibration. The subsequent accuracy will depend on factors such as care, handling, frequency of use and the amount of different users. It is recommended that re-calibration should be performed at an interval, which will ensure that the instrument remains within the desired limits and/or manufacturer's specifications.*

*The South African National Accreditation System (SANAS) is member of the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA). This arrangement allows for mutual recognition of technical test and calibration data by member accreditation bodies worldwide. For more information on the arrangement please consult www.ilac.org*

| | |
|---|---|
| Electrical Tests Calibrated by:<br>C. De Clercq<br>C. DE CLERCQ<br>(CALIBRATION TECHNICIAN) | ½" Microphone Calibrated by:<br>W.S. SIBANYONI<br>(CALIBRATION TECHNICIAN) |
| Authorized/Checked by:<br>M Naude<br>M. NAUDÉ<br>(SANAS TECHNICAL SIGNATORY) | Date of Issue:<br>04 December 2015 |

Director: Marianka Naudé

## APPENDIX C – Typical Sound Power and Sound Pressure Levels

| Acoustic Power | Degree | | Pressure Level | Source |
|---|---|---|---|---|
| 32 GW | Deafening | | 225 dB | 12” Cannon @ 12ft in front and below |
| 25 to 40 MW | | | 195 dB | Saturn Rocket |
| 100 Kw | | | 170 dB | Turbojet engine with afterburner |
| 10 Kw | | | 160 dB | Turbojet engine, 7000lb thrust |
| 1 kW | | | 150 dB | 4 Propeller Airliner |
| 100 W | | | 140 dB | Artillery Fire |
| 10 W | Threshold of pain | | 130 dB | Pneumatic Rock Drill |
| | | | | 130 dB causes immediate ear damage |
| 3 W | | | 125 dB | Small aircraft engine |
| 1.0 W | | | 120 dB | Thunder |
| 100 Mw | | | 110 dB | Close to train |
| | | | | |
| 10 mW | Very Loud | | 100 dB | Home lawn mower |
| 1 mW | | | 90 dB | Symphony or a Band |
| | | | | 85 dB regularly can cause ear damage |
| 100 uW | Loud | | 80 dB | Police whistle |
| 10 uW | | | 70 dB | Average radio |
| | | | | |
| 1 uW | Moderate | | 60 dB | Normal conversational voice |
| 100 nW | | | 50 dB | Quiet stream |
| | | | | |
| 10 nW | Faint | | 40 dB | Quiet conversation |
| 1 nW | | | 30 dB | Very soft whisper |
| | | | | |
| 100 pW | Very faint | | 20 dB | Ticking of a watch |
| 10 pW | Threshold of hearing | | 10 dB | |
| 1 pW | | | 0 dB | Absolute silence |

| Change in Sound Level | Perception |
|---|---|
| 3 dB | Barely perceptible |
| 5 dB | Clearly perceptible |
| 10 dB | Twice as loud |

## APPENDIX D – Brandvalley Detailed Project Description

Brandvalley WEF will have an energy generation capacity (at point of grid feed-in) of up to 140 megawatt (MW), and will include the following:

- Up to 70 potential wind turbine positions (between 1.5MW and 4MW in capacity each), each with a foundation of 25m in diameter and 4m in depth.
- The hub height of each turbine will be up to 120m, and the rotor diameter up to 140m.
- Permanent compacted hard-standing laydown areas for each wind turbine (70mx50m, total 24.5ha) will be required during construction and for on-going maintenance purposes.
- Electrical turbine transformers (690V/33kV) adjacent to each turbine (typical footprint of 2m x 2m, but can be up to 10m x 10m at certain locations) would be required to increase the voltage to 33kV.
- Underground 33kV cabling between turbines buried along access roads, where feasible.
- Internal access roads up to 12m wide, including structures for storm-water control would be required to access each turbine location and turning circles. Where possible, existing roads will be upgraded.
- 33kV overhead power lines linking groups of wind turbines to onsite 33/132kV substation(s). A number of potential electrical 33kV powerlines will be required in order to connect wind turbines to the preferred onsite substation. The layout of the 33kV powerlines will be informed by sensitive features identified. The facility will consist of both above and below ground 33kV electrical infrastructure depending on what will require the shortest distance and result in the least amount of impacts to the environment.
- A number of potential 33/132kV onsite substation location(s) will be assessed. The footprint of these 33/132kV substation(s) will need to be assessed in both this EIA and the Basic Assessment process for electrical infrastructure as the applicant will remain in control of the low voltage components of the 33/132kV substation (including isolators, control room, cabling, transformers etc.) (assessed in this EIA), whereas the high voltage components of this substation (assessed in BA) will likely be ceded to Eskom. The total footprint of this onsite substation will be approximately 200m x 200m. The exact coordinates of the low voltage components footprint (to be assessed in this EIA) and high voltage components footprint (to be assessed in the basic assessment process) will be provided in the EIA phase.
- Up to 4 x 120m tall wind measuring lattice masts strategically placed within the wind farm development footprint to collect data on wind conditions during the operational phase.
- Temporary infrastructure including a large construction camp (~10ha) and an on-site concrete batching plant (~1ha) for use during the construction phase.
- Borrow pits and quarries for locally sourcing aggregates required for construction (~4.5ha), in addition to onsite turbine excavations where required. All materials excavated will eventually be used on the compacting of the roads and hard-standing areas and no material will be sold to any third parties. The number and size of the borrow pits depends on suitability of the subsurface soils and the requirement for granular material for access road construction and other earthworks. Alternative borrow pit locations will be assessed in a separate BA process.
- Fencing will be limited around the construction camp and the entire facility would not necessarily need to be fenced off. The height of fences around the

construction camp are anticipated to be up to 4m.

- Temporary infrastructure to obtain water from available local sources/ new or existing boreholes. Water will potentially be stored in temporary water storage tanks. The necessary approvals from the DWS will be applied for separately to this EIA process.

**Brandvalley alternatives**

The above sections describe the alternatives considered in the Scoping Phase and the reasons for selecting the following alternatives for consideration in the EIA Phase:

1. Fundamental alternatives:
   1.1 Project area location alternative: One project location alternative namely Brandvalley Wind Farm
   1.2 Access road location alternatives: two access road alternatives namely access road alternative 1 and access road alternative 2
   1.3 Construction camp alternatives namely construction camp 1, 2, or 3.
   1.4 Four onsite substation location alternatives namely substation alternative 1, 2, 3 or 4.
   1.5 Technology alternative: One technology alternative namely a WEF
2. Incremental alternatives:
   2.1 Turbine layout alternatives
   2.2 200m buffer on access roads for sensitivity alternatives
3. No-go alternative

## APPENDIX E – NSA's Descriptions

| NSA Number | Property | Notes |
| --- | --- | --- |
| NSA 1 | Ou Mure 1/74 | Owner based in Cape Town. 2-3 worker families reside on Ou Mure. Barendskraal not permanently inhabited. |
| NSA 2 | Fortuin RE/74 | Owner permanently resides on farm. 6 farm worker families on Fortuin. 1 farm worker family on Kruispad. |
| NSA 3 | Nuwerus RE/ 284 | Owner resides in Cape Town, but frequently visits farm to monitor operation. Three worker families permanently reside on farm. |
| NSA 4 | Fortuin RE/74 | Owner permanently resides on farm. 6 farm worker families on Fortuin. 1 farm worker family on Kruispad. |
| NSA 5 | Nuwerus RE/87 | Owner resides in Cape Town, but frequently visits farm to monitor operation. Three worker families permanently reside on farm. |
| NSA 6 | Out of project area | / |
| NSA 7 | Rietkloof Annexe 1/88 | None. Owner resides in Gauteng. |
| NSA 8 | Vogelstruisfontein 81 | Owner on farm during the week, but resides in Boland. Two worker families live permanently on the farm. |
| NSA 9 | Out of project area | / |
| NSA 10 | Out of project area | / |
| NSA 11 | Out of project area | / |
| NSA 12 | Snyders Kloof RE/80 | Owners reside in Cape Town. Two worker families permanently reside on the property. |
| NSA 13 | Snyders Kloof RE/80 | Owners reside in Cape Town. Two worker families permanently reside on the property. |
| NSA 14 | Hartjieskraal 1/77 | Owners reside in Boland. 2 worker families live on property. |
| NSA 15 | Out of project area | / |
| NSA 16 | Out of project area | / |
| NSA 17 | Out of project area | / |
| NSA 18 | Hartjieskraal RE/77 | Owner permanently resides on farm. Two worker families permanently reside on farm. |
| NSA 19 | Snyders Kloof 1/80 | None. Part of Hartebeesfontein farming operation based east of Laingsburg. |
| NSA 20 | Barendskraal 1/76 | None. Part of a larger farming operation based closer to Matjiesfontein. Owner lives in Stellenbosch. |
| NSA 21 | Out of project area | / |
| NSA 22 | Muishond Rivier 1/161 | None. Owners live in the Cape. |
| NSA 23 | Muishond Rivier 1/161 | None. Owners live in the Cape. |
| NSA 24 | Out of project area | / |
| NSA 25 | Out of project area | / |

| NSA Number | Property | Notes |
|---|---|---|
| NSA 26 | Rietfontein 197 | None permanently. Owner and most workers reside on Klipfontein to the east. One worker based on farm for 8 months of year to water seed crops. |
| NSA 27 | Out of project area | / |
| NSA 28 | Out of project area | / |
| NSA 29 | Out of project area | / |

## APPENDIX F – Field Study Weather Conditions

| **Laingsburg Weather Data www.wunderground.com** | **15/02/2016** | **16/02/2016** |
|---|---|---|
| **Temperature** | | |
| Mean Temperature | **21** °C | **22** °C |
| Max Temperature | **27** °C | **28** °C |
| Min Temperature | **15** °C | **15** °C |
| **Moisture** | | |
| Dew Point | **7** °C | **9** °C |
| Average Humidity | 34 | 36 |
| Maximum Humidity | 49 | 53 |
| Minimum Humidity | 12 | 21 |
| **Precipitation** | | |
| Precipitation | **0.0** mm | **0.0** mm |
| **Wind** | | |
| Wind Speed | **5** km/h () | **7** km/h () |
| Max Wind Speed | **15** km/h | **20** km/h |