

ENVIRONMENT HEALTH SAFETY

#### ENVIRONMENTAL NOISE SPECIALIST ASSESSMENT:

#### Environmental Impact Assessment for the Proposed Development of the Klipkraal Wind Energy Facility 3, Northern Cape Province.



Report prepared for: SiVEST (Pty) Ltd La Lucia Ridge Office Estate 4 Pencarrow Crescent Umhlanga Rocks 4320 South Africa Report prepared by: Dr Brett Williams (Safetech) 64 Worraker Street Newton Park Gqeberha 6057 South Africa

2 December 2022

# **Executive Summary**



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Northern Office: PO Box 80171, Doornpoort, Pretoria, 0017 Tel: +27 (0)82 411 1571 Fax: +27 (0)86 6579864

Southern Office: PO Box 27607, Greenacres, Port Elizabeth 6057 Tel: +27 (0)41 3656846 / Fax: +27 (0)41 3652123 info@safetech.co.za / www.safetech.co.za Safetrain cc T/A Safetech Reg. No 1992/034818/23 VAT No. 4180135461 Directors: B Williams, C Williams



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Safetech were appointed by SiVEST (Pty) Ltd to conduct an Environmental Noise Impact Assessment for the proposed construction of the Klipkraal Wind Energy Facility 3 (Klipkraal WEF 3) near Fraserburg in the Northern Cape Province.

A literature review and desktop modelling were conducted. Baseline monitoring was done of the residual noise levels at the site.

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

- There will be a short-term increase in noise in the vicinity of the site during the construction phase.
- The area surrounding the construction sites will be affected for short periods of time in all directions, should numerous construction equipment be used simultaneously.
- The day time SANS 10103:2008 noise limit of 45dB(A) will not be exceeded at any of the noise sensitive areas.
- The night-time outdoor guideline noise rating limit of 35dB(A) will not be exceeded at any of the noise sensitive areas, except at two noise sensitive areas (NSA 2) when the windspeed is above 10m/s. There will most likely be wind noise masking at this windspeed that will mitigate the impact. On site monitoring at these two noise sensitive areas is recommended during the construction phase. Mitigation measures to be considered if the noise impact exceeds the 35dB(A) night noise rating limit, include running the turbines in low power mode at certain wind speeds at night. It is unlikely that the indoor limit will be exceeded as the residents' buildings will attenuate some sound.
- The cumulative impacts will not exceed the day time SANS 10103:2008 noise limit of 45dB(A).
- The cumulative impacts will exceed the night-time SANS 10103:2008 noise limit of 35dB(A) at NSA 2 and NSA 8. There will most likely be wind noise masking at this windspeed that will mitigate the impact.
- The construction phase and operational phase will have a low noise impact on the noise sensitive receptors.

Due to the potential low noise impacts associated with the construction and operational phases of the proposed project, it is recommended the project receive Environmental Authorisation, from a noise impact perspective.

Dr Brett Williams



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## List of Abbreviations

| WTG  | Wind Turbine Generator   |  |  |  |  |
|------|--|--|--|--|--|
| dBA  | The decibel is the unit used to measure sound pressure levels. The human ear does not perceive all sound pressures equally at all frequencies. The "A" weighted scale adjusts the measurement to approximate a human ear response. |  |  |  |  |
| DFFE | Department of Forestry, Fisheries, and the Environment   |  |  |  |  |
| LAeq | The Equivalent continuous A-weighted sound pressure level.   |  |  |  |  |
| L90  | Sound Pressure level exceeded for 90% of the measurement time  |  |  |  |  |
| SANS | South African National Standards   |  |  |  |  |
| WEF  | Wind Energy Facility   |  |  |  |  |
| MW   | Megawatt   |  |  |  |  |
| МР   | Monitoring Point   |  |  |  |  |
| NIA  | Noise Impact Study   |  |  |  |  |
| NEMA | National Environmental Management Act  |  |  |  |  |
| NSA  | Noise Sensitive Area   |  |  |  |  |

## Glossary

| Ambient Noise                 | 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><b>Authors Note:</b> Ambient noise <u>includes</u> the noise alleged to be causing a noise nuisance or disturbing noise.  |
|-------------------------------|---|
| Ambient Noise<br>(SANS 10103) | Totally encompassing sound in each situation at a given time, and usually composed of sound from many sources, both near and far <i>NOTE: Ambient noise includes</i> 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 $\mu$ Pa).  |
| Disturbing Noise              | <ul> <li>"means a noise, excluding the unamplified human voice, which— <ul> <li>(a) exceeds the rating level by 7 dBA;</li> <li>(b) exceeds the residual noise level where the residual noise level is higher than the rating level;</li> <li>(c) exceeds the residual noise level by 3 dBA where the residual noise level is lower than the rating level; or</li> <li>(d) in the case of a low-frequency noise, exceeds the level specified in Annex B of SANS 10103;</li> </ul></li></ul> |



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| Equivalent Continuous<br>Rating Level (L <sub>Req, T</sub> )                       | The equivalent continuous A-weighted sound pressure level (L <sub>Aeq, T</sub> ) during a specified<br>time interval, plus specified adjustments for tonal character and impulsiveness of the<br>sound and derived from the applicable equation:<br>L <sub>Req,T</sub> = LAeq, T + Ci + Ct + kn<br>Where:<br>L <sub>aeq,T</sub> is the equivalent A-weighted sound pressure level in decibels;<br>Ci is the impulse correction;<br>Ct is the correction for tonal character;<br>Kn is the adjustment for day or night (0dB for day and +10dB for night<br>measurements   |
|--|--|
| Equivalent continuous A-<br>weighted sound pressure<br>level (L <sub>Aeq,T</sub> ) | Value of the A-weighted sound pressure level of a continuous steady sound that, within a specified time interval T <sub>m</sub> , has the same mean-square sound pressure as a sound under consideration whose level varies with time and is given using the following equation:<br>$LAeq, T = 10 \log[\frac{1}{Tm} \int_{t1}^{t2} \frac{p_A^2(t)}{p_o^2} dt]$<br>Where:<br>$L_{Aeq,T}$ is the equivalent continuous A-weighted sound pressure level, determined over a time interval T <sub>m</sub> that starts at t <sub>1</sub> and ends at t <sub>2</sub> in decibels;<br>P <sub>A</sub> (t) is the instantaneous A-weighted sound pressure of the sound signal, in pascals;<br>P <sub>o</sub> is the reference sound pressure (p <sub>o</sub> =20µPa) |
| Low Frequency Noise  | Means sound which contains sound energy at frequencies predominantly below 100 Hz.   |
| Noise Nuisance   | Any sound which impairs or may impair the convenience or peace of a reasonable person.   |
| Noise Rating Level   | The applicable outdoor equivalent continuous rating level indicated as per Table 2 of SANS 10103:2008.   |
| Residual Noise<br>(SANS 10103)   | 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.<br><u>excluding</u> noise alleged to be causing a noise nuisance or disturbing noise.<br>Authors note: This would usually be called the "Ambient Noise", but in terms of the Regulations, "ambient noise" includes the noise under investigation.   |
| 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.   |
| SANS 10328:2008  | The South African National Standards code of practice for environmental noise monitoring.  |
| Sound Level  | The equivalent continuous rating level as defined in SANS 10103, considering impulse, tone, and night-time corrections.  |
| Sound Pressure Level<br>(L <sub>pA</sub> )   | Ten times the logarithm to the base 10 of the ratio of the square of the sound pressure, $p_A$ , to the square of a reference value, $p_0$ , expressed in decibels<br>$L_{pA} = 10 \log \left(\frac{p_A}{p_o}\right)^2$<br>$p_A$ is the root-mean-square sound pressure, using the frequency weighting network A (see SANS 61672-1 and SANS 656), in pascals<br>$p_0$ is the reference sound pressure (po = 20 µPa)<br>NOTE 1 A-weighted sound pressure level is expressed in decibels.<br>NOTE 2 The internationally accepted symbol for sound level, dBA, is used throughout this document   |
| Sound Power (P)  | Through a surface, a product of the sound pressure, $p$ , and the component of the particle velocity, $u_n$ , at a point on the surface in the direction normal to the surface, integrated over that surface<br>Note 1 to entry: Sound power is expressed in watts.<br>Note 2 to entry: The quantity relates to the rate at which airborne sound energy is radiated by a source.   |



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| Sound Power Level (L <sub>w</sub> ) | ten times the logarithm to the base 10 of the ratio of the <i>sound power</i> , P, of a source to a reference value, $P_0$ , expressed in decibels<br>$L_W = 10 \lg \frac{P}{P_0} dB$<br>where the reference value, $P_0$ , is 1 pW<br>If a specific frequency weighting as specified in IEC 61672-1 and/or specific frequency<br>bands are applied, this is indicated by appropriate subscripts; e.g. $L_{WA}$ denotes the<br>A-weighted sound power level. |
|-------------------------------------|--|



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# **ENVIRONMENTAL NOISE SPECIALIST ASSESSMENT**

## 1. Introduction

This report serves as the Noise Specialist Assessment that was prepared by Safetech as part of the Scoping and Environmental Impact Assessment (S&EIA) for the proposed development of the Klipkraal WEF 3 near Fraserburg in the Northern Cape Province.

### 1.1 Scope, Purpose and Objectives of this Specialist Report

A Noise Impact Assessment (NIA) for the Basic Assessment was conducted in accordance with SANS 10328:2008 (3<sup>rd</sup> Ed. and SANS 10103:2008 (6<sup>th</sup> Ed.). The scope of the project is described below:

- Determine the land use zoning of 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 residual 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 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 noise level on surrounding land users 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 10103,10328; the Environment Conservation Act: National Noise Control Regulations (GNR 154 - 1992)
- 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 in line with Appendix 6 of the EIA regulations, 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.



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### **1.2 Details of Specialist**

This specialist assessment has been undertaken by Dr Brett Williams of Safetech, Brett Williams is registered with the Southern African Institute of Occupational Hygienists (SAIOH), with Registration Number 0220 as a Registered Occupational Hygienist. A curriculum vitae is included in Annexure A of this specialist assessment.

In addition, a signed specialist statement of independence is included in Annexure B of this specialist assessment.

### 1.3 Terms of Reference

The Term of Reference provided by the client for this noise study are as follows:

Conduct field surveys and compile specialist studies in adherence to:

- the gazetted Environmental Assessment Protocols of the NEMA EIA Regulations (2014, as amended), where applicable (Protocol for the Specialist Assessment and Minimum Report Content Requirements for Noise Impacts (GG 43110 / GNR 320, 20 March 2020)). This protocol replaces the requirements of Appendix 6 of the 2014 NEMA EIA Regulations (as amended); and
- any additional relevant legislation and guidelines that may be deemed necessary (e.g. noise standards and methodologies stipulated in SANS 10103:2008 and SANS 10328:2008 (or latest versions) for residential and non-residential areas as defined in these standards).
- Provide Site Sensitivity Verification Reports based on the requirements documented in the Assessment Protocols published on 20 March 2020, in Government Gazette 43110, GN 320.
- Following from the outcome of the site sensitivity verification, provide a Noise Impact Assessment (NIA) Report based on the requirements documented in the Assessment Protocols published on 20 March 2020, in Government Gazette 43110, GN 320.
- Determine, describe, and map the baseline environmental conditions and sensitivity of the study area.
   Specify setbacks or buffers and provide clear reasons for these recommendations. Also, map the extent of disturbance and transformation of the sites.
- Provide sensitivities in KMZ or similar GIS format.
- Provide review input on the preferred infrastructure layout i.e. wind turbines, construction platforms, construction camps, on-site substations, etc. following the sensitivity analysis and layout identification.
- Identify and assess the potential direct, indirect, and cumulative impacts of the proposed WEF development. Impact significance must be rated both <u>without</u> and <u>with</u> mitigation, and must cover the construction, operational and decommissioning phases of the projects. The Impact Assessment Methodology must follow that contained in Annexure D.



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- Identify any additional protocols, legal and permit requirements that are relevant to these projects and the implications thereof.
- Provide recommendations with regards to potential monitoring programmes.
- Determine mitigation and/or management measures, which could be implemented to as far as possible reduce the effect of negative impacts and enhance the effect of positive impacts. Also, identify best practice management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts. This must be included in the EMPr.
- Incorporate and address all review comments made by the Project Team (SiVEST and Project Applicant) (before public release) and following public review for submission to the Competent Authority for decisionmaking.
- Incorporate and address all issues and concerns raised by Stakeholders, Competent Authority, I&APs, and the public during the Public Participation Process (where relevant and applicable).

### 1.4 Approach and Methodology

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

- A desktop study to model the likely noise emissions from the site.
- Field measurements of the existing residual noise at different locations in the vicinity of the project during the day and night-time; and
- The identification of potential noise sensitive areas.

The desktop study was conducted using the available literature on noise impacts from wind turbines as well as numerical calculations of the possible noise emissions. A Danish modelling program, EMD WindPro Software Version 3.6 was used, which has been developed specifically for wind turbine noise. This program is used extensively worldwide and has been developed and validated in Denmark. 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 similar to SANS 10357:2004 and is used worldwide for modelling noise from various sources including wind turbine generators (Wind turbines). Where a tonal character is identified in the noise emitted from the turbines, a 5 dB(A) penalty is included in the modelling result.



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The numerical results were then used to produce "noise maps" that visually indicate the extent of the noise emissions from the site. The noise emissions were modelled for various wind speeds from 6 m/s to 12 m/s. The direction of the wind was not taken into consideration as the wind could blow from any direction at the speeds that were modelled. The modelling is thus for worst-case scenarios and takes the topography around the turbine and location of the noise sensitive area (NSA) into account. The site elevation data was sourced from the NASA STRM database and imported into WindPro. A comparison was done using the digital elevation data and the contour heights from a topographical map. The comparison showed that the digital data and the map corresponded well. Furthermore, the digital data provided a better resolution.

For the field study, a long-term measurement was taken by placing a noise meter on a tripod and ensuring that it was placed at least 1.2 m from floor level and 3.5 m from any large flat reflecting surface. The measurement period lasted for approximately 36-hours and included one "day" period (06:00-22:00) and two "night" periods (22:00-06:00). The noise meter was calibrated before and after the survey. At no time was the difference more than one decibel (dBA) (Note: If the difference between measurements at the same point under the same conditions is more than 1 dBA, then this is an indication that the noise meter is not properly calibrated). The weighting used was on the A scale and the meter was placed on "fast", which is the preferred method as per SANS 10103:2008. The meter was fitted with a windscreen, which is supplied by the manufacturer. The windscreen is designed to reduce wind noise around the microphone and not bias the measurements. The short-term monitoring utilized the same method but over a 10-minute period for each measurement taken.

The test environment contained the following noise sources:

- Birds and insects;
- vegetation rustling; and
- Wind Noise.

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

 Rion NL-62 and UC-59L Integrating Sound Level Meter with built-in ¼-Octave Filter and ½" Microphone with NC-74 Sound Calibrator: Type 1, Rion NL-62, NH-26, UC-59L Integrating Sound Level Meter with built-in ¼-Octave Filter and ½" Microphone. Serial no.: 00420125; 01697; 00840. Calibrated by: M and N Acoustic Services cc on 06-20 July 2021 (calibration due July 2022 as per SANS 10083:2013). Certificate number: 2021-AS-0751. Calibration certificate attached in Annexure. Total uncertainty of measurements: Integrating Sound Level Meter: Refer to calibration certificate. ½" Microphone: ± 0.3 dB. Built-in ¼-Octave Filter: ± 0.3 dB.



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Rion NC-74, NC-74-002 Sound Calibrator: Serial no.: 34425540. Calibrated by: M and N Acoustic Services cc on 07 July 2021 (calibration due July 2022). Certificate number: 2019-AS-0749. Calibration certificate attached in Annexure. Total uncertainty of measurements: Sound Calibrator: ± 0.19 dB

### **1.5 Information Sources**

The information used to conduct the study included:

- The project technical information was provided by the client e.g., turbine generator capacity and types, site layouts etc.
- Local, provincial, and national legislation and standards. The list of applicable legislation and standards is listed below.
- Satellite imagery and related GIS Data from Google Earth and QGIS.
- Residual Noise data collected onsite.

### 1.6 Assumptions, Knowledge Gaps and Limitations

The following assumptions and limitations are applicable to this study:

- The turbine positions were supplied by the applicant and are accepted as an accurate layout for the purposes of the environmental impact assessment.
- The worst-case scenario impacts were modelled. These scenarios consider factors such as wind blowing in any direction (not only the prevailing wind) and maximum turbine size as required for the site and the worst-case meteorological conditions.
- Due to final design parameters of the Wind Turbines being unconfirmed, the Goldwind 6.0MW model was
  chosen as the acoustic performance of this model is available to the author. Therefore, the developer will
  be able to choose any Wind Turbine Generator, provided the maximum Sound Power Level Rating does
  not exceed 111.6dB(A). If a model with a higher rating is chosen, this will require a reassessment of the
  noise impacts. The maximum Sound Power Level is based on the highest rated (from a noise perspective)
  Wind Turbines currently available on the market.
- No wind noise masking effect is considered.
- The noise levels at the identified noise sensitive areas could thus be lower if the wind noise masks the turbine noise emissions.
- For the cumulative impact assessment, it was assumed that all proposed projects would still undergo construction. Although this is unlikely, the assumption was made to assess the worst-case scenario.



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Cumulative impacts are assessed by adding expected impacts from this proposed development to
existing and proposed developments with similar impacts in a 30 km radius. The existing and proposed
developments that were taken into consideration for cumulative impacts are listed in Annexure F of this
report.

## 2. Description of Project Aspects relevant to Environmental Noise

### 2.1 Background and General Description

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.

### 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; and
- Auxiliary Equipment (e.g., hydraulics).

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.

Figure 1 below shows the type of transmission path, and the sound power levels for the individual components for a 2 MW wind turbine.



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Figure 1: Typical Sound Power Levels of a 2 MW Turbine (Moraleda 2019)

#### 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. A large number of complex flow phenomena occur, each of which might generate some sound (see Figure 2). Aerodynamic sound generally increases with rotor speed. The various aerodynamic sound generation mechanisms that must 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; and
- Aerofoil Self Noise: This group includes the sound generated by the air flow right along the surface of the aerofoil. 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.



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Figure 2: Sources of Aerodynamic Noise (Wagner 1996)

Modern air foil design takes all the above factors into account and are generally much quieter that the first generation of bade design.

#### Residual Sound & Wind Speed

The ability to hear a wind turbine depends on the residual sound level. When the background sounds and wind turbine sounds are of the same magnitude, the wind turbine sound may get lost in the background. Both the wind turbine sound power level and the residual sound pressure level will be functions of wind speed. Thus, whether the sound emitted from a wind turbine exceeds the residual 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. Several 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 emitted from large modern wind turbines during constant speed operation tend to increase more slowly with increasing wind speed, than 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 sometimes masks the wind turbine sound above 8 m/s.



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It should be remembered that average sound level 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 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 hub height of the turbine, a listener might find moments when the wind turbine could be heard over the residual sound.

#### Low Frequency Noise and Infrasound

Infrasound was a significant 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.

As depicted in Figure 3 below, 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 to be infrasound, even though there may be some human perception in that range. Because the ranges of low frequency sound and infrasound overlap it is important to understand how the terms are applied in a given context.



Figure 3: Low Frequency Hearing Threshold Levels



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Infrasound is always present in the environment and stems from many sources including residual air turbulence from wind, 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 changes on their ears, from top to bottom of the swing, is nearly 120 dB(A) 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 3 above);
- Tonality cannot be perceived below around 18 Hz; and
- 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; and
- 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; and
- 120 130 dB and above: Exposure for 24 hours causes physiological damage.

The typical range of sound power level for wind turbine generators is in the range of 100 to 111.6 dB(A) - a much lower sound power level (10 dB or more) than the majority of construction machinery such as bulldozers. For infrasound to be audible even to a person with the most sensitive hearing at a distance of 300 m would require a sound power level of at least 140 dB at 10 Hz and even higher emission levels than this at lower frequencies and



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at greater distances. There is no information available to indicate that wind turbine generators emit infrasound anywhere near this intensity.

### 2.2 Identification of Noise Sources

The facility will be comprised of 40 individual Wind Turbine Generators (WTGs) making up a total generation capacity of up to 300 MW. The final design specifications have not yet been confirmed and the developers are considering several options, of which one of the preferred is presented in Table 1 below.

Table 1: Turbine Models under consideration

| Manufacturer | Model | Hub height (m) | Rotor Diameter (m) | Blade Length (m) |
|--------------|-------|----------------|--------------------|------------------|
| GoldWind     | N/A   | Up to 200      | Up to 200 m        | Up to 100 m      |

The final WTG model has not yet been confirmed by the developer. The known parameters are a hub height of up to 200 m and blade length of up to 100 m. Further details of the WTG that was used are described in Table 2 below.

The model of Turbine chosen will represent a likely worst-case scenario of 111.6dB(A) maximum sound power level. The modelled hub height is 200 m. If a higher or lower final hub height is chosen, the noise impacts could be reduced or increase depending on the sound power of the turbine. Furthermore, if the final turbine that is chosen has a maximum sound power level that is similar or lower than the turbine modelled in this report, it can be assumed that the noise impacts will be similar or lower, irrespective of the turbine manufacturer.

Table 2: Modelled Turbine Specifications

| Manufacturer              | Goldwind    |
|---------------------------|-------------|
| Type / Version            | GW165-6.0   |
| Rated Power Output        | 6MW         |
| Rotor Diameter            | Up to 200 m |
| Tower                     | Tubular     |
| Grid Connection           | 50/60 Hz    |
| Maximum Sound Power Level | 111.6 dB(A) |
| Hub Height                | 200 m       |
| Turbine Power Mode        | Mode 0      |

Sound Power Level dB(A) reference to 1pW inferred from WindPro 3.6 Catalogue

\*The specifications of this turbine model were used as this is the preferred model of the applicant. This does not bind the applicant to this specific model, and any turbine model with similar turbine specifications will be acceptable. An equal or lower maximum sound power level would be acceptable for the site without the need for re-modelling, provided the turbine positions do not change substantially (i.e. more than 50 m).



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Figure 4 below shows the layout of the 40 WTGs in addition to the site boundary. The turbine positions are based on geospatial data supplied by the client.



Figure 4: Klipkraal WEF 3 Turbine Layout.

The coordinates of the 40 WTGs are given in Table 3 below.

#### Table 3: WTG Coordinates

| WTG Name | Latitude          | Longitude         |
|----------|-------------------|-------------------|
| 1        | 32 ° 06' 34.84" S | 21 ° 49' 53.93" E |
| 2        | 32 ° 06' 36.05" S | 21 ° 49' 18.53" E |
| 3        | 32 ° 06' 44.19" S | 21 ° 49' 36.14" E |
| 4        | 32 ° 06' 30.90" S | 21 ° 50' 12.18" E |
| 5        | 32 ° 07' 21.03" S | 21 ° 49' 03.13" E |
| 6        | 32 ° 06' 52.78" S | 21 ° 49' 19.84" E |
| 7        | 32 ° 06' 46.35" S | 21 ° 49' 10.22" E |
| 8        | 32 ° 07' 31.31" S | 21 ° 49' 08.67" E |
| 9        | 32 ° 07' 36.67" S | 21 ° 49' 25.89" E |
| 10       | 32 ° 06' 59.04" S | 21 ° 49' 29.29" E |
| 11       | 32 ° 07' 30.17" S | 21 ° 49' 52.92" E |
| 12       | 32 ° 07' 06.58" S | 21 ° 49' 45.64" E |
| 13       | 32 ° 07' 21.04" S | 21 ° 51' 06.63" E |
| 14       | 32 ° 07' 06.64" S | 21 ° 51' 22.16" E |
| 15       | 32 ° 07' 06.05" S | 21 ° 50' 22.40" E |
| 16       | 32 ° 07' 06.49" S | 21 ° 49' 59.20" E |
| 17       | 32 ° 06' 44.58" S | 21 ° 50' 14.87" E |



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| WTG Name | Latitude          | Longitude         |
|----------|-------------------|-------------------|
| 18       | 32 ° 07' 25.56" S | 21 ° 50' 56.03" E |
| 19       | 32 ° 07' 28.23" S | 21 ° 50' 04.83" E |
| 20       | 32 ° 07' 41.55" S | 21 ° 49' 15.54" E |
| 21       | 32 ° 08' 02.43" S | 21 ° 49' 35.48" E |
| 22       | 32 ° 07' 51.79" S | 21 ° 49' 24.07" E |
| 23       | 32 ° 07' 24.90" S | 21 ° 49' 18.51" E |
| 24       | 32 ° 07' 16.02" S | 21 ° 49' 37.14" E |
| 25       | 32 ° 07' 19.86" S | 21 ° 49' 58.68" E |
| 26       | 32 ° 07' 16.33" S | 21 ° 50' 21.14" E |
| 27       | 32 ° 07' 16.06" S | 21 ° 50' 39.71" E |
| 28       | 32 ° 07' 15.18" S | 21 ° 50' 57.52" E |
| 29       | 32 ° 07' 04.47" S | 21 ° 50' 37.37" E |
| 30       | 32 ° 07' 13.32" S | 21 ° 51' 34.77" E |
| 31       | 32 ° 07' 26.90" S | 21 ° 49' 30.13" E |
| 32       | 32 ° 06' 44.51" S | 21 ° 49' 50.99" E |
| 33       | 32 ° 06' 38.87" S | 21 ° 50' 04.93" E |
| 34       | 32 ° 07' 29.93" S | 21 ° 49' 41.08" E |
| 35       | 32 ° 07' 14.19" S | 21 ° 51' 14.74" E |
| 36       | 32 ° 07' 06.64" S | 21 ° 51' 07.45" E |
| 37       | 32 ° 07' 32.55" S | 21 ° 49' 18.38" E |
| 38       | 32 ° 06' 27.45" S | 21 ° 49' 56.86" E |
| 39       | 32 ° 07' 13.22" S | 21 ° 50' 29.24" E |
| 40       | 32 ° 07' 17.07" S | 21 ° 49' 47.62" E |

## **3. Baseline Environmental Description**

### **3.1 General Description**

Klipkraal Wind Facility 3 (Pty) Ltd proposes the development of a Wind Energy Facility approximately 35km to the southeast of Fraserburg in the Northern Cape Province.

The project will comprise of up to 40 turbines producing a maximum export capacity of up to approximately 300MW.

This development (Klipkraal WEF 3) will include auxiliary infrastructure such as substations and access roads. However, for the purpose of this Noise Study, these auxiliary components have not been assessed as their impact will be negligible.

Two additional WEF's are being considered on the properties and are assessed by way of separate impact assessment processes contained in the 2014 Environmental Impact Assessment Regulations (GN No. R982, as amended) for listed activities contained Listing Notices 1, 2 and 3 (GN R983, R984 and R985, as amended). These projects are known as Klipkraal Wind Energy Facility 1 (Klipkraal WEF 1) and Klipkraal Wind Energy Facility 2



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(Klipkraal WEF 2). These projects fall under separate Environmental Applications and are only assessed for cumulative impacts in this report.

The construction noise impacts from the access road traversing the project were assessed in conjunction with the noise impacts from the Wind Turbine Generators. All other infrastructure was not included as part of the noise study as these features are not expected to impact sensitive receptors in the area.

The current land use of the proposed properties is an agricultural area with sheep and goat farming conducted in a very arid environment – this is the only agricultural land use on the site and surrounds which is restricted by the arid nature of the local climate. Due to the limited stock carrying capacity, the farms are large in size. The area has a very low density of rural settlement, with relatively few isolated farmsteads. Man-made modifications associated with farming are related to those typical of the low intensity sheep farming. This includes wind pumps with stock watering points. These features are small in scale in the landscape and do not detract from the sense of place.

The land use of the receiving environment in relation to the Klipkraal WEF 3 site can be classified as rural (agricultural, focusing primarily on livestock). Furthermore, the topography of the area is characterized by relatively flat terrain with hills, and valleys. The area is sparsely populated with homesteads and kraals. During the analysis of the satellite imagery, it was difficult to confirm the classification of each structure identified. To eliminate uncertainty, it was assumed that all structures are occupied to simulate a worst-case scenario (despite the likelihood that some structures are abandoned and unoccupied).



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### 3.2 Field Study

The field study validated the classification of the study area as a rural district. Table 4 below shows the SANS 10103:2008 guidelines for day and night noise limits of a rural district. These guidelines are discussed in further detail in Section 7 of this report. National and provincial standards classify noise levels exceeding 7dB(A) above the residual noise levels as a disturbing noise.

#### Table 4: Noise limits for rural districts

|                  | Equivalent Continuous Rating Level, LReq.T for Noise |         |            |                                |         |            |  |
|------------------|--|---------|------------|--------------------------------|---------|------------|--|
| Type of District | Outdoors (dB(A))                                     |         |            | Indoors, with open windows (dB |         |            |  |
|                  | Day-night  | Daytime | Night-time | Day-night                      | Daytime | Night-time |  |
| Rural Districts  | 45   | 45      | 35         | 35                             | 35      | 25         |  |

The field study was conducted from the 18<sup>th</sup> of September 2021 to the 24<sup>th</sup> of September 2021 in accordance with SANS 10103:2008. The guidelines to determine the residual noise levels of the area are described in the methodology below:

A long-term measurement was taken by placing a noise meter on a tripod and ensuring that it was placed at least 1.2 m from floor level and 3.5 m from any large flat reflecting surface. The 36-hour measurement time encompassed one "day" period (06:00-22:00) and two "night" periods (22:00-06:00). The noise meter was calibrated before and after the survey. At no time was the difference more than one decibel (dB) (Note: If the difference between measurements at the same point under the same conditions is more than 1 dB, then this is an indication that the noise meter is not properly calibrated). The weighting used was on the A scale and the meter was placed on "fast", which is the preferred method as per SANS 10103:2008, the measurement and rating of environmental noise. The meter was fitted with a windscreen, which is supplied by the manufacturer. The windscreen is designed to reduce wind noise around the microphone and not bias the measurements. The short-term monitoring utilized the same method but over a 10-minute period for each measurement taken.

The results of the baseline residual noise monitoring for the long-term measurement are shown in Figure 5 and Figure 6 below. Monitoring was conducted at three locations surrounding the proposed development. However, due to the changing of the layout, only Monitoring Point 1 and Monitoring Point 2 were chosen based on the proximity to the proposed project location. The noise sources during the time of the monitoring were typical of the rural Karoo landscape. Noise sources included birds chirping, wind noise and leaves rustling. Weather conditions during the daytime hours were sunny.



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Figure 5: Long Term Ambient Noise Levels vs Weather Conditions at MP 1

The LAeq value at Monitoring Point 1 was as follows:

- Day time (06:00-22:00): **40.8dB(A)**
- Night-time (22:00-06:00): 30.3 dB(A)



Figure 6: Long Term Ambient Noise Levels vs Weather Conditions at MP 2

The L<sub>Aeq</sub> value at Monitoring Point 2 was as follows:

- Day time (06:00-22:00): 37.0dB(A)
- Night-time (22:00-06:00): **34.0 dB(A).**



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Two weather stations are located within the study area. Weather Station 2 wind speeds, recorded at 60m and 120m above ground level, were used as this station was closer to the monitoring points. The Coordinates of Weather Station 2 are: 32° 5' 29.40" S; 21° 47' 49.70" E.

The location of the monitoring equipment can be seen in Figure 7 below. These points were taken at the closest NSAs, namely NSA 2 and NSA 8.

## 4. Identification of Environmental Sensitivities

### 4.1 Sensitivities identified by the National Web-Based Environmental Screening Tool

#### Human Sensitive Receptors

The initial identification of potential noise sensitive areas was conducted through a visual scan of satellite imagery of the area. A total of 23 Noise Sensitive Areas (NSA's) were identified. These NSAs are a combination of farmer's houses, staff houses, remote homesteads and possibly "Shepherd's Huts".

Figure 7 below shows the location of the NSAs in relation to the development boundary. The location of the long-term monitoring point is also depicted.

Due to the presence of these NSAs, it can be confirmed that the sensitivity rating "Very High" is applicable.



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Figure 7: Locations of Noise Sensitive Areas and Monitoring Points

Figure 7 above shows the locations of the 23 NSAs and the Monitoring Points. Monitoring Point 3 (MP 3) is shown for informational purposes only as it is not applicable to this study due to its distance from the location of the proposed project. The coordinates of the identified NSAs, in addition to the distance of the nearest WTG is described in Table 5 below.

| Name   | Latitude       | Longitude      | Nearest WTG | Distance to Nearest WTG (m) |
|--------|----------------|----------------|-------------|-----------------------------|
| NSA 1  | 32°05'54,99" S | 21°43'38,68" E | 7           | 10 421                      |
| NSA 2  | 32°05'46,00" S | 21°47'00,18" E | 7           | 4 585                       |
| NSA 3  | 32°06'48,99" S | 21°52'41,18" E | 30          | 2 237                       |
| NSA 4  | 32°05'48,87" S | 21°52'26,01" E | 14          | 3 457                       |
| NSA 5  | 32°05'39,37" S | 21°52'21,75" E | 14          | 3 680                       |
| NSA 6  | 32°08'20,06" S | 21°57'19,43" E | 30          | 10 932                      |
| NSA 7  | 32°07'56,72" S | 21°57'10,97" E | 30          | 10516                       |
| NSA 8  | 32°03'33,62" S | 21°46'27,74" E | 2           | 8 498                       |
| NSA 9  | 32°03'15,20" S | 21°49'31,49" E | 38          | 7 059                       |
| NSA 10 | 32°03'35,13" S | 21°50'43,12" E | 38          | 6 449                       |
| NSA 11 | 32°02'29,34" S | 21°51'02,26" E | 38          | 8 921                       |
| NSA 12 | 32°02'20,12" S | 21°50'54,23" E | 38          | 9 198                       |

| Table 5: Coordinates of No | ise Sensitive Areas |
|----------------------------|---------------------|
|----------------------------|---------------------|



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| Name   | Latitude       | Longitude      | Nearest WTG | Distance to Nearest WTG (m) |
|--------|----------------|----------------|-------------|-----------------------------|
| NSA 13 | 32°02'39,11" S | 21°41'23,98" E | 7           | 17 007                      |
| NSA 14 | 32°00'34,29" S | 21°41'03,90" E | 2           | 20 203                      |
| NSA 15 | 31°58'43,05" S | 21°42'00,55" E | 2           | 21 935                      |
| NSA 16 | 32°00'35,33" S | 21°43'22,84" E | 2           | 17 152                      |
| NSA 17 | 31°58'02,73" S | 21°48'32,32" E | 38          | 18 595                      |
| NSA 18 | 31°58'23,24" S | 21°47'20,55" E | 38          | 18 312                      |
| NSA 19 | 32°10'43,76" S | 21°51'03,72" E | 21          | 6 493                       |
| NSA 20 | 32°08'37,40" S | 21°54'15,88" E | 30          | 5 851                       |
| NSA 21 | 32°09'55,66" S | 21°45'21,43" E | 20          | 8 740                       |
| NSA 22 | 32°08'58,41" S | 21°42'08,79" E | 5           | 13 296                      |
| NSA 23 | 32°03'13,29" S | 21°54'23,65" E | 30          | 10 198                      |

#### Natural Environment Receptors

The vegetation surrounding the development site is characterised by typical karoo vegetation. The fauna includes bats, birds, commercial livestock, smaller mammals, reptiles, and buck.

### 5. Issues, Risks, and Impacts

The following section discusses the potential impacts, from a noise perspective, on the human receptors previously identified. These impacts have been classified according to the various stages of the project, namely the construction phase, operational phase, decommissioning phase.

### 5.1 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 sites in South Africa and have recorded the noise emissions of various pieces of construction equipment. The results are presented in Table 6 below.

| Table 6: | Typical | Construction | Noise |
|----------|---------|--------------|-------|
|----------|---------|--------------|-------|

| Type of Equipment                                  | L <sub>Req.T</sub> 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 the Tables above and below. As an example, if several pieces of equipment are used simultaneously, the noise levels can



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be added logarithmically and then calculated at various distances from the site to determine the distance at which the residual level will be reached (refer to Tables 7 - 9).

Table 7: Combining Different Construction Noise Sources - High Impacts (Worst Case)

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

\*The total is a logarithmic total and not a sum of the values (at approximately 3 m).

Table 8: Combining Different Construction Noise Sources - Low Impacts (at approximately 3 m)

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

\*The total is a logarithmic total and not a sum of the values (at approximately 3 m).

The information in Tables 7 to 9 can then 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 residual noise levels.

An illustration of attenuation by distance from a noise of 117 dB measured from the source is presented in Table 9 below.

Table 9: Attenuation by Distance

| Distance from noise source<br>(m) | 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 Table 9 above is that if the residual noise level is at 45 dB(A), the construction noise will be similar to the residual noise level at approximately 1 280 m from the noise source, if the noise characteristics



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|-----------------|-------------|-------|----------------------------|-----------------------|
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are similar. Beyond this distance, the noise level will be below the residual noise and will therefore have little impact. NSA 3 is the closest receptor to a WTG, the distance is 2 237 m. Therefore, it can be expected that NSA 3 will experience noise levels below 45dB(A). All other receptors are located at greater distances and will therefore not be impacted.

The above only applies to the construction noise and light wind conditions. 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 residual noise is louder and there are unstable atmospheric conditions.

#### Low frequency noise concerns

The effects of low frequency noise include sleep disturbance, nausea, vertigo etc. These effects are unlikely to impact upon residents due to the distance between the site and the nearest communities. Sources of low frequency noise also include wind and vehicular traffic.

### 5.2 Predicted noise levels for the Operational Phase

The tables and figures below indicate the isopleths for the noise generated by the turbines at wind speeds of 12 m/s. It must be remembered that as the wind speed increases, so too does the background noise. The modelling results are contained in Table 10 below.

| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 6,0                 | 5,8                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 6,3                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 6,8                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 7,3                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 7,8                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 8,3                                  | 45  | No                                    | 35  | No   |
| NSA 1         | 9,0                 | 8,8                                  | 45  | No                                    | 35  | No   |
|               | 9,5                 | 9,3                                  | 45  | No                                    | 35  | No   |
|               | 10,0                | 9,8                                  | 45  | No                                    | 35  | No   |
|               | 10,5                | 10,3                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 10,8                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 11,3                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 11,8                                 | 45  | No                                    | 35  | No   |

#### Table 10: Klipkraal WEF 3 Noise Modelling Results



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|-----------------|-------------|-------|----------------------------|-----------------------|--|
| Klipkraal WEF 3 | 30          | 85    | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |  |

| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 6,0                 | 15.8                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 16.3                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 16.8                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 17,3                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 17,8                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 18,3                                 | 45  | No                                    | 35  | No   |
| NSA 2         | 9,0                 | 18,8                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 19,3                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 19,8                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 20,3                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 20,8                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 21,3                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 21,8                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 21,3                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 21,8                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 22,3                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 22,8                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 23,3                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 23,8                                 | 45  | No                                    | 35  | No   |
| NSA 3         | 9,0                 | 24,3                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 24,8                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 25,3                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 25,8                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 26,3                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 26,8                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 27,3                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 18,1                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 18,6                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 19,1                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 19,6                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 20,1                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 20,6                                 | 45  | No                                    | 35  | No   |
| NSA 4         | 9,0                 | 21,1                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 21,6                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 22,1                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 22,6                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 23,1                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 23,6                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 24,1                                 | 45  | No                                    | 35  | No   |



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| Klipkraal WEF 3 | 31          | 85    | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |  |

| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 6,0                 | 17,7                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 18,2                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 18,7                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 19,2                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 19,7                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 20,2                                 | 45  | No                                    | 35  | No   |
| NSA 5         | 9,0                 | 20,7                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 21,2                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 21,7                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 22,2                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 22,7                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 23,2                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 23,7                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 4,0                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 4,5                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 5,0                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 5,5                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 6,0                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 6,5                                  | 45  | No                                    | 35  | No   |
| NSA 6         | 9,0                 | 7,0                                  | 45  | No                                    | 35  | No   |
|               | 9,5                 | 7,5                                  | 45  | No                                    | 35  | No   |
|               | 10,0                | 8,0                                  | 45  | No                                    | 35  | No   |
|               | 10,5                | 8,5                                  | 45  | No                                    | 35  | No   |
|               | 11,0                | 9,0                                  | 45  | No                                    | 35  | No   |
|               | 11,5                | 9,5                                  | 45  | No                                    | 35  | No   |
|               | 12,0                | 10,0                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 4,4                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 4,9                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 5,4                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 5,9                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 6,4                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 6,9                                  | 45  | No                                    | 35  | No   |
| NSA 7         | 9,0                 | 7,4                                  | 45  | No                                    | 35  | No   |
|               | 9,5                 | 7,9                                  | 45  | No                                    | 35  | No   |
|               | 10,0                | 8,4                                  | 45  | No                                    | 35  | No   |
|               | 10,5                | 8,9                                  | 45  | No                                    | 35  | No   |
|               | 11,0                | 9,4                                  | 45  | No                                    | 35  | No   |
|               | 11,5                | 9,9                                  | 45  | No                                    | 35  | No   |
|               | 12,0                | 10,4                                 | 45  | No                                    | 35  | No   |



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| Klipkraal WEF 3 | 32          | 85    | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |

| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 6,0                 | 8,7                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 9,2                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 9,7                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 10,2                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 10,7                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 11,2                                 | 45  | No                                    | 35  | No   |
| NSA 8         | 9,0                 | 11,7                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 12,2                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 12,7                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 13,2                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 13,7                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 14,2                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 14,6                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 11,2                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 11,7                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 12,2                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 12,7                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 13,2                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 13,7                                 | 45  | No                                    | 35  | No   |
| NSA 9         | 9,0                 | 14,2                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 14,7                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 15,2                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 15,7                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 16,2                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 16,7                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 17,2                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 12,4                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 12,9                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 13,4                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 13,9                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 14,4                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 14,9                                 | 45  | No                                    | 35  | No   |
| NSA 10        | 9,0                 | 15,4                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 15,9                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 16,4                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 16,9                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 17,4                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 17,9                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 18,4                                 | 45  | No                                    | 35  | No   |



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| Klipkraal WEF 3 | 33          | 85    | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |

| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA)   | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 6,0                 | 8.2                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 8.7                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 9.2                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 9.7                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 10.2                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 10,7                                 | 45  | No                                    | 35  | No   |
| NSA 11        | 9,0                 | 11.2                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 11,7                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 12,2                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 12,7                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 13,2                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 13,7                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 14,2                                 | Noise<br>Rating<br>Limit<br>(dBA)         Is the Day<br>time Limit<br>Exceeded?         Noise<br>Rating<br>Limit<br>(dBA)         No           45         No         35         1           45         No         35         1 | No                                    |   |  |
|               | 6,0                 | 7,5                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 8,0                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 8,5                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 9,0                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 9,5                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 10,0                                 | 45  | No                                    | 35  | No   |
| NSA 12        | 9,0                 | 10,5                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 11,0                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 11,5                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 12,0                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 12,5                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 13,0                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 13,5                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 0,4                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 0,9                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 1,4                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 1,9                                  | 45  | No                                    | 35  | No   |
| NSA 13        | 9,0                 | 2,4                                  | 45  | No                                    | 35  | No   |
|               | 9,5                 | 2,9                                  | 45  | No                                    | 35  | No   |
|               | 10,0                | 3,4                                  | 45  | No                                    | 35  | No   |
|               | 10,5                | 3,9                                  | 45  | No                                    | 35  | No   |
|               | 11,0                | 4,4                                  | 45  | No                                    | 35  | No   |
|               | 11,5                | 4,9                                  | 45  | No                                    | 35  | No   |
|               | 12,0                | 5,4                                  | 45  | No                                    | 35  | No   |



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| Klipkraal WEF 3 | 34          | 85    | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |  |

| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 6,0                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 0,0                                  | 45  | No                                    | 35  | No   |
| NSA 14        | 9,0                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 9,5                 | 0,3                                  | 45  | No                                    | 35  | No   |
|               | 10,0                | 0,8                                  | 45  | No                                    | 35  | No   |
|               | 10,5                | 1,3                                  | 45  | No                                    | 35  | No   |
|               | 11,0                | 1,8                                  | 45  | No                                    | 35  | No   |
|               | 11,5                | 2,3                                  | 45  | No                                    | 35  | No   |
|               | 12,0                | 2,8                                  | 45  | No                                    | 35  | No   |
|               | 6,0                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 0,0                                  | 45  | No                                    | 35  | No   |
| NSA 15        | 9,0                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 9,5                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 10,0                | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 10,5                | 0,2                                  | 45  | No                                    | 35  | No   |
|               | 11,0                | 0,7                                  | 45  | No                                    | 35  | No   |
|               | 11,5                | 1,2                                  | 45  | No                                    | 35  | No   |
|               | 12,0                | 1,7                                  | 45  | No                                    | 35  | No   |
|               | 6,0                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 0,1                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 0,6                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 1,1                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 1,6                                  | 45  | No                                    | 35  | No   |
| NSA 16        | 9,0                 | 2,1                                  | 45  | No                                    | 35  | No   |
|               | 9,5                 | 2,6                                  | 45  | No                                    | 35  | No   |
|               | 10,0                | 3,1                                  | 45  | No                                    | 35  | No   |
|               | 10,5                | 3,6                                  | 45  | No                                    | 35  | No   |
|               | 11,0                | 4,1                                  | 45  | No                                    | 35  | No   |
|               | 11,5                | 4,6                                  | 45  | No                                    | 35  | No   |
|               | 12,0                | 5,1                                  | 45  | No                                    | 35  | No   |



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| Klipkraal WEF 3 | 35                | 85 | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |  |

| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 6,0                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 0,2                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 0,7                                  | 45  | No                                    | 35  | No   |
| NSA 17        | 9,0                 | 1,2                                  | 45  | No                                    | 35  | No   |
|               | 9,5                 | 1,7                                  | 45  | No                                    | 35  | No   |
|               | 10,0                | 2,2                                  | 45  | No                                    | 35  | No   |
|               | 10,5                | 2,7                                  | 45  | No                                    | 35  | No   |
|               | 11,0                | 3,2                                  | 45  | No                                    | 35  | No   |
|               | 11,5                | 3,7                                  | 45  | No                                    | 35  | No   |
|               | 12,0                | 4,2                                  | 45  | No                                    | 35  | No   |
|               | 6,0                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 0,0                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 0,4                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 0,9                                  | 45  | No                                    | 35  | No   |
| NSA 18        | 9,0                 | 1,4                                  | 45  | No                                    | 35  | No   |
|               | 9,5                 | 1,9                                  | 45  | No                                    | 35  | No   |
|               | 10,0                | 2,4                                  | 45  | No                                    | 35  | No   |
|               | 10,5                | 2,9                                  | 45  | No                                    | 35  | No   |
|               | 11,0                | 3,4                                  | 45  | No                                    | 35  | No   |
|               | 11,5                | 3,9                                  | 45  | No                                    | 35  | No   |
|               | 12,0                | 4,4                                  | 45  | No                                    | 35  | No   |
|               | 6,0                 | 11,7                                 | 45  | No                                    | 35  | No   |
| NSA 19        | 6,5                 | 12,2                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 12,7                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 13,2                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 13,7                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 14,2                                 | 45  | No                                    | 35  | No   |
|               | 9,0                 | 14,7                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 15,2                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 15,7                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 16,2                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 16,7                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 17,2                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 17,7                                 | 45  | No                                    | 35  | No   |



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| Klipkraal WEF 3 | 36                | 85 | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |  |

| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 6,0                 | 12,0                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 12.5                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 13,0                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 13,5                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 14,0                                 | 45  | No                                    | 35  | No   |
| NSA 20        | 8,5                 | 14,5                                 | 45  | No                                    | 35  | No   |
|               | 9,0                 | 15,0                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 15,5                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 16,0                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 16,5                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 17,0                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 17,5                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 18,0                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 8,0                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 8,5                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 9,0                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 9,5                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 10,0                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 10,5                                 | 45  | No                                    | 35  | No   |
| NSA 21        | 9,0                 | 11,0                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 11,5                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 12,0                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 12,5                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 13,0                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 13,5                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 14,0                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 2,6                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 3,1                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 3,6                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 4,1                                  | 45  | No                                    | 35  | No   |
| NSA 22        | 8,0                 | 4,6                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 5,1                                  | 45  | No                                    | 35  | No   |
|               | 9,0                 | 5,6                                  | 45  | No                                    | 35  | No   |
|               | 9,5                 | 6,1                                  | 45  | No                                    | 35  | No   |
|               | 10,0                | 6,6                                  | 45  | No                                    | 35  | No   |
|               | 10,5                | 7,1                                  | 45  | No                                    | 35  | No   |
|               | 11,0                | 7,6                                  | 45  | No                                    | 35  | No   |
|               | 11,5                | 8,1                                  | 45  | No                                    | 35  | No   |
|               | 12,0                | 8,5                                  | 45  | No                                    | 35  | No   |


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| Klipkraal WEF 3 | 37          | 85    | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |  |

| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 6,0                 | 6,5                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 7,0                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 7,5                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 8,0                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 8,5                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 9,0                                  | 45  | No                                    | 35  | No   |
| NSA 23        | 9,0                 | 9,5                                  | 45  | No                                    | 35  | No   |
|               | 9,5                 | 10,0                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 10,5                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 11,0                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 11,5                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 12,0                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 12,5                                 | 45  | No                                    | 35  | No   |

Figure 8 below shows the predicted noise levels visually.



Figure 8: Predicted Noise Levels from WTGs (at 12m/s wind speed)



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| Klipkraal WEF 3 | 38          | 85    | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |  |

Figure 9 below shows the noise level contours when the WTGs are operating at lower wind speeds (6m/s). at these speeds, the wind masking effects may not be as prominent.



Figure 9: Predicted Noise Levels from WTGs (at 6m/s wind speed)

# 5.3 Predicted noise levels during the decommissioning phase

The noise levels experienced during the decommissioning phase of the project will be similar to the construction phase. Therefore, it is likely that the impacts, from a noise perspective, will be low. Furthermore, a "no-go" alternative was not assessed as there will be no noise impact if the site is not developed.

## 5.4 Cumulative Noise Impacts

The proposed windfarm is located adjacent to two other renewable energy facilities, in the Environmental Authorization Phase, within a 35 km radius. Klipkraal WEF 1 and Klipkraal 2 have been assessed together with Klipkraal WEF 3 to determine the cumulative noise levels that are predicted during the operational phase.

Figure 10 below illustrates the location of the surrounding developments.



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| Klipkraal WEF 3 | 39          | 85    | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |



Figure 10: Klipkraal WEF 1, 2 and 3 turbines considered for cumulative impact noise modelling

The predicted cumulative noise levels from the operation of all three Klipkraal WEFs was modelled to determine the cumulative impacts on identified NSAs, the summary of the results can be seen in Table 11 below. These results indicate the maximum noise levels that may be experienced at each NSA, usually occurring at higher wind speeds where wind masking is likely to occur.

| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 6,0                 | 22,7                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 23,2                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 23,7                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 24,2                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 24,7                                 | 45  | No                                    | 35  | No   |
| NSA 1         | 8,5                 | 25,2                                 | 45  | No                                    | 35  | No   |
|               | 9,0                 | 25,7                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 26,2                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 26,7                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 27,2                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 27,7                                 | 45  | No                                    | 35  | No   |

Table 11: Cumulative Noise Modelling Results



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|-----------------|-------------|-------|----------------------------|-----------------------|--|
| Klipkraal WEF 3 | 40          | 85    | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |  |

| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 11,5                | 28,2                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 28,7                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 36,6                                 | 45  | No                                    | 35  | Yes  |
|               | 6,5                 | 37,1                                 | 45  | No                                    | 35  | Yes  |
|               | 7,0                 | 37,6                                 | 45  | No                                    | 35  | Yes  |
|               | 7,5                 | 38,1                                 | 45  | No                                    | 35  | Yes  |
|               | 8,0                 | 38,6                                 | 45  | No                                    | 35  | Yes  |
|               | 8,5                 | 39,1                                 | 45  | No                                    | 35  | Yes  |
| NSA 2         | 9,0                 | 39,6                                 | 45  | No                                    | 35  | Yes  |
|               | 9,5                 | 40,1                                 | 45  | No                                    | 35  | Yes  |
|               | 10,0                | 40,6                                 | 45  | No                                    | 35  | Yes  |
|               | 10,5                | 41,1                                 | 45  | No                                    | 35  | Yes  |
|               | 11,0                | 41,6                                 | 45  | No                                    | 35  | Yes  |
|               | 11,5                | 42,1                                 | 45  | No                                    | 35  | Yes  |
|               | 12,0                | 42,6                                 | 45  | No                                    | 35  | Yes  |
|               | 6,0                 | 21,8                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 22,3                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 22,8                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 23,3                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 23,8                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 24,3                                 | 45  | No                                    | 35  | No   |
| NSA 3         | 9,0                 | 24,8                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 25,3                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 25,8                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 26,3                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 26,8                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 27,3                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 27,8                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 19,5                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 20,0                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 20,5                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 21,0                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 21,5                                 | 45  | No                                    | 35  | No   |
| NSA 4         | 8,5                 | 22,0                                 | 45  | No                                    | 35  | No   |
|               | 9,0                 | 22,5                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 23,0                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 23,5                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 24,0                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 24,5                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 25,0                                 | 45  | No                                    | 35  | No   |



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| Klipkraal WEF 3 | 41          | 85    | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |

| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 12,0                | 25,5                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 19,3                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 19,8                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 20,3                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 20,8                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 21,3                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 21,8                                 | 45  | No                                    | 35  | No   |
| NSA 5         | 9,0                 | 22,3                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 22,8                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 23,3                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 23,8                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 24,3                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 24,8                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 25,3                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 6,1                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 6,6                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 7,1                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 7,6                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 8,1                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 8,6                                  | 45  | No                                    | 35  | No   |
| NSA 6         | 9,0                 | 9,1                                  | 45  | No                                    | 35  | No   |
|               | 9,5                 | 9,6                                  | 45  | No                                    | 35  | No   |
|               | 10,0                | 10,1                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 10,6                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 11,1                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 11,6                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 12,1                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 6,5                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 7,0                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 7,5                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 8,0                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 8,5                                  | 45  | No                                    | 35  | No   |
| NSA 7         | 8,5                 | 9,0                                  | 45  | No                                    | 35  | No   |
| NSA 7         | 9,0                 | 9,5                                  | 45  | No                                    | 35  | No   |
|               | 9,5                 | 10,0                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 10,5                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 11,0                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 11,5                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 12,0                                 | 45  | No                                    | 35  | No   |



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| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 12,0                | 12,5                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 30,1                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 30,6                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 31,1                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 31,6                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 32,1                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 32,6                                 | 45  | No                                    | 35  | No   |
| NSA 8         | 9,0                 | 33,1                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 33,6                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 34,1                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 34,6                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 35,1                                 | 45  | No                                    | 35  | Yes  |
|               | 11,5                | 35,6                                 | 45  | No                                    | 35  | Yes  |
|               | 12,0                | 36,1                                 | 45  | No                                    | 35  | Yes  |
|               | 6,0                 | 20,0                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 20,5                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 21,0                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 21,5                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 22,0                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 22,5                                 | 45  | No                                    | 35  | No   |
| NSA 9         | 9,0                 | 23,0                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 23,5                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 24,0                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 24,5                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 25,0                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 25,5                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 25,9                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 18,3                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 18,8                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 19,3                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 19,8                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 20,3                                 | 45  | No                                    | 35  | No   |
| NSA 10        | 8,5                 | 20,8                                 | 45  | No                                    | 35  | No   |
|               | 9,0                 | 21,3                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 21,8                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 22,3                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 22,8                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 23,3                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 23,8                                 | 45  | No                                    | 35  | No   |



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| Klipkraal WEF 3 | 43          | 85    | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |

| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 12,0                | 24,3                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 14,1                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 14,6                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 15,1                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 15,6                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 16,1                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 16,6                                 | 45  | No                                    | 35  | No   |
| NSA 11        | 9,0                 | 17,1                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 17,6                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 18,1                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 18,6                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 19,1                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 19,6                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 20,1                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 13,9                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 14,4                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 14,9                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 15,4                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 15,9                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 16,4                                 | 45  | No                                    | 35  | No   |
| NSA 12        | 9,0                 | 16,9                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 17,4                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 17,9                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 18,4                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 18,9                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 19,4                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 19,9                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 12,3                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 12,8                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 13,3                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 13,8                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 14,3                                 | 45  | No                                    | 35  | No   |
| NGA 13        | 8,5                 | 14,8                                 | 45  | No                                    | 35  | No   |
|               | 9,0                 | 15,3                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 15,8                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 16,3                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 16,8                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 17,3                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 17,8                                 | 45  | No                                    | 35  | No   |



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| Klipkraal WEF 3 | 44                | 85 | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |  |

| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 12,0                | 18,3                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 7,9                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 8,4                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 8,9                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 9,4                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 9,9                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 10,4                                 | 45  | No                                    | 35  | No   |
| NSA 14        | 9,0                 | 10,9                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 11,4                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 11,9                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 12,4                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 12,9                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 13,4                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 13,9                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 5,8                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 6,3                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 6,8                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 7,3                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 7,8                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 8,3                                  | 45  | No                                    | 35  | No   |
| NSA 15        | 9,0                 | 8,8                                  | 45  | No                                    | 35  | No   |
|               | 9,5                 | 9,3                                  | 45  | No                                    | 35  | No   |
|               | 10,0                | 9,8                                  | 45  | No                                    | 35  | No   |
|               | 10,5                | 10,3                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 10,8                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 11,3                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 11,8                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 11,7                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 12,2                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 12,7                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 13,2                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 13,7                                 | 45  | No                                    | 35  | No   |
| NGA 16        | 8,5                 | 14,2                                 | 45  | No                                    | 35  | No   |
|               | 9,0                 | 14,7                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 15,2                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 15,7                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 16,2                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 16,7                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 17,2                                 | 45  | No                                    | 35  | No   |



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| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 12,0                | 17,7                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 6,4                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 6,9                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 7,4                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 7,9                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 8,4                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 8,9                                  | 45  | No                                    | 35  | No   |
| NSA 17        | 9,0                 | 9,4                                  | 45  | No                                    | 35  | No   |
|               | 9,5                 | 9,9                                  | 45  | No                                    | 35  | No   |
|               | 10,0                | 10,4                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 10,9                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 11,4                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 11,9                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 12,4                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 7,2                                  | 45  | No                                    | 35  | No   |
|               | 6,5                 | 7,7                                  | 45  | No                                    | 35  | No   |
|               | 7,0                 | 8,2                                  | 45  | No                                    | 35  | No   |
|               | 7,5                 | 8,7                                  | 45  | No                                    | 35  | No   |
|               | 8,0                 | 9,2                                  | 45  | No                                    | 35  | No   |
|               | 8,5                 | 9,7                                  | 45  | No                                    | 35  | No   |
| NSA 18        | 9,0                 | 10,2                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 10,7                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 11,2                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 11,7                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 12,2                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 12,7                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 13,2                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 13,0                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 13,5                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 14,0                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 14,5                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 15,0                                 | 45  | No                                    | 35  | No   |
| NSA 19        | 8,5                 | 15,5                                 | 45  | No                                    | 35  | No   |
|               | 9,0                 | 16,0                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 16,5                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 17,0                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 17,5                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 18,0                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 18,5                                 | 45  | No                                    | 35  | No   |



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| Klipkraal WEF 3 | 46                | 85 | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |  |

| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 12,0                | 19,0                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 13,1                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 13,6                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 14,1                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 14,6                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 15,1                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 15,6                                 | 45  | No                                    | 35  | No   |
| NSA 20        | 9,0                 | 16,1                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 16,6                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 17,1                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 17,6                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 18,1                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 18,6                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 19,1                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 12,4                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 12,9                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 13,4                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 13,9                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 14,4                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 14,9                                 | 45  | No                                    | 35  | No   |
| NSA 21        | 9,0                 | 15,4                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 15,9                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 16,4                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 16,9                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 17,4                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 17,9                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 18,4                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 10,4                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 10,9                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 11,4                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 11,9                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 12,4                                 | 45  | No                                    | 35  | No   |
| NSA 22        | 8,5                 | 12,9                                 | 45  | No                                    | 35  | No   |
|               | 9,0                 | 13,4                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 13,9                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 14,4                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 14,9                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 15,4                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 15,9                                 | 45  | No                                    | 35  | No   |



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| Receptor Name | Wind speed<br>(m/s) | Noise<br>Levels<br>from WTG<br>(dBA) | Day time<br>Noise<br>Rating<br>Limit<br>(dBA) | Is the Day<br>time Limit<br>Exceeded? | Night-time<br>Noise<br>Rating<br>Limit<br>(dBA) | ls the<br>Night-time<br>Limit<br>Exceeded? |
|---------------|---------------------|--------------------------------------|---|---------------------------------------|---|--|
|               | 12,0                | 16,3                                 | 45  | No                                    | 35  | No   |
|               | 6,0                 | 10,0                                 | 45  | No                                    | 35  | No   |
|               | 6,5                 | 10,5                                 | 45  | No                                    | 35  | No   |
|               | 7,0                 | 11,0                                 | 45  | No                                    | 35  | No   |
|               | 7,5                 | 11,5                                 | 45  | No                                    | 35  | No   |
|               | 8,0                 | 12,0                                 | 45  | No                                    | 35  | No   |
|               | 8,5                 | 12,5                                 | 45  | No                                    | 35  | No   |
| NSA 23        | 9,0                 | 13,0                                 | 45  | No                                    | 35  | No   |
|               | 9,5                 | 13,5                                 | 45  | No                                    | 35  | No   |
|               | 10,0                | 14,0                                 | 45  | No                                    | 35  | No   |
|               | 10,5                | 14,5                                 | 45  | No                                    | 35  | No   |
|               | 11,0                | 15,0                                 | 45  | No                                    | 35  | No   |
|               | 11,5                | 15,5                                 | 45  | No                                    | 35  | No   |
|               | 12,0                | 16,0                                 | 45  | No                                    | 35  | No   |

The results above indicate that at no time will the noise levels experienced at the relevant NSAs be above the SANS 10103:2008 day time limits as a result of all three Klipkraal WEFs being in operation simultaneously. However, the SANS Night-Time Rating will be exceeded at NSA 2 and NSA 8. The exceedances are likely to have little impact as the wind will create a masking effect.

The cumulative impacts can therefore be expected to be of low significance.

# 6. Impact Assessment

The "no-go" alternative was not assessed as there will be no noise impact if the site is not developed. The potential impacts during the construction, operational, and decommissioning phases are discussed below. Each subsection summarizes the potential impacts. The Impact Rating Table in subsection 6.5 shows the significance of the impacts at each phase.



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# 6.1 Potential Impacts during the Construction Phase

The following can potential impacts have been identified:

- There will be an impact on the immediate surrounding environment from the construction activities, especially if pile driving is to be done. This, however, will only occur if the underlying geological structure requires piling.
- The area surrounding the construction site will be affected for a short period of time in all directions by construction noise impacts, should several pieces of construction equipment be used simultaneously.
- The number of construction vehicles that will be used in the project will add to the existing residual levels and will most likely cause a disturbing noise, albeit for a short period of time.

In conclusion, there will be a short-term increase in noise in the vicinity of the site during the construction phase as the residual noise level will be exceeded. The impact during the construction phase will be difficult to mitigate. The significance of the construction noise impact is predicted to be low (before and after mitigation).

The following mitigation measures are recommended for construction activities:

- All construction operations should only occur during daylight hours, if possible.
- No construction piling should occur at night. Piling should only occur during the hottest part of the day to take advantage of unstable atmospheric conditions.
- Construction staff should be given "noise sensitivity" training to mitigate the noise impacts caused during construction as well as noise protective gear.



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# 6.2 Potential Impacts during the Operational Phase

The residual noise increases as the wind speed increases and the wind noise masking effect increases i.e. the audible noise from the wind farm becomes less as wind noise masking increases. Under very stable atmospheric conditions, a temperature inversion or a light wind, the turbines will in all likelihood not be operational as the cut-in speed is 3 m/s. As the wind speed increases above the cut-in speed the residual noise will also increase. If the atmospheric conditions are such that the wind is very light (<3 m/s), at ground level, but the wind speed exceeds the cut-in speed at hub height, then the turbines will begin to operate. It is thus feasible that little noise masking will occur at this low windspeed. The critical wind speeds are thus between 3-5 m/s at hub height when there may be little possibility of masking at ground level.

The noise modelling indicates that the noise levels from the turbines will be below the SANS 10103:2008 day time and night-time limits for rural areas at all NSA's.

## 6.3 Potential Impacts during the Decommissioning Phase

During the de-commissioning phase, the noise impacts will be the same as the construction phase.

## 6.4 Cumulative Impacts

Klipkraal WEF 1-3 have been assessed for cumulative impacts as all other projects within a 35 km radius are too far away to have an impact, from a noise perspective, on the identified NSAs.

Table 13 below shows the NSAs that may experience an exceedance of SANS 10103:2008 night-time noise limits from the operation of only turbines on Klipkraal WEF 3 and compares them to the cumulative noise levels from all three Klipkraal WEFs.

| NSA Name | Maximum Level of Noise Exposure<br>(dB[A]) |
|----------|--|
| NSA 2    | 42.6                                       |
| NSA 8    | 36.1                                       |

Table 12: Noise Levels Exceeding SANS Night-time Limits due to Cumulative Impacts



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# 6.5 Impact Assessment Summary

Table 13 below shows the overall impact significance findings, following the implementation of the proposed mitigation measures. The Impact Rating Methodology was supplied by SiVEST and is attached in Annexure C

| Table 13:                                     | ole 13: Impact Rating Methodology Summary                                    |          |                            |   |   |   |             |       |                 |       |  |  |   |   |   |   |             |       |                 |     |  |
|---|--|----------|----------------------------|---|---|---|-------------|-------|-----------------|-------|--|--|---|---|---|---|-------------|-------|-----------------|-----|--|
|   |  |          |                            |   |   |   |             | Klip  | okra            | al Wi | nd Energy Facility 3   |  |   |   |   |   |             |       |                 |     |  |
| RAMETER                                       | RONMENTAL  | EN<br>BE | ENVIRONMENTAL SIGNIFICANCE |   |   |   |             |       |                 |       | SATION   | ENVIRONMENTAL SIGNIFICANCE<br>AFTER MITIGATION |   |   |   |   |             |       |                 |     |  |
| ENVIRONMENTAL PAF                             | ISSUE / IMPACT / ENVI<br>EFFECT/ NATURE                                      | E        | Ρ                          | R | L | D | I<br>/<br>M | TOTAL | STATUS (+ OR -) | S     | RECOMMENDED MITIC<br>MEASURES  | E  | Ρ | R | L | D | I<br>/<br>M | TOTAL | STATUS (+ OR -) | S   |  |
| Construe                                      | ction Phase  |          |                            |   |   |   |             |       |                 |       |  |  |   |   |   |   |             |       |                 |     |  |
| Noise emissions during the Construction Phase | Noise Pollution due to construction activities (equipment and vehicle noise) | 2        | 1                          | 1 | 1 | 1 | 1           | 6     | -               | Low   | <ol> <li>Staff to receive training on noise sensitivity.</li> <li>Monitoring of noise during the construction phase to confirm noise levels are within limits.</li> <li>Limit construction to day time in order to take advantage of unstable weather conditions.</li> <li>Regularly service equipment to ensure no unnecessary noise is emitted.</li> </ol> | 2  | 1 | 1 | 1 | 1 | 1           | 6     | -               | Low |  |
| Operatio                                      | nal Phase  |          |                            |   |   |   |             |       |                 |       |  |  |   |   |   |   |             |       |                 |     |  |





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|   | Klipkraal Wind Energy Facility 3         |          |            |   |   |   |             |       |                 |       |   |   |   |   |   |   |             |       |                 |     |
|---|--|----------|------------|---|---|---|-------------|-------|-----------------|-------|---|---|---|---|---|---|-------------|-------|-----------------|-----|
| AMETER<br>RONMENTAL   |  | EN<br>BE | Vir<br>Fof | CONMENTAL SIGNIFICANCE<br>RE MITIGATION |   |   |             |       |                 | ATION | ENVIRONMENTAL SIGNIFICANCE<br>AFTER MITIGATION  |   |   |   |   |   |             |       | CE              |     |
| ENVIRONMENTAL PAF<br>ISSUE / IMPACT / ENVI  | EFFECT/ NATURE                           | E        | Ρ          | R                                       | L | D | I<br>/<br>M | TOTAL | STATUS (+ OR -) | S     | RECOMMENDED MITIC<br>MEASURES   | E | Ρ | R | L | D | I<br>/<br>M | TOTAL | STATUS (+ OR -) | S   |
| Noise emissions during the Operational<br>Phase (Day time)<br>Mechanical and aerodynamic noise from the   | operation of the wind turbine components | 2        | 1          | 1                                       | 1 | 3 | 1           | 8     | -               | Low   | stermine actual noise impacts and whether<br>uch as running the turbines in low power mode<br>ensure no wind turbines impacts these   | 2 | 1 | 1 | 1 | З | 1           | 8     | -               | Low |
| Noise emissions during the Operational Phase<br>(Night-time)<br>Mechanical and aerodynamic noise from the | operation of the wind turbine components | 2        | 1          | 1                                       | 1 | 3 | 2           | 16    | -               | Low   | <ol> <li>Conduct noise monitoring during the operational to de<br/>further mitigations measures need to be implemented su<br/>at certain wind speeds at night.</li> <li>Implement a 500m "no-go" buffer around all NSAs to<br/>sensitive receptors</li> </ol> | 2 | 1 | 1 | 1 | 3 | 1           | 8     | -               | Low |



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|   | Klipkraal Wind Energy Facility 3   |          |             |             |               |             |             |       |                 |     |  |   |   |   |   |   |             |       |                 |     |  |
|---|--|----------|-------------|-------------|---------------|-------------|-------------|-------|-----------------|-----|--|---|---|---|---|---|-------------|-------|-----------------|-----|--|
| AMETER  | RONMENTAL  | EN<br>BE | ivir<br>Fof | onn<br>Re M | MEN'<br>NITIC | TAL<br>SATI | sig<br>Ion  | NIFI  | CAN             | CE  | ENVIRONMENTAL SIGNIFICANCE<br>AFTER MITIGATION   |   |   |   |   |   |             |       |                 |     |  |
| ENVIRONMENTAL PAF                               | ISSUE / IMPACT / ENVI<br>EFFECT/ NATURE  | E        | Ρ           | R           | L             | D           | I<br>/<br>M | TOTAL | STATUS (+ OR -) | S   | RECOMMENDED MITIGAT<br>MEASURES  |   | Ρ | R | L | D | I<br>/<br>M | TOTAL | STATUS (+ OR -) | S   |  |
| Noise emission during the decommissioning phase | Noise Pollution similar to construction activities (equipment and vehicle noise) | 2        | 1           | 1           | 1             | 1           | 1           | 6     |                 | Low | <ol> <li>Staff to receive training on noise sensitivity.</li> <li>Monitoring of noise during the construction phase to confirm noise levels are within limits.</li> <li>Limit construction to day time in order to take advantage of unstable weather conditions.</li> <li>Regularly service equipment to ensure no unnecessary noise is emitted.</li> </ol> | 2 | 1 | 1 | 1 | 1 | 1           | 6     |                 | Low |  |
| Cumulat   | ive  |          |             |             |               |             |             |       |                 |     |  |   |   |   |   |   |             |       |                 |     |  |



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|   | Klipkraal  |          |   |   |   |   |             |       |                 |     | nd Energy Facility 3  |  |   |   |   |   |             |       |                 |     |  |
|---|--|----------|---|---|---|---|-------------|-------|-----------------|-----|---|--|---|---|---|---|-------------|-------|-----------------|-----|--|
| RAMETER   | RONMENTAL  | EN<br>BE | ENVIRONMENTAL SIGNIFICANCE<br>BEFORE MITIGATION |   |   |   |             |       |                 | CE  | SATION  | ENVIRONMENTAL SIGNIFICANCE<br>AFTER MITIGATION |   |   |   |   |             |       |                 |     |  |
| ENVIRONMENTAL PAF   | ISSUE / IMPACT / ENVI<br>EFFECT/ NATURE  | E        | Ρ   | R | L | D | I<br>/<br>M | TOTAL | STATUS (+ OR -) | S   | RECOMMENDED MITIGAT<br>MEASURES   |  | Ρ | R | L | D | I<br>/<br>M | TOTAL | STATUS (+ OR -) | S   |  |
| Noise emissions from the cumulative effect of all three Klipkraal WEFs operating simultaneously | Mechanical and aerodynamic noise from the operation of the wind turbine components from all three Klipkraal WEFs | 2        | 1   | 1 | 1 | 3 | 2           | 16    | _               | Low | <ol> <li>Conduct noise monitoring during the operational to determine actual noise<br/>impacts and whether further mitigations measures need to be implemented<br/>such as running the turbines in low power mode at certain wind speeds at<br/>night.</li> <li>Implement a 500m "no-go" buffer around all NSAs to ensure no wind<br/>turbines impacts these sensitive receptors</li> </ol> | 2  | 1 | 1 | 1 | 3 | 1           | 8     |                 | Low |  |

# 7. Legislative Guidelines and Requirements

The following standards and regulatory frameworks have been used to aid this study and guide the decisionmaking process with regards to noise pollution:

- 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 National Environmental Management Act, 107 OF 1998 Procedures for the Assessment and Minimum Criteria for Reporting on identified Environmental Themes in terms of Sections 24(5)(a) and



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(h) and 44 of the Act when applying for Environmental Authorisation" – GN 320 of 20th March 2020. Page 53 – 56 Section on Noise.

- 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);
- SANS 10103:2008 Version 6 The measurement and rating of environmental noise with respect to annoyance and to speech communication;
- SANS 10357:2004 Version 2.1 The calculation of sound propagation by the Concawe method;
- ISO 9613-1: Attenuation of sound during propagation outdoors, Part 1: Calculation of sound by the atmosphere;
- ISO 9613-2: Attenuation of sound during propagation outdoors, Part 2: General method of calculation and;
- SANS 10328:2008 Methods for environmental noise impact assessments.
- SANS 10210:2004 Edition 2.2 Calculating and predicting road traffic noise

Furthermore, SANS 10103:2008 provides typical rating levels for noise in various types of districts, as described in Table 14 below.

|   | Equivalent Continuous Rating Level, LReq.T for Noise |             |                |                                       |         |                |  |  |  |  |  |
|---|--|-------------|----------------|---------------------------------------|---------|----------------|--|--|--|--|--|
| Type of District  | Οι   | itdoors (dB | (A))           | Indoors, with open windows<br>(dB(A)) |         |                |  |  |  |  |  |
|   | Day-<br>night  | Daytime     | Night-<br>time | Day-<br>night                         | Daytime | Night-<br>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:<br>Workshops; business premises and main roads | 60   | 60          | 50             | 50                                    | 50      | 40             |  |  |  |  |  |
| Central business districts  | 65   | 65          | 55             | 55                                    | 55      | 45             |  |  |  |  |  |
| Industrial districts  | 70   | 70          | 60             | 60                                    | 60      | 50             |  |  |  |  |  |

Table 14: Typical rating levels for noise in various types of districts

The proposed development is situated in rural district. This implies that the noise levels in the area should not exceed 45 dB(A) during the day (06:00 to 22:00) and not exceed 35 dB(A) during the night-time hours (22:00 to 06:00) when standing outdoors. Noise levels predicted for each NSA can be considered as outdoor levels as the model does not take buildings and barriers into account.

These rating levels can be seen as the target levels for any noise emissions arising from the construction and operation of the proposed development.



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SANS 10103:2008 also provides a guideline for expected community responses to excess environmental noise above the residual noise. These are reflected in Table 15 below.

| Excess<br>(ΔL <sub>Req,T</sub> ) |             | 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                             | Verv Strong | Vigorous community / group action   |  |  |  |  |  |  |  |

Table 15: Expected community response to excess noise levels

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

The  $\Delta L_{ReqT}$  should be calculated from the appropriate of the following options:

1)  $\Delta L_{\text{Req},T} = L_{\text{Req},T}$  of ambient noise under investigation MINUS  $L_{\text{Req},T}$  of the residual noise (determined in the absence of the specific noise under investigation);

2)  $\Delta L_{\text{Req,T}}$  =  $L_{\text{Req,T}}$  of ambient noise under investigation MINUS the maximum rating level for the ambient noise given in table 1 of SANS 10103:2008;

3)  $\Delta L_{\text{Req},T}$  =  $L_{\text{Req},T}$  of ambient noise under investigation MINUS the typical rating level for the applicable district as determined from table 2 of SANS 10103:2008; or

4)  $\Delta L_{\text{Req},T}$  = Expected increase in  $L_{\text{Req},T}$  of ambient noise in an area because of a proposed development under investigation.

There are no legal permits or licenses required that are related to noise emissions.

The modelling results show that the SANS 10103:2008 noise rating limits will not be exceeded during the operational phase. It is therefore unlikely that complaints will be received.

# 8. Environmental Management Programme Inputs

Table 16 and 17 below outline the recommended mitigation actions to be included in the Environmental Management Programme (EMPr).

| Impact/Aspect                | Mitigation/Management<br>Actions   | Responsibility   | Methodology | Mitigation/Management<br>Objectives and<br>Outcomes                         | Frequency                           |
|------------------------------|--|------------------|-------------|---|-------------------------------------|
| Reduce<br>construction noise | Conduct noise sensitivity<br>training for all<br>construction staff. No<br>construction piling<br>should occur at night.<br>Piling should only occur<br>during the hottest part of<br>the day to take<br>advantage of unstable<br>atmospheric conditions | Holder of the EA | Training    | Reduction in Noise and<br>thus reduction in chance<br>of complaints arising | Before<br>construction<br>commences |

Table 16: Monitoring and Mitigation Actions for input into EMPr (Construction Phase)



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| Impact/Aspect                 | Mitigation/Management<br>Actions                | Responsibility                 | Methodology   | Mitigation/Management<br>Objectives and<br>Outcomes  | Frequency  |
|-------------------------------|---|--------------------------------|---|--|--|
| Monitor<br>construction noise | Ambient noise<br>monitoring to be<br>conducted. | Specialist noise<br>consultant | As per the<br>requirements of<br>SANS<br>10103:2008 | Validation of Noise<br>Impact Assessment<br>Findings to determine if<br>further noise mitigation<br>is required. | Three times<br>during the<br>construction<br>phase |

Table 17: Monitoring and Mitigation Actions for input into EMPr (Operational Phase)

| Impact/Aspect               | Mitigation/Management<br>Actions   | Responsibility                 | Methodology               | Mitigation/Management<br>Objectives and<br>Outcomes                         | Frequency                                   |
|-----------------------------|--|--------------------------------|---------------------------|---|---|
| Reduce<br>operational noise | Ambient noise<br>monitoring to be<br>conducted at the closest<br>receptor when<br>operations commence to<br>verify the noise<br>emissions meet the night<br>time noise rating limit.<br>Mitigation measures to<br>be implemented if the<br>noise impact exceeds<br>the 35dB(A) night noise<br>rating limit such as<br>running the turbines in<br>low power mode at<br>certain wind speeds at<br>night. | Specialist Noise<br>Consultant | As per SANS<br>10103:2008 | Reduction in Noise and<br>thus reduction in chance<br>of complaints arising | Once off<br>during<br>project<br>operations |

Mitigation measures for the decommissioning phase will be the same as for the construction phase.

# 9. Final Specialist Statement and Authorisation Recommendation

# 9.1 Statement and Reasoned Opinion

Based on the modelling results, the impact will be low from a noise perspective. It is recommended that the development receives environmental authorisation.

# 9.2 EA Condition Recommendations

The conditions as contained in the EMPr should be included in the environmental authorisation.



# References

- Australia Environmental Protect Agency Wind farms environmental noise guidelines. July 2009.
- International Finance Corporation 2007 General EHS Guidelines: Environmental Noise.
- ISO 9613-2 Acoustics Attenuation of sound during propagation outdoors. Part 2 General method of calculation.
- Renewable Energy Research Laboratory Department of Mechanical and Industrial Engineering. University of Massachusetts at Amherst. A White Paper on Wind Turbine Acoustic Noise. Authors: Anthony L. Rogers, Ph.D. James F. Manwell, Ph.D. Sally Wright. Amended January 2006
- 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)
- 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
- South Africa SANS 10103:2008 Version 6 The measurement and rating of environmental noise with respect to annoyance and to speech communication.
- Swedish Environmental Protection Agency Noise Annoyance from Wind Turbines a Review. Authors:
   Eja Pedersen, Högskolan i Halmstad. August 2003.
- University of Groningen 11th International Meeting on Low Frequency Noise and Vibration and its Control. Do wind turbines produce significant low frequency sound levels? GP. van den Berg. September 2003.
- World Health Organization Guidelines for Community Noise. 1999
- Larom, D, Garstang, M., Payne, K., Raspet, R. & Lindeque, M. 1997. The Journal of Experimental Biology 200, 421–431.
- Wagner, S., Bareib, R. and Guidati, G., Wind Turbine Noise, Springer, Berlin, 1996
- Moraleda, Victoria & Pliego Marugán, Alberto & García Márquez, Fausto Pedro. (2019). Acoustic Maintenance Management Employing Unmanned Aerial Vehicles in Renewable Energies. 10.1007/978-3-319-93351-1\_76.



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# <u>Annexure</u>

## Annexure A: Specialist Expertise

## SPECIALIST EXPERTISE

## (RELATING TO NOISE)

### **Dr Brett Williams**

| Name of Organization: | Safetech      |
|-----------------------|---------------|
| Position in Firm:     | Owner         |
| Date of Birth:        | 21/04/1963    |
| Years with Firm:      | 29            |
| Nationality:          | South African |

### MEMBERSHIP OF PROFESSIONAL BODIES

• Occupational Hygienist Registered with the Southern African Institute of Occupational Hygienists (Registration Number 0221).

### **BIOGRAPHICAL SKETCH**

Brett Williams has been involved in Health, Safety and Environmental Management since 1987. He has been measuring noise related impacts since 1996. Brett is the owner of Safetech who have offices in Pretoria and Port Elizabeth. He has consulted to many different industries including, mining, chemical, automotive, food production etc.

He is registered with the Department of Employment and Labour as well as the Chamber of Mines to measure environmental stressors, which include chemical monitoring, noise and other physical stresses.

### PROJECT EXPERIENCE

Brett has conducted various projects to assess environmental noise impacts. The list below presents a selection of his project experience, relevant to noise:

- CES Coega SEZ Floating Power Barge (Gas to Power)
- SRK Coega SEZ Zone 13 and Zone 10 North and Zone 10 South (Gas to Power)
- SRK Engie SEZ Zone 13 (Gas to Power)
- SLR Consulting Atlantis Azura (Gas to Power)
- SiVest Oya Hybrid Energy Facility
- Arcus Gibb Kouga Wind Energy Project
- CSIR Umgeni Water Desalination Plant
- CSIR Saldanha Desalination Plant
- CSIR Atlantis Gas to Power Project (current)
- CSIR Walvis Bay Port Extension
- CSIR Noise Impact Study of Namwater Desalination Plant



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- · CSIR Kouga Wind Energy Project Background Noise Measurements
- CSIR Kouga Wind Energy Project
- CSIR Wind Current Wind Energy Project
- CSIR Langefontein Wind Energy Project
- CSIR Mossel Bay Wind Energy Project
- CSIR Coega IDZ Wind Energy Project
- CSIR Baakenskop Wind Energy Project
- CSIR Biotherm Wind Energy Project
- CSIR Innowind Mossel Bay
- CSIR Langefontein Wind Energy Project
- CSIR Bulk Manganese Terminal (Port of Ngqura)
- CSIR Phyto Amandla Biodiesel Project
- CSIR Vleesbaai Wind Energy Project
- CSIR Kudusberg Wind Energy Project
- CES Coega IDZ Gas to Power Project (Current)
- CES Coega IDZ Wind Energy Project
- CES Middleton Wind Energy Project
- CES Waainek Wind Energy Project
- CES Ncora Wind Energy Project
- CES Qunu Wind Energy Project
- CES Nqamakwe Wind Energy Project
- CES Plan 8 Wind Energy Project
- CES Qumbu Wind Energy Project
- CES Peddie Wind Energy Project
- CES Cookhouse Wind Energy Project
- CES Madagascar Heavy Minerals
- CES Richards Bay Wind Energy Project
- CES Hluhluwe Wind Energy Project
- CEN Kwandwe Airport Development Project
- CEN Swartkops Manganese Project
- CEN N2 Petro Port Project
- SiVest Rondekop Wind Energy Project
- SiVest Tooverberg Wind Energy Project
- SRK Roodeplaat Wind Energy Project
- SRK Tronox Slimes Dam Pumping Station
- Savannah Witberg Wind Energy Project
- Savannah Kareebosch Wind Energy Project

# TERTIARY EDUCATION

- · PhD University of Pretoria (Environmental Management)
- Various Health & Safety Courses.
- National Diploma Health & Safety Management
- · Harvard University Applications of Industrial Hygiene Principles including noise
- United States EPA Pollution Measurement course conducted at the University Of Cincinnati (EPA Training Centre)
- US EPA Air Dispersion Modelling Training Course
- Master of Business Administration (University of Wales) with dissertation on environmental reporting in South Africa.
- Environmental Auditor (ISO 14001:2015 and ISO 45001:2018)

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Annexure B: Specialist Statement of Independence



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| Ap<br>and   | plication for authorisation in terms of the Na<br>d the Environmental Impact Assessment (El  | tional Environmental Management Act, Act No. 107 of 1998, as amended<br>A) Regulations, 2014, as amended (the Regulations)  |
| PR  | OJECT TITLE  |   |
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| 1.  | This form must always be used for ap   | plications that must be subjected to Basic Assessment or Scoping  |
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| 2.  | This form is current as of 01 September 2  | 2018. It is the responsibility of the Applicant / Environmental Assessme  |
|   | Practitioner (EAP) to ascertain whether s  | ubsequent versions of the form have been published or produced by the   |
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| 3.  | A copy of this form containing original sig  | natures must be appended to all Draft and Final Reports submitted to th   |
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| 4.<br>5.<br>Dej<br>Atti<br>Pre<br>000<br>Phy  | department for consideration.<br>All documentation delivered to the physi<br>Departmental Officer Hours which is visibl<br>All EIA related documents (includes app<br>emailed; delivered to Security or placed<br>submissions are accepted.<br>partmental Details<br>stal address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environmental<br>vate Bag X447<br>etoria<br>D1<br>ysical address:<br>partment of Environmental Affairs   | ical address contained in this form must be delivered during the offici<br>ie on the Departmental gate.<br>Dication forms, reports or any EIA related submissions) that are faxed<br>in the Departmental Tender Box will not be accepted, only hardcop<br>ental Authorisations  |
| 4.<br>5.<br>De<br>De<br>De<br>De<br>Atto<br>De<br>Atto                                  | department for consideration.<br>All documentation delivered to the physi<br>Departmental Officer Hours which is visibl<br>All EIA related documents (includes app<br>emailed; delivered to Security or placed<br>submissions are accepted.<br>partmental Details<br>stal address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environmental<br>vate Bag X447<br>etoria<br>D1<br>ysical address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environmental<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environmental<br>partment of Environmental Affairs   | ical address contained in this form must be delivered during the offici<br>ie on the Departmental gate.<br>Dication forms, reports or any EIA related submissions) that are faxed<br>in the Departmental Tender Box will not be accepted, only hardcop<br>ental Authorisations  |
| 4.<br>5.<br>De<br>De<br>Att<br>Pre<br>000<br>Phy<br>De<br>De                            | department for consideration.<br>All documentation delivered to the physi<br>Departmental Officer Hours which is visibl<br>All EIA related documents (includes app<br>emailed; delivered to Security or placed<br>submissions are accepted.<br>partmental Details<br>stal address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vate Bag X447<br>etoria<br>D1<br>ysical address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vate Bag X447<br>etoria  | ical address contained in this form must be delivered during the offici<br>ie on the Departmental gate.<br>Dication forms, reports or any EIA related submissions) that are faxed<br>in the Departmental Tender Box will not be accepted, only hardcop<br>ental Authorisations  |
| 4.<br>5.<br>De<br>Po<br>De<br>Pre<br>000<br>Phi<br>De<br>Atto                           | department for consideration.<br>All documentation delivered to the physi<br>Departmental Officer Hours which is visibl<br>All EIA related documents (includes app<br>emailed; delivered to Security or placed<br>submissions are accepted.<br>partmental Details<br>stal address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vate Bag X447<br>etoria<br>01<br>ysical address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vate Bag X447<br>etoria<br>01<br>ysical address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vironment House<br>3 Steve Biko Road  | ical address contained in this form must be delivered during the offici<br>ie on the Departmental gate.<br>Dication forms, reports or any EIA related submissions) that are faxed<br>in the Departmental Tender Box will not be accepted, only hardcop<br>ental Authorisations  |
| 4.<br>5.<br>De<br>Pri<br>Pre<br>000<br>Phi<br>De<br>Atto<br>En<br>Atto<br>En<br>Atto    | department for consideration.<br>All documentation delivered to the physi<br>Departmental Officer Hours which is visibl<br>All EIA related documents (includes app<br>emailed; delivered to Security or placed<br>submissions are accepted.<br>partmental Details<br>stal address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vate Bag X447<br>etoria<br>D1<br>ysical address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vironment House<br>3 Steve Biko Road<br>cadia  | ical address contained in this form must be delivered during the officia<br>ie on the Departmental gate.<br>In the Departmental Tender Box will not be accepted, only hardcop<br>ental Authorisations   |
| 4.<br>5.<br>De<br>De<br>Att<br>Pri<br>De<br>Att<br>En<br>Att                            | department for consideration.<br>All documentation delivered to the physi<br>Departmental Officer Hours which is visibl<br>All EIA related documents (includes app<br>emailed; delivered to Security or placed<br>submissions are accepted.<br>partmental Details<br>stal address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vate Bag X447<br>storia<br>01<br>ysical address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vironment House<br>3 Steve Biko Road<br>cadia<br>eries must be directed to the Directorate: Co   | ical address contained in this form must be delivered during the offici<br>ie on the Departmental gate.<br>Dication forms, reports or any EIA related submissions) that are faxed<br>in the Departmental Tender Box will not be accepted, only hardcop<br>ental Authorisations  |
| 4.<br>5.<br>De<br>De<br>De<br>De<br>De<br>De<br>Atto<br>En<br>Qu                        | department for consideration.<br>All documentation delivered to the physi<br>Departmental Officer Hours which is visibl<br>All EIA related documents (includes app<br>emailed; delivered to Security or placed<br>submissions are accepted.<br>partmental Details<br>stal address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vate Bag X447<br>etoria<br>D1<br>ysical address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vironment House<br>3 Steve Biko Road<br>cadia<br>eries must be directed to the Directorate: Con<br>nail: EIAAdmin@environment.gov.za   | ical address contained in this form must be delivered during the offici<br>ie on the Departmental gate.<br>Dication forms, reports or any EIA related submissions) that are faxed<br>in the Departmental Tender Box will not be accepted, only hardcop<br>ental Authorisations<br>ental Authorisations  |
| 4.<br>5.<br>De<br>De<br>De<br>De<br>De<br>De<br>Atto<br>En<br>Atto<br>En<br>Arc<br>Qu   | department for consideration.<br>All documentation delivered to the physi<br>Departmental Officer Hours which is visibl<br>All EIA related documents (includes app<br>emailed; delivered to Security or placed<br>submissions are accepted.<br>partmental Details<br>stal address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vate Bag X447<br>etoria<br>01<br>ysical address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vironment House<br>3 Steve Biko Road<br>cadia<br>eries must be directed to the Directorate: Ca<br>tail: EIAAdmin@environment.gov.za  | ical address contained in this form must be delivered during the offici<br>ie on the Departmental gate.<br>Dication forms, reports or any EIA related submissions) that are faxed<br>in the Departmental Tender Box will not be accepted, only hardcop<br>ental Authorisations<br>ental Authorisations  |
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| 4.<br>5.<br>De<br>De<br>Pri<br>Pre<br>000<br>Phi<br>De<br>Atto<br>En<br>Qu<br>En<br>Del | department for consideration.<br>All documentation delivered to the physic<br>Departmental Officer Hours which is visible<br>All EIA related documents (includes apprenailed; delivered to Security or placed<br>submissions are accepted.<br><u>partmental Details</u><br>stal address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vate Bag X447<br>etoria<br>D1<br>ysical address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vate Bag X447<br>etoria<br>D1<br>ysical address:<br>partment of Environmental Affairs<br>ention: Chief Director: Integrated Environment<br>vironment House<br>3 Steve Biko Road<br>cadia<br>eries must be directed to the Directorate: Cataal: EIAAdmin@environment.gov.za<br>tails of Specialist, Declaration and Undertaking U | ical address contained in this form must be delivered during the offici<br>e on the Departmental gate.<br>Dication forms, reports or any EIA related submissions) that are faxed<br>i in the Departmental Tender Box will not be accepted, only hardcop<br>ental Authorisations<br>ental Authorisations<br>cordination, Strategic Planning and Support at:  |



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#### 1. SPECIALIST INFORMATION

| Specialist Company Name:   | SAFETECH   |                   |                           |   |  |  |
|----------------------------|--|-------------------|---------------------------|---|--|--|
| B-BBEE                     | Contribution level (indicate 1<br>to 8 or non-compliant) | Non-<br>Compliant | Percentage<br>Procurement | 0 |  |  |
|                            |  |                   | recognition               |   |  |  |
| Specialist name:           | Dr Brett Williams  |                   |                           |   |  |  |
| Specialist Qualifications: | PHD  |                   |                           |   |  |  |
| Professional               | Registered Occupational Hygi                             | enist             |                           |   |  |  |
| affiliation/registration:  |  |                   |                           |   |  |  |
| Physical address:          | 64 Worraker Street, Newton P                             | ark, Gqeberha     | 3                         |   |  |  |
| Postal address:            | PO BOX 27607, Greenacres                                 |                   |                           |   |  |  |
| Postal code:               | 6057 Cell: 082 550 2137                                  |                   |                           |   |  |  |
| Telephone:                 | e: 041 365 6846 Fax: 041 365 2123                        |                   |                           |   |  |  |
| E-mail:                    | Brett.williams@safetech.co.za                            |                   |                           |   |  |  |

#### 2. DECLARATION BY THE SPECIALIST

I, Brett Williams, declare that -

- · I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings
  that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that
  reasonably has or may have the potential of influencing any decision to be taken with respect to the application by
  the competent authority; and the objectivity of any report, plan or document to be prepared by myself for
  submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Safetech

Name of Company:

28/07/2022

Date

Details of Specialist, Declaration and Undertaking Under Oath





Field Survey Date Report Page - Of - Pages Amendments Klipkraal WEF 3 63 85 Version 1 as on 02/12/2022 18/09/2021-24/09/2021 UNDERTAKING UNDER OATH/ AFFIRMATION 3. I, Brett Williams, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct. Signature of the Specialist. Safetech Name of Company 28/07/2022 Date 1 Signatule of the Commissioner of Oaths 19/08/2022 Date CINDY KILLIAN COMMISSIONER OF OATHS PRACTISING ATTORNEY 70 WORRAKER STREET, NEWTON PARK PORT ELIZABETH, 6045 Details of Specialist, Declaration and Undertaking Under Oath Page 3 of 3



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## Annexure C: Impact Assessment Methodology (SiVEST)



#### 1 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) METHODOLOGY

The Environmental Impact Assessment (EIA) Methodology assists in evaluating the overall effect of a proposed activity on the environment. Determining of the significance of an environmental impact on an environmental parameter is determined through a systematic analysis.

#### 1.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global), whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 1.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

#### 1.2 Impact Rating System

The impact assessment must take account of the nature, scale and duration of effects on the environment and whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the various project stages, as follows:

- Planning;
- Construction;
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

The significance of Cumulative Impacts should also be rated (As per the Excel Spreadsheet Template).

#### 1.2.1 Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 1: Rating of impacts criteria



|                                  |  |                                     |   | SiV   | 'EST 🔡   |
|----------------------------------|--|-------------------------------------|---|---|--|
|                                  |  | EN                                  | VIRONMEN  | ITAL PARAMETER  |  |
| A brie                           | f description of the   | environmental as                    | pect likely to  | o be affected by the proposed ac  | tivity (e.g. Surface W   |
|                                  |  | ISSUE / IMPAC                       | T / ENVIRC  | NMENTAL EFFECT / NATURE   |  |
| Includ                           | le a brief descriptio  | n of the impact of                  | environmer  | ntal parameter being assessed in  | the context of the pro-  |
| This o                           | riterion includes a  | brief written stater                | ment of the   | environmental aspect being impa   | acted upon by a parti  |
| action                           | n or activity (e.g. oil  | spill in surface wa                 | ater).  |   |  |
|                                  |  |                                     | EXT   | (ENT (E)  |  |
| This i                           | s defined as the ar  | rea over which the                  | e impact wil  | I be expressed. Typically, the se   | everity and significan   |
| an im                            | pact have different  | scales and as suc                   | ch bracketin  | ng ranges are often required. This  | s is often useful durin  |
| detail                           | ed assessment of a   | a project in terms (                | of further de   | efining the determined.   |  |
| 1                                | Site   |                                     | The im  | pact will only affect the site  |  |
| 2                                | Local/district   |                                     | Will aff  | ect the local area or district  |  |
| 3                                | Province/region  | 1                                   | Will aff  | fect the entire province or region  |  |
| 4                                | International an   | d National                          | Will aff  | ect the entire country  |  |
|                                  | •  |                                     | PROB  | ABILITY (P)   |  |
| This o                           | lescribes the chan   | ce of occurrence of                 | of an impac   | t   |  |
|                                  |  |                                     | The ch  | ance of the impact occurring is e   | extremely low (Less th   |
| 1                                | Unlikely   |                                     | 25% cł  | hance of occurrence).   |  |
|                                  |  |                                     | The in  | npact may occur (Between a  | 25% to 50% chance  |
| 2                                | Possible   |                                     | occurre   | ence).  |  |
|                                  |  |                                     | The in  | pact will likely occur (Between   | a 50% to 75% chan  |
| 3                                | Probable   |                                     | occurre   | ence).  |  |
|                                  |  |                                     | Impact  | will certainly occur (Greater   | than a 75% chance  |
| 4                                | Definite   |                                     | occurre   | ence).  |  |
|                                  |  |                                     | REVER   | SIBILITY (R)  |  |
| This comp                        | lescribes the degre<br>letion of the propos  | e to which an impa<br>sed activity. | act on an er  | nvironmental parameter can be s   | uccessfully reversed   |
|                                  |  |                                     | The im  | pact is reversible with implemer  | ntation of minor mitig   |
| 1                                | Completely reve  | ersible                             | measu   | res   |  |
|                                  |  |                                     | The in  | mpact is partly reversible but  | more intense mitig   |
| 2                                | Partly reversible  | •                                   | measu   | res are required.   |  |
|                                  |  |                                     | The im  | pact is unlikely to be reversed ev  | ven with intense mitig   |
| 3                                | Barely reversible  | e                                   | measu   | res.  |  |
|                                  | Irreversible   |                                     | The im  | pact is irreversible and no mitiga  | tion measures exist.   |
| 4                                |  |                                     |   | OSS OF RESOURCES (L)  |  |
| 4                                |  | IRREPLA                             |   |   |  |
| 4<br>This d                      | describes the deare  | e to which resour                   | ces will be   | irreplaceably lost as a result of a   | proposed activity.   |
| 4<br>This o                      | describes the degre  | e to which resour                   | rces will be<br>The im                                | irreplaceably lost as a result of a<br>pact will not result in the loss of a  | any resources.   |
| 4<br>This of<br>1<br>2           | No loss of resoutions of Marginal loss of  | e to which resour<br>irce.          | rces will be<br>The im<br>The im                      | irreplaceably lost as a result of a<br>pact will not result in the loss of<br>pact will result in marginal loss o   | proposed activity.<br>any resources.<br>of resources.                |
| 4<br>This of<br>1<br>2<br>3      | describes the degree<br>No loss of resou<br>Marginal loss of<br>Significant loss                     | irce.<br>f resource<br>of resources | The im<br>The im<br>The im                            | irreplaceably lost as a result of a<br>pact will not result in the loss of<br>pact will result in marginal loss o<br>pact will result in significant loss   | of resources.<br>of resources.                                       |
| 4<br>This of<br>1<br>2<br>3<br>4 | Marginal loss of<br>Complete loss of   | irce.<br>f resource<br>of resources | rces will be<br>The im<br>The im<br>The im<br>The im  | irreplaceably lost as a result of a<br>pact will not result in the loss of<br>pact will result in marginal loss o<br>pact will result in significant loss<br>pact is result in a complete loss              | of resources.<br>of resources.<br>of resources.<br>of all resources. |
| 4<br>This of<br>1<br>2<br>3<br>4 | describes the degree<br>No loss of resou<br>Marginal loss of<br>Significant loss<br>Complete loss of | f resource<br>of resources          | The im<br>The im<br>The im<br>The im<br>The im<br>DUR | irreplaceably lost as a result of a<br>pact will not result in the loss of<br>pact will result in marginal loss o<br>pact will result in significant loss<br>pact is result in a complete loss<br>ATION (D) | of resources.<br>of resources.<br>of resources.<br>of all resources. |



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|       |                                 | The impact and its effects will either disappear with mitigation   |
|-------|---------------------------------|--|
|       |                                 | will be mitigated through natural process in a span shorter the  |
|       |                                 | the construction phase (0 - 1 years), or the impact and its effect   |
|       |                                 | will last for the period of a relatively short construction period a   |
|       |                                 | a limited recovery time after construction, thereafter it will   |
| 1     | Short term                      | entirely negated (0 - 2 years).  |
|       |                                 |  |
|       |                                 | The impact and its effects will continue or last for some time af  |
|       |                                 | the construction phase but will be mitigated by direct hum   |
| 2     | Medium term                     | action or by natural processes thereafter (2 – 10 years).  |
|       |                                 | The impact and its effects will continue or last for the enti-   |
|       |                                 | operational life of the development, but will be mitigated by dire   |
| 3     | Long term                       | human action or by natural processes thereafter (10 - 50 year  |
|       |                                 | The only class of impact that will be non-transitory. Mitigati   |
|       |                                 | either by man or natural process will not occur in such a way  |
|       |                                 | such a time span that the impact can be considered transie   |
| 4     | Permanent                       | (Indefinite).  |
|       | <b>I</b>                        | INTENSITY / MAGNITUDE (I / M)  |
| Desc  | ribes the severity of an impa   | ct (i.e. whether the impact has the ability to alter the functionality or quality  |
| a sys | tem permanently or temporar     | rily).   |
| -     |                                 | Impact affects the quality use and integrity of t  |
| 1     | Low                             | evetem/component in a way that is barely percentible   |
| ·     | 2011                            | Impact alters the quality use and integrity of t   |
|       |                                 | autom/component but autom/ component still continues   |
|       |                                 | function in a moderately modified way and maintains gans   |
| -     | Madium                          | intentity (come intentity)   |
| 2     | Medium                          | Integrity (some impact on integrity).  |
|       |                                 | Impact affects the continued viability of the system/component   |
|       |                                 | and the quality, use, integrity and functionality of the system  |
|       |                                 | component is severely impaired and may temporarily cease. Hi   |
| 3     | High                            | costs of rehabilitation and remediation.   |
|       |                                 | Impact affects the continued viability of the system/component   |
|       |                                 | and the quality, use, integrity and functionality of the system  |
|       |                                 | component permanently ceases and is irreversibly impair  |
|       |                                 | (system collapse). Rehabilitation and remediation of   |
|       |                                 | impossible. If possible rehabilitation and remediation of  |
|       |                                 | unfeasible due to extremely high costs of rehabilitation a   |
| 4     | Very high                       | remediation.   |
|       | •                               | SIGNIFICANCE (S)   |
| Signi | ficance is determined throug    | h a synthesis of impact characteristics. Significance is an indication of t  |
| impo  | rtance of the impact in terms   | s of both physical extent and time scale, and therefore indicates the level  |
| mitia | ation required. This describ    | es the significance of the impact on the environmental parameter. T  |
| calcu | lation of the significance of a | n impact uses the following formula:   |
| Janua | autor of the eighnouries of th  | a supervision of the following formation.  |
| Sign  | ificance = (Extent + probabi    | ility + reversibility + irreplaceability + duration) x magnitude/intensity.  |
|       | (                               | ·····, ······, ····, ···, ····, ····, ···, ···, ···, ···, ···, ····, ···-, ···, ···, ···, ···, ···-, ···, ···, ··· |
|       |                                 |  |



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|                 |                   |    |                            |                       |



The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

| Points   | Impact Significance Rating | Description   |
|----------|----------------------------|---|
|          |                            |   |
| 5 to 23  | Negative Low impact        | The anticipated impact will have negligible negative effects and      |
|          |                            | will require little to no mitigation.                                 |
| 5 to 23  | Positive Low impact        | The anticipated impact will have minor positive effects.              |
| 24 to 42 | Negative Medium impact     | The anticipated impact will have moderate negative effects and        |
|          |                            | will require moderate mitigation measures.                            |
| 24 to 42 | Positive Medium impact     | The anticipated impact will have moderate positive effects.           |
| 43 to 61 | Negative High impact       | The anticipated impact will have significant effects and will require |
|          |                            | significant mitigation measures to achieve an acceptable level of     |
|          |                            | impact.   |
| 43 to 61 | Positive High impact       | The anticipated impact will have significant positive effects.        |
| 62 to 80 | Negative Very high impact  | The anticipated impact will have highly significant effects and are   |
|          |                            | unlikely to be able to be mitigated adequately. These impacts         |
|          |                            | could be considered "fatal flaws".                                    |
| 62 to 80 | Positive Very high impact  | The anticipated impact will have highly significant positive effects. |
|          |                            |   |

The table below is to be represented in the Impact Assessment section of the report. The excel spreadsheet template can be used to complete the Impact Assessment.



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# Annexure D: Compliance with the Noise Assessment Protocol (GN 320, 20 March 2020)

Compliance with Specialist Noise Impact Assessment as per GNR 320 of the EIA Regulations **March 2020** Requirement Section **Baseline Description** Current Residual sound levels over 2 nights 3.2 Records of approximate wind speed 3.2 Mapped Distance of the receiver from the proposed source 4.1 (Table 8) Discussion of temporal aspects of ambient conditions 3.2 Assessment in accordance with SANS 10103:2008 & 10328:2008 Characterization of noise (e.g. frequency, temporal, content, vibration) 2.1 5.0 Projected noise during construction, commissioning, and operation Desired noise levels for the area 7.0 **Noise Specialist Report Requirements** CV of Specialist Annexure A Signed statement of independence Annexure B Duration and date of field study and weather conditions Annexure G 3.2 Description of methodology (equipment used & results of noise study) Map of proposed development with buffer 2.2 (Figure 4) Confirmation that all reasonable mitigation measure has been considered 9.2 Substantiated statement of acceptability (or not) and recommendation of 9.1 approval Any conditions to which statement is objected 9.2 Identify alternative development footprints within the preferred site that would be N/A "low" Motivation if alternatives found N/A Mitigation measures input into EMPr 8.0 Assumptions and limitations 1.6



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| Annexure I | E: Decibel | Reference | Scale |
|------------|------------|-----------|-------|
|------------|------------|-----------|-------|

|             | 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                     |



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# Annexure F: Site Sensitivity Report

Prior to commencing with the Noise Specialist Assessment in accordance with the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity (Government Notice 320, dated 20 March 2020), a site sensitivity verification was undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

The details of the site sensitivity verification are noted below:

| Date of Site Visit               | 18/09/2021 – 24/09/2021                                    |
|----------------------------------|--|
| Specialist Name                  | Dr Brett Williams  |
| Professional Registration Number | 0220   |
| Specialist Affiliation / Company | South African Institute of Occupational Hygienists (SAIOH) |



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ENVIRONMENT HEALTH SAFETY

# SITE SENSITIVITY VERIFICATION REPORT

FOR THE KLIPKRAAL WIND ENERGY FACILITY 3 NEAR FRASERBURG, NORTHERN CAPE.



Specialist Name: Dr Brett Williams Professional Registration Number: Specialist Affiliation / Company: Safetech Document Version: Version 2 Proposed WEF Project Name: Klipkraal Wind Energy Facility 3

Date of Site Visit: 18/09/2021 - 24/09/2021 SAIOH 0221 Specialist Topic: Noise Impact Assessment

28th July 2022



HW592A1000508

Northem Office: PO Box 80171, Doompoort, Pretoria, 0017 Tel: +27 (0)82 411 1571 Fax: +27 (0)86 6579864

Southern Office: PO Box 27607, Greenacres, Port Elizabeth 6057 Tel: +27 (0)41 3656846 / Fax: +27 (0)41 3652123 info@safetech.co.za / www.safetech.co.za Safetrain cc T/A Safetech Reg. No 1992/034818/23 VAT No. 4180135461 Directors: B Williams, C Williams



Approved Inspection Authority (OH0049-CI-09)



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#### 1. Introduction

Klipkraal Wind Facility 3 (Pty) Ltd proposes to develop the Klipkraal Wind Energy Facility 3 and Grid Connection located to the south of Fraserburg in the Northern Cape. The Wind Energy Facility (WEF) will be one of five, separate wind developments proposed by the developer. This report will only address the Klipkraal WEF 3. Safetech has been appointed to conduct the noise impact assessment.

The first stage in the assessment is to conduct a site sensitivity report as per the requirements of the Environmental Assessment Protocols of the NEMA EIA Regulations (2014, as amended), and the Protocol for the Specialist Assessment and Minimum Report Content Requirements for Noise Impacts (GG 43110 / GNR 320, 20 March 2020).

The grid connection will not require a full noise impact assessment. The noise from the construction of the grid connection will be addressed in the final EIA report.

The potential noise impacts from the construction and operation of the proposed development of the Klipkraal Wind Energy Facilities and Grid Connection will including the following:

- Construction equipment and vehicle noise
- · Mechanical and aerodynamic noise from the operation of the various wind turbine components.

The impacts of mechanical and aerodynamic noise are described in detail below.

#### 2. Description of Noise Impacts

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 and past the tower.

#### Mechanical Sounds

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

- Gearboxes
- Main electrical generator
- Yaw Drives
- Cooling Fans and
- Auxiliary Equipment (e.g. hydraulic pumps).

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 also 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.




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Figure 1 below shows the type of transmission path, and the sound power levels for the individual components for a wind turbine.

Figure 1: Typical Sound Power Levels of a Turbine (Moraleda 2019).

#### 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, especially the downward moving blade. A large number of complex flow phenomena occur, each of which might generate some sound (see Figure 2). Aerodynamic sound generally increases with rotor speed. The various aerodynamic sound generation mechanisms that must 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 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.





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Figure 2: Sources of Aerodynamic Noise (Wagner 1996).

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

#### Residual Sound & Wind Speed

The ability to hear a wind turbine depends on the residual sound level<sup>1</sup>. When the background sounds and wind turbine sounds are of the same magnitude, the wind turbine sound may get lost in the background noise. Both the wind turbine sound power level and the residual sound pressure level will be functions of wind speed. Thus, whether the sound emitted from a wind turbine exceeds the residual 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. Several 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 emitted from large modern wind turbines during constant speed operation tend to increase more slowly with increasing wind speed, than 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 sometimes masks the wind turbine sound above 8 m/s.

It should be remembered that average sound level 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 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 hub height of the turbine, a listener might find moments when the wind turbine could be heard over the residual sound.

<sup>&</sup>lt;sup>1</sup> In laymans terms this is the "ambient sound or background noise" although this is defined differrently in environmental noise legislation.





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#### Low Frequency Noise and Infrasound

Infrasound was a significant 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.

As depicted in Figure 3 below, 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 to be infrasound, even though there may be some human perception in that range. Because the ranges of low frequency sound and infrasound overlap it is important to understand how the terms are applied in a given context.





Infrasound is always present in the environment and stems from many sources including residual air turbulence from wind, 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 changes on their ears, from top to bottom of the swing, is nearly 120 dB(A) 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 3 above)





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- Tonality cannot be perceived below around 18 Hz and
- 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; and
- 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 and
- 120 130 dB and above: Exposure for 24 hours causes physiological damage.

The typical range of sound power level for wind turbine generators is in the range of 100 to 105 dB(A) – a much lower sound power level (10 dB or more) than the majority of construction machinery such as bulldozers. For infrasound to be audible even to a person with the most sensitive hearing at a distance of 300 m would require a sound power level of at least 140 dB at 10 Hz 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.

## 3. Possible Mitigation Measures of Potential Noise Impacts

To mitigate the potential noise impacts of the proposed development, the following measures will be considered if needed:

- Construction Phase:
  - Conduct Noise Sensitivity Training for all construction staff where construction takes place close to sensitive receptors.
  - No construction should occur during night-time hours (22:00-06:00).
  - If possible, piling activities should occur during the hottest part of the day to take advantage of the unstable atmospheric conditions.
  - Residual Noise Monitoring should be conducted during the construction phase at sensitive NSAs.
- Operational Phase:
  - Wind Turbine Generators (WTGs) should not be placed within 500m of any occupied Noise Sensitive Area (NSA).
  - If the night-time noise rating limit for rural areas (35dB(A)) is exceeded, the WTGs could be operated in a lower power mode at certain wind speeds or be relocated further away from an NSA.

The potential noise mitigation measures will be determined during the final modelling and noise impact assessment phase.





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# 4. Description of the Affected Environment

Figure 4 below shows the regional context, including the four other wind energy developments bordering the proposed development. A total of 23 Noise Sensitive Areas (NSAs) were identified. The site verification process determined that most NSAs are not permanently occupied. Furthermore, some NSAs are kraals for livestock and abandoned buildings.



Figure 4: Klipkraal Regional Context

The noise emissions could have an impact on the residents at the NSA's. Figure 5 below shows the NSA's that are most likely to be impacted by Klipkraal WEF 3, due to their distance to the closest turbine. These distances are shown in Annexure B.





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Figure 5: Klipkraal WEF 3 Local Context

Three noise measurements were conducted. The locations of the monitoring points (MP) are shown in Figure 5.

# 5. Field Study

The field study validated the classification of the study area as a rural district. Table 1 below shows the SANS 10103:2008 guidelines for day and night noise limits. National and provincial standards classify noise levels exceeding 7dB(A) above the ambient noise levels as a disturbing noise.

Table 1: Noise limits for rural districts

|                  |           | Equivalent Continuous Rating Level, LReq.T for Noise |            |                                    |         |            |  |  |  |
|------------------|-----------|--|------------|------------------------------------|---------|------------|--|--|--|
| Type of District | (         | Dutdoors (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         |  |  |  |

The field study was conducted from the 18<sup>th</sup> of September 2021 to the 24<sup>th</sup> of September 2021 in accordance with SANS 10103:2008. The guidelines to determine the ambient noise levels of the area are described in the methodology below:

A long-term measurement was taken by placing a noise meter on a tripod and ensuring that it was placed at least 1.2 m from floor level and 3.5 m from any large flat reflecting surface. The 36-hour measurement time encompassed one "day" period (06:00-22:00) and two "night" periods (22:00-06:00). The noise meter was calibrated before and after the survey. At no time was the difference more than one decibel (dB) (Note: If the difference between measurements at the same point under the same conditions is more than 1 dB, then this is an indication that the noise meter is not properly calibrated). The weighting used was on the A scale and the meter was placed on "fast", which is the preferred





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method as per SANS 10103:2008, the measurement and rating of environmental noise. The meter was fitted with a windscreen, which is supplied by the manufacturer. The windscreen is designed to reduce wind noise around the microphone and not bias the measurements.

The results of the baseline residual noise monitoring for the three monitoring points are illustrated in Figures 6 to 11 below. The noise profiles during the time of the monitoring were typical of the rural landscape. Noise sources included birds chirping, occasional cars passing by wind and rustling of leaves from surrounding vegetation.

The details of the equipment used are as follows, the calibration certificates can be found in Annexure A:

- Rion NL-62 and UC-59L Integrating Sound Level Meter with built-in ½-Octave Filter and ½" Microphone with NC-74 Sound Calibrator: Type 1, Rion NL-62, NH-26, UC-59L Integrating Sound Level Meter with built-in ½-Octave Filter and ½" Microphone. Serial no.: 00420125; 01697; 00840. Calibrated by: M and N Acoustic Services cc on 06-20 July 2021 (calibration due July 2022 as per SANS 10083:2013). Certificate number: 2021-AS-0751. Calibration certificate attached in Annexure. Total uncertainty of measurements: Integrating Sound Level Meter: Refer to calibration certificate. ½" Microphone: ± 0.3 dB. Built-in ½-Octave Filter: ± 0.3 dB.
- Rion NC-74, NC-74-002 Sound Calibrator: Serial no.: 34425540. Calibrated by: M and N Acoustic Services cc on 07 July 2021 (calibration due July 2022). Certificate number: 2019-AS-0749. Calibration certificate attached in Annexure. Total uncertainty of measurements: Sound Calibrator: ± 0.19 dB



Figure 6: Monitoring Point 1 Residual Noise Levels vs Weather Conditions

Figure 7 below shows the frequency distribution of sound for MP 1 during the same time period.





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For MP 1 above, the  $L_{Aeq}$  value for the daytime period was 40.8 dB(A). The  $L_{Aeq}$  value for the night-time period was 30.3 dB(A).



Figure 8: Monitoring Point 2 Residual Noise Levels vs Weather Conditions

Figure 9 below shows the frequency distribution of sound for MP 2 during the same time period.







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For MP 2 above, the  $L_{Aeq}$  value for the daytime period was 37.0 dB(A). The  $L_{Aeq}$  value for the night-time period was 34.0 dB(A).



Figure 11 below shows the frequency distribution of sound for MP 3 during the same time period.



For MP 3 above, the  $L_{Aeq}$  value for the daytime period was 41.2 dB(A). The  $L_{Aeq}$  value for the night-time period was 28.8 dB(A).

The weather data for the monitoring period was supplied by the client. Two weather stations are located within the study area. Weather Station 2 wind speeds, recorded at 60m and 120m above ground level, were used as this station was closer to the monitoring points. The Coordinates of Weather Station 2 are: 32° 5' 29.40" S; 21° 47' 49.70" E.





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## 6. Cumulative Study

As per the Screening Report, no other Wind Energy Facilities or Solar Farms are located within 30km of the proposed development. The cumulative impacts will not need to be assessed.

The cumulative impacts study will therefore only consider the other four Klipkraal Wind Energy Facilities, as shown in Figure 4.

# 7. Grid Connection

From a noise perspective, no impacts are anticipated from the operation of the grid connection infrastructure. Therefore, a separate noise impact assessment will not be required. The noise impacts arising from the construction of the grid connection will be assessed as part of the construction of the Wind Energy Facilities (internal roads and turbines).

# 8. Screening Tool

Figure 12 below shows the noise themed sensitivities shown in the screening tool.



Figure 12: Noise Themed Sensitivities

The site visit confirmed the location of the Noise Sensitive Areas in Figure 12. Additional NSA's were also identified.





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# 9. Legal Requirements

As part of the noise impact assessment, relevant noise related legislation and standards will be identified. Where applicable the following standards will also be consulted:

- 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).
- South Africa GNR. 320 of 20 March 2020: Procedures for the Assessment and Minimum Criteria for Reporting on identified Environmental Themes under Sections 24(5)(a) and (h) of the National Environmental Management Act, 1998 (Act no. 107 of 1998).
- SANS 10103:2008 Version 6 The measurement and rating of environmental noise with respect to annoyance and to speech communication.
- SANS 10357:2004 Version 2.1 The calculation of sound propagation by the Concawe method.
- International Finance Corporation 2007 General EHS Guidelines: Environmental Noise.

#### 10. Conclusion

The following is concluded and verified:

- The project site is situated in a rural district.
- The project could impact on several noise sensitive areas.
- It is recommended that a 500m buffer be placed around all noise sensitive receptors for planning purposes. The WTG layout for Klipkraal WEF 3 should adhere to this recommendation.

The proposed mitigations measures of the potential noise impacts have been described in Section 3.

It is recommended that a full noise impact assessment, that includes emission modelling be conducted. A comprehensive report will be provided that will include noise mitigation measures to be included in the environmental management plan as well as predicted noise levels during the construction and operation phase.

Dr Brett Williams





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| Calibration Laboratory   | M AND N ACOUSTIC SERVICES (Pty) I<br>or me w. part transfor ver No. 430025870 BEE Status: Le<br>P.D. Bys 61713, Pierre ven Pyneveld, 0045  |  |  |
|--|--|--|--|
| 148<br>1302  | No. 15, Muzhard Avenue<br>Pierre van Rynolwas 2045   |  |  |
|  | Tel: 012 683-2007 (076 750 0070) + Fax: 088 821 4690<br>E-mail: admin@mnacoustics.co.au<br>Wabsite: www.mnacoustics.co.za  |  |  |
| CERTIFICATE  | OF CALIBRATION   |  |  |
| CERTIFICATE NUMBER   | 2021-AS-0751   |  |  |
| ORGANISATION   | RUBICEPT (PTY) LTD   |  |  |
| ORGANISATION ADRESS  | 14 ROSE STREET, GQEBERHA   |  |  |
| CALIBRATION OF   | INTEGRATING SOUND LEVEL METER complete with built<br>in %- OCTAVE/OCTAVE FILTER, %" PRE-AMPLIFIER and<br>%" MICROPHONE   |  |  |
| MANUFACTURERS  | RION   |  |  |
| MODEL NUMBERS  | NL-62, NH-26 and UC-59L  |  |  |
| SERIAL NUMBERS   | 00420125, 01697 and 00840  |  |  |
| DATE OF CALIBRATION  | 06-20 JULY 2021  |  |  |
| RECOMMENDED DUE DATE   | JULY 2022  |  |  |
| PAGE NUMBER  | PAGE 1 OF 6  |  |  |
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| This certificate is issued in acco<br>African National Accreditation<br>without the written approval of S.<br>The measurement results record<br>The subsequent accuracy will de<br>the number of different users. It is<br>interval, which will ensure that<br>manufacturer's specifications.<br>The South African National Acc<br>Laboratory Accreditation Cooper<br>arrangement allows for mutual r<br>accreditation bodies worldwide.<br>were idee or | reactee with the conditions of approval granted by the South<br>System (SANAS). This Certificate may not be reproduced<br>ANAS and M and N Acoustic Services.<br>ed in this certificate were correct at the time of calibration.<br>pend on factors such as care, handling, frequency of use and<br>s recommended that re-calibration should be performed at an<br>t the instrument remains within the desired limits and/or<br>creditation System (SANAS) is member of the International<br>ration (ILAC) Mutual Recognition Arrangement (MRA). This<br>ecognition of technical test and calibration data by member<br>For more information on the arrangement please consult |  |  |
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| Report          | Page - Of - Pages |    | Amendments                 | Field Survey Date     |
|-----------------|-------------------|----|----------------------------|-----------------------|
| Klipkraal WEF 3 | 85                | 85 | Version 1 as on 02/12/2022 | 18/09/2021-24/09/2021 |

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# ANNEXURE B - Closest Distance from Proposed WTGs to Noise Sensitive Areas

| Name   | Closest WTG Distance<br>(m) |  |  |
|--------|-----------------------------|--|--|
| NSA 3  | 1 896                       |  |  |
| NSA 4  | 2 878                       |  |  |
| NSA 5  | 3 048                       |  |  |
| NSA 2  | 3 559                       |  |  |
| NSA 20 | 4 957                       |  |  |
| NSA 10 | 5 477                       |  |  |
| NSA 19 | 5 492                       |  |  |
| NSA 9  | 6 016                       |  |  |
| NSA 8  | 7 067                       |  |  |
| NSA 21 | 7 195                       |  |  |
| NSA 11 | 7 569                       |  |  |
| NSA 12 | 7 806                       |  |  |
| NSA 1  | 8 385                       |  |  |
| NSA 23 | 8 576                       |  |  |
| NSA 7  | 8 914                       |  |  |
| NSA 6  | 9 266                       |  |  |
| NSA 22 | 11 143                      |  |  |
| NSA 13 | 14 093                      |  |  |
| NSA 16 | 14 373                      |  |  |
| NSA 18 | 15 506                      |  |  |
| NSA 17 | 15 785                      |  |  |
| NSA 14 | 16 870                      |  |  |
| NSA 15 | 18 442                      |  |  |



