

1st August 2018

Mr. S. Taylor
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Dear Mr Taylor

RE-MODELLING OF NOISE IMPACT ASSESSMENT – WITBERG WIND ENERGY PROJECT

As per our recent correspondence, please find attached the re-modelling report for the Witberg Wind Energy Project near Laingsburg in the Western Cape Province.

This report is to be viewed as an addendum to the main Noise Impact Report that was issued by Jongens Keet Associates (March 2011). The methodologies used to conduct the modelling, identification of noise sensitive areas and the project description is described in the main report and is not repeated here.

The purpose of this report is to determine if the 25 turbine project layout with proposed amended turbine layout and specifications will comply with the noise emission limits as contained in the Department of Environmental Affairs - Environmental Authorisation (12/12/20/1966) issued in 2011. The wind turbine specifications as authorised, are proposed to be amended, however. The proposed amendments include the following:

- Increase in output capacity per wind turbine between 3MW and up to 5MW;
- Increase in the hub height from 92m to a range between 92m up to 120m; and
- Increase in rotor diameter from 116m to, a range between 116m up to 136m.

This has necessitated a remodelling of the layout. The results of the modelling are presented below.

Yours sincerely



Dr Brett Williams



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DoL Approved Inspection
Authority (OH0049-CI-
09)

1. Introduction

Witberg Wind Farm (Pty) Ltd proposes to construct a Wind Energy Facility (WEF) with an installed capacity of up to 120 Megawatts (MW) on several farms situated in the Western Cape Provinces. The WEF will host up to 25 turbines, each with a capacity of between 3MW and 5MW.

2. Approach and Methodology

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

- A desktop study to model the likely noise emissions from the site;
- The identification of potential noise sensitive areas.

The desktop study was done 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 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 Concauwe 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.

The noise emissions were modelled for various wind speeds from 3 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 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 1:50 000 topographical map. The comparison showed that the digital data and the map corresponded well. Furthermore, the digital data provided a better resolution.

3. Field Study

A field study was not undertaken as this was conducted in 2011 by Jongens Keet. This data was available to the author.

4. Assumptions 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 i.e. wind from any direction, not only the prevailing wind, maximum turbine size as required for the site and the worst-case meteorological conditions.
- No wind noise masking effect is 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 enter into construction. Although this is very unlikely, the assumption was made in order to assess the worst case scenario.
- The results are limited to the layout data that was supplied by the developer.

The above assumptions and limitations do not differ from the original noise impact assessment study.

5. Description of the Affected Environment

The proposed Witberg WEF is to be constructed on farmland. The topography surrounding the site is characterised by steep hills, mountains and valleys.

Site Location

The location and position of the various wind turbines are contained in the Table 1 and Figure 1 and 2 below.

Table 1 - Wind Turbine Location Co-ordinates for the proposed Witberg WEF

WTG Number	Longitude	Latitude
1	20°28'23.16"E	33°17'4.97"S
2	20°28'9.84"E	33°17'7.88"S
3	20°28'8.82"E	33°16'59.07"S
4	20°27'58.98"E	33°17'9.71"S
5	20°27'48.42"E	33°17'11.90"S
6	20°27'29.38"E	33°17'22.74"S
7	20°27'28.41"E	33°16'59.33"S
8	20°27'16.41"E	33°17'24.43"S
9	20°27'14.18"E	33°17'0.46"S
11	20°27'2.33"E	33°17'21.48"S
12	20°26'59.96"E	33°17'0.88"S
13	20°26'51.87"E	33°17'30.93"S
14	20°26'49.54"E	33°17'21.87"S
15	20°26'44.72"E	33°17'59.29"S
16	20°26'39.57"E	33°17'31.76"S
17	20°26'31.76"E	33°18'0.94"S
19	20°26'18.51"E	33°17'58.18"S
20	20°26'15.98"E	33°17'45.06"S
21	20°26'5.34"E	33°17'55.46"S
22	20°25'51.44"E	33°17'57.28"S
23	20°25'38.42"E	33°17'59.93"S
24	20°22'22.34"E	33°17'49.96"S
25	20°21'59.66"E	33°17'54.29"S
26	20°21'45.50"E	33°17'54.78"S
27	20°21'31.88"E	33°17'54.92"S

WTG Numbers 10 and 18 were removed from the project.

The positions of the turbines and noise sensitive areas are shown in Figure 1 below.

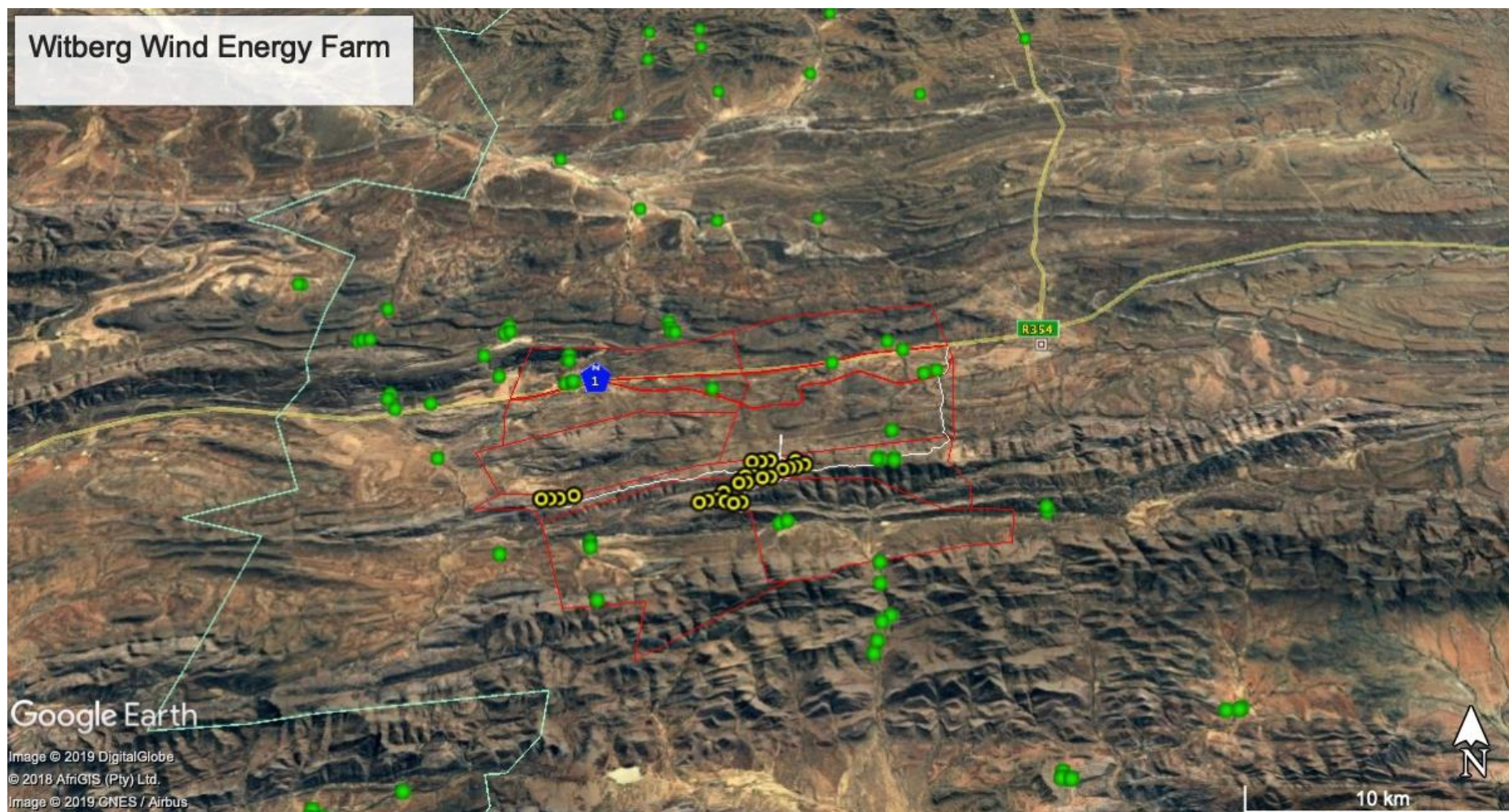
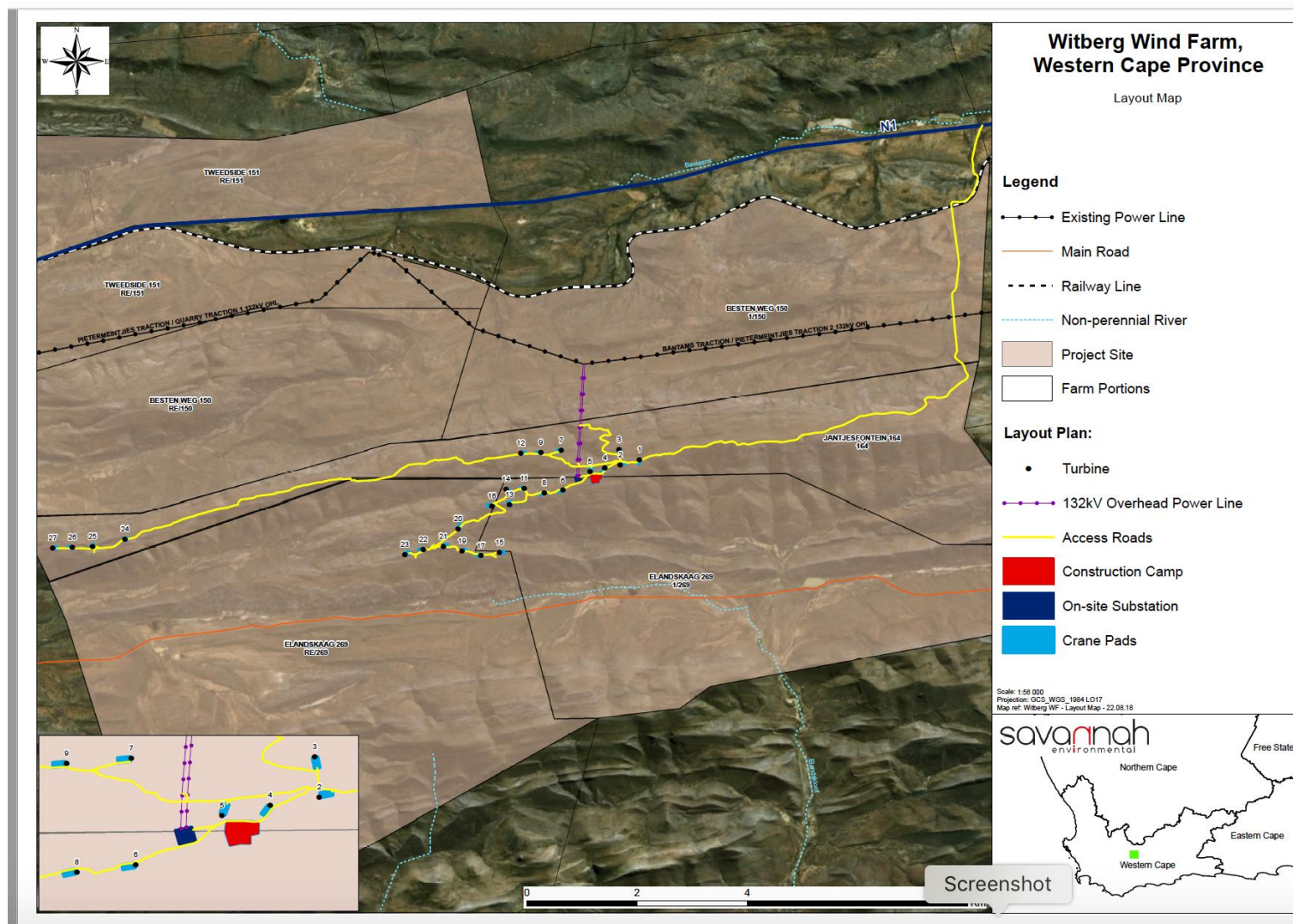


Figure 1 - The proposed positions of the wind turbines and Noise Sensitive Areas
Wind turbines (yellow dots) and Noise Sensitive Areas (green dots).



The potential sensitive receptors are discussed below. The main noise sensitive receptors that could be affected by noise pollution are humans, terrestrial fauna and avifauna.

The site is situated in a farming community. Several homesteads are located on the properties where the turbines will be erected as well as on neighboring farms. The sensitive noise receptors (homesteads) have been recorded in Table 2 below.

Table 2 - Noise Sensitive Areas in relation to the proposed Witberg WEF

Description	East	South	Within Project Boundary	Type
NSA 1	20°32'52.95"	32°59'17.09"	No	Dwelling
NSA 2	20°33'46.32"	32°59'14.37"	No	Dwelling
NSA 3	20°32'50.35"	32°57'02.29"	No	Dwelling
NSA 4	20°35'33.02"	33°04'25.19"	No	Dwelling
NSA 5	20°32'05.41"	33°06'21.26"	No	Dwelling
NSA 6	20°28'42.37"	33°05'39.22"	No	Dwelling
NSA 7	20°25'16.20"	33°04'42.77"	No	Dwelling
NSA 8	20°25'12.34"	33°04'05.64"	No	Dwelling
NSA 9	20°27'42.38"	33°02'14.52"	No	Dwelling
NSA 10	20°29'22.70"	33°03'29.97"	No	Dwelling
NSA 11	20°25'51.25"	33°06'16.52"	No	Dwelling
NSA 12	20°30'17.98"	32°57'10.36"	No	Dwelling
NSA 13	20°26'46.16"	33°00'14.09"	No	Dwelling
NSA 14	20°21'25.27"	32°57'21.97"	No	Dwelling
NSA 15	20°22'07.75"	32°58'30.41"	No	Dwelling
NSA 16	20°27'23.33"	32°52'42.15"	No	Dwelling
NSA 17	20°19'04.30"	33°00'15.86"	No	Dwelling
NSA 18	20°28'03.61"	32°49'35.63"	No	Dwelling
NSA 19	20°16'15.80"	32°57'29.91"	No	Dwelling
NSA 20	20°25'54.64"	33°10'25.14"	No	Dwelling
NSA 21	20°19'48.45"	32°53'44.67"	No	Dwelling
NSA 22	20°28'51.50"	33°10'20.42"	No	Dwelling
NSA 23	20°22'49.16"	33°07'02.69"	No	Dwelling
NSA 24	20°33'09.67"	32°54'52.62"	No	Dwelling
NSA 25	20°23'36.35"	33°04'12.21"	No	Dwelling
NSA 26	20°23'36.68"	33°05'09.54"	No	Dwelling
NSA 27	20°21'09.93"	33°08'30.26"	No	Dwelling
NSA 28	20°36'03.35"	32°58'22.39"	No	Dwelling

Description	East	South	Within Project Boundary	Type
NSA 29	20°23'38.50"	33°10'03.51"	No	Dwelling
NSA 30	20°24'54.14"	32°52'02.62"	No	Dwelling
NSA 31	20°32'07.95"	32°49'19.83"	No	Dwelling
NSA 32	20°28'41.48"	32°45'52.81"	No	Dwelling
NSA 33	20°21'48.77"	32°45'14.37"	No	Dwelling
NSA 34	20°21'55.77"	33°14'22.80"	No	Dwelling
NSA 35	20°21'54.96"	33°14'13.17"	Yes	Dwelling
NSA 36	20°21'53.27"	33°14'21.97"	Yes	Dwelling
NSA 37	20°22'05.21"	33°14'54.95"	Yes	Dwelling
NSA 38	20°22'07.88"	33°14'57.39"	Yes	Dwelling
NSA 39	20°22'03.70"	33°14'58.84"	Yes	Dwelling
NSA 40	20°22'52.26"	33°18'59.87"	Yes	Dwelling
NSA 41	20°22'51.42"	33°18'57.20"	Yes	Dwelling
NSA 42	20°22'51.21"	33°18'52.03"	Yes	Dwelling
NSA 43	20°20'34.15"	33°19'09.45"	No	Dwelling
NSA 44	20°18'39.92"	33°16'52.91"	No	Dwelling
NSA 45	20°23'07.81"	33°20'11.41"	Yes	Dwelling
NSA 46	20°17'05.46"	33°24'37.04"	No	Dwelling
NSA 47	20°16'55.17"	33°24'38.30"	No	Dwelling
NSA 48	20°16'50.26"	33°24'27.63"	No	Dwelling
NSA 49	20°16'47.86"	33°24'36.69"	No	Dwelling
NSA 50	20°18'53.00"	33°24'06.83"	No	Dwelling
NSA 51	20°28'43.33"	33°24'43.75"	No	Dwelling
NSA 52	20°28'41.91"	33°24'46.19"	No	Dwelling
NSA 53	20°30'23.63"	33°24'42.99"	No	Dwelling
NSA 54	20°34'30.42"	33°23'51.50"	No	Dwelling
NSA 55	20°34'22.09"	33°23'50.41"	No	Dwelling
NSA 56	20°34'19.63"	33°23'49.13"	No	Dwelling
NSA 57	20°34'19.55"	33°23'43.04"	No	Dwelling
NSA 58	20°34'16.84"	33°23'50.61"	No	Dwelling
NSA 59	20°38'23.94"	33°22'29.47"	No	Dwelling
NSA 60	20°38'43.01"	33°22'28.48"	No	Dwelling
NSA 61	20°38'46.68"	33°22'26.64"	No	Dwelling
NSA 62	20°34'36.70"	33°18'02.42"	No	Dwelling
NSA 63	20°34'37.48"	33°18'09.41"	No	Dwelling
NSA 64	20°30'13.98"	33°19'19.98"	No	Dwelling
NSA 65	20°30'13.26"	33°19'48.70"	No	Dwelling
NSA 66	20°30'26.76"	33°20'31.43"	No	Dwelling
NSA 67	20°30'13.33"	33°20'39.17"	No	Dwelling

Description	East	South	Within Project Boundary	Type
NSA 68	20°30'05.66"	33°21'03.67"	No	Dwelling
NSA 69	20°29'59.70"	33°21'20.04"	No	Dwelling
NSA 70	20°27'54.06"	33°18'23.33"	Yes	Dwelling
NSA 71	20°27'41.72"	33°18'26.90"	Yes	Dwelling
NSA 72	20°30'42.16"	33°16'10.92"	Yes	Dwelling
NSA 73	20°25'53.21"	33°15'07.23"	Yes	Dwelling
NSA 74	20°30'23.17"	33°16'54.02"	Yes	Dwelling
NSA 75	20°30'19.23"	33°16'51.54"	Yes	Dwelling
NSA 76	20°30'16.66"	33°16'54.07"	Yes	Dwelling
NSA 77	20°30'43.48"	33°16'55.41"	Yes	Dwelling
NSA 78	20°30'44.24"	33°16'52.59"	Yes	Dwelling
NSA 79	20°32'00.43"	33°14'37.85"	Yes	Dwelling
NSA 80	20°31'39.47"	33°14'42.26"	Yes	Dwelling
NSA 81	20°31'06.82"	33°14'04.72"	Yes	Dwelling
NSA 82	20°30'42.09"	33°13'51.76"	Yes	Dwelling
NSA 83	20°29'09.33"	33°14'26.02"	Yes	Dwelling
NSA 84	20°21'52.66"	33°14'59.27"	Yes	Dwelling
NSA 85	20°18'17.04"	33°15'30.14"	No	Dwelling
NSA 86	20°17'05.84"	33°15'22.64"	No	Dwelling
NSA 87	20°17'20.37"	33°15'38.44"	No	Dwelling
NSA 88	20°17'09.02"	33°15'15.26"	No	Dwelling
NSA 89	20°19'34.32"	33°14'14.77"	No	Dwelling
NSA 90	20°16'20.60"	33°13'47.59"	No	Dwelling
NSA 91	20°16'09.05"	33°13'48.26"	No	Dwelling
NSA 92	20°16'01.45"	33°13'50.90"	No	Dwelling
NSA 93	20°16'42.49"	33°12'58.05"	No	Dwelling
NSA 94	20°20'03.20"	33°14'47.84"	No	Dwelling
NSA 95	20°20'13.24"	33°13'35.60"	No	Dwelling
NSA 96	20°20'03.86"	33°13'38.81"	No	Dwelling
NSA 97	20°20'06.13"	33°13'40.99"	No	Dwelling
NSA 98	20°20'10.81"	33°13'26.18"	No	Dwelling
NSA 99	20°14'02.56"	33°12'15.00"	No	Dwelling
NSA 100	20°14'08.63"	33°12'15.80"	No	Dwelling
NSA 101	20°24'48.60"	33°13'36.92"	No	Dwelling
NSA 102	20°24'42.12"	33°13'36.18"	No	Dwelling
NSA 103	20°24'39.49"	33°13'29.96"	No	Dwelling
NSA 104	20°24'37.29"	33°13'19.61"	No	Dwelling

6. Natural Environment Receptors

The vegetation around the site is characterised by typical Karoo vegetation. The fauna includes bats, birds, commercial livestock, smaller mammals, reptiles and a variety of buck.

7. Ambient Noise at Proposed Site

The general ambient noise at each location varies as the ambient sound is influenced by human activities, vehicles, wind noise and animal sounds.

8. Wind Turbine Generators (WTG)

The wind turbine generator that was modelled is described in Table 3 below. This turbine was chosen to closely represent the proposed amended turbine specifications for a wind turbine up to 5 MW and up to 120m hub height. This model of turbine was chosen as it has published noise data in the WindPro catalogue of wind turbines. Furthermore, the noise data has been tested according to the methods described in IEC 61400-11 and are thus traceable. The modelled hub height (125m) is slightly higher than the hub height amendment proposed by the developer (120m), however for the purpose of the assessment, considered comparable as a slightly higher hub height, would reduce the noise impacts.

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 3 - Proposed Turbine Specifications

Manufacturer	Nordex
Type / Version	N149/4.0-4.5
Rated Power	4.5 MW
Rotor Diameter	149m
Tower	Tubular
Grid Connection	50 Hz
Maximum Sound Power Level	108.1 dB
Hub Height	125m

Sound Power Level dB(A) reference to 1pW from WindPro 3.2 Catalogue

*The specifications of this turbine model were used as the data is available in WindPro. This does not bind the applicant to this specific model, and any turbine model with similar turbine specifications. An equal or lower maximum sound power level would be acceptable for the site.

The sound power levels at lower and higher wind speeds as stated above were interpolated from the published data. The actual sound power levels may thus be less than those stated when the final turbine is selected. The levels used in the re-modelling are thus a worst-case scenario.

9. Cumulative Impacts

The proposed windfarm is located adjacent to several other windfarms. The details are as follows:

- Rietkloof – 60 wind turbines
- Karreebosch – 65 wind turbines
- Brandvalley – 58 wind turbines
- Esizayo – 55 wind turbines
- Roggeveld – 47 wind turbines
- Soetwater – 43 wind turbines
- Karusa – 43 wind turbines

The locations of these turbines are recorded in Annexure A. The turbine positions that are recorded in Annexure A, are purely as a record of what informed the cumulative noise modelling assessment. The same turbine data (as described in Table 2) was used to model the cumulative impacts from all the adjacent windfarms. This is thus a worst-case scenario, as it is unlikely that all 398 turbines will be operational simultaneously and if all the sites obtain the required regulatory approval. The above information informed the cumulative assessment to ensure the objectivity thereof.

10. Modelling Results

The masking effect of the wind noise will mitigate the noise impact. The results are based on NO wind noise masking, which in reality rarely occurs when the turbines are operational. The maximum noise rating limit (24 hour day/night) for rural areas in SANS 10103:2008 is 45 dB(A). The noise impacts were modelled in WindPro Version 3.2.669 using the above data. The results area as follows:

Table 4 - Modelling Results

SANS 10103:2008 Limit = 45dB(A)

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
NSA 1	2	0.0	20.9
	4	0.0	23.7
	6	0.0	33.1
	8	0.0	34.4
	10	0.0	34.4
	12	0.0	34.4
NSA 2	2	0.0	21.2
	4	0.0	24.0
	6	0.0	33.4
	8	0.0	34.7
	10	0.0	34.7
	12	0.0	34.7
NSA 3	2	0.0	23.5
	4	0.0	26.3
	6	0.0	35.7
	8	0.0	37.0
	10	0.0	37.0
	12	0.0	37.0
NSA 4	2	0.0	11.2
	4	0.0	14.0
	6	0.0	23.4
	8	0.0	24.6
	10	0.0	24.6
	12	0.0	24.6
NSA 5	2	0.0	14.5
	4	0.0	17.3
	6	0.0	26.7
	8	0.0	27.9
	10	0.0	27.9
	12	0.0	27.9
NSA 6	2	0.0	20.6
	4	0.0	23.4
	6	0.0	32.8

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	8	0.0	34.0
	10	0.0	34.0
	12	0.0	34.0
NSA 7	2	0.0	20.1
	4	0.0	22.9
	6	0.0	32.3
	8	0.0	33.6
	10	0.0	33.6
	12	0.0	33.6
NSA 8	2	0.0	20.5
	4	0.0	23.3
	6	0.0	32.7
	8	0.0	33.9
	10	0.0	33.9
	12	0.0	33.9
NSA 9	2	0.0	21.8
	4	0.0	24.6
	6	0.0	34.0
	8	0.0	35.3
	10	0.0	35.3
	12	0.0	35.3
NSA 10	2	0.0	22.0
	4	0.0	24.8
	6	0.0	34.2
	8	0.0	35.5
	10	0.0	35.5
	12	0.0	35.5
NSA 11	2	0.0	15.2
	4	0.0	18.0
	6	0.0	27.4
	8	0.0	28.7
	10	0.0	28.7
	12	0.0	28.7
NSA 12	2	0.0	28.1
	4	0.0	30.9
	6	0.0	40.3
	8	0.0	41.6

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	10	0.0	41.6
	12	0.0	41.6
NSA 13	2	0.0	22.9
	4	0.0	25.7
	6	0.0	35.1
	8	0.0	36.4
	10	0.0	36.4
	12	0.0	36.4
NSA 14	2	0.0	13.5
	4	0.0	16.3
	6	0.0	25.7
	8	0.0	26.7
	10	0.0	26.7
	12	0.0	26.7
NSA 15	2	0.0	16.5
	4	0.0	19.3
	6	0.0	28.7
	8	0.0	30.0
	10	0.0	30.0
	12	0.0	30.0
NSA 16	2	0.0	23.4
	4	0.0	26.2
	6	0.0	35.6
	8	0.0	36.9
	10	0.0	36.9
	12	0.0	36.9
NSA 17	2	0.0	2.4
	4	0.0	5.2
	6	0.0	14.6
	8	0.0	15.7
	10	0.0	15.7
	12	0.0	15.7
NSA 18	2	0.0	30.1
	4	0.0	32.9
	6	0.0	42.3
	8	0.0	43.6
	10	0.0	43.6

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	12	0.0	43.6
NSA 19	2	0.0	10.2
	4	0.0	13.0
	6	0.0	22.3
	8	0.0	23.0
	10	0.0	23.0
	12	0.0	23.0
NSA 20	2	0.0	0.0
	4	0.0	0.0
	6	0.9	5.4
	8	2.2	6.5
	10	2.2	6.5
	12	2.2	6.5
NSA 21	2	0.0	20.9
	4	0.0	23.7
	6	0.0	33.1
	8	0.0	33.8
	10	0.0	33.8
	12	0.0	33.8
NSA 22	2	0.0	0.0
	4	0.0	0.0
	6	0.8	7.1
	8	2.1	8.3
	10	2.1	8.3
	12	2.1	8.3
NSA 23	2	0.0	0.2
	4	0.0	3.0
	6	0.0	12.4
	8	0.0	13.7
	10	0.0	13.7
	12	0.0	13.7
NSA 24	2	0.0	19.7
	4	0.0	22.5
	6	0.0	31.9
	8	0.0	33.1
	10	0.0	33.1
	12	0.0	33.1

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
NSA 25	2	0.0	10.4
	4	0.0	13.2
	6	0.0	22.6
	8	0.0	23.9
	10	0.0	23.9
	12	0.0	23.9
NSA 26	2	0.0	8.4
	4	0.0	11.2
	6	0.0	20.6
	8	0.0	21.9
	10	0.0	21.9
	12	0.0	21.9
NSA 27	2	0.0	0.0
	4	0.0	0.0
	6	0.0	2.0
	8	0.0	3.2
	10	0.0	3.2
	12	0.0	3.2
NSA 28	2	0.0	27.2
	4	0.0	30.0
	6	0.0	39.4
	8	0.0	40.7
	10	0.0	40.7
	12	0.0	40.7
NSA 29	2	0.0	0.0
	4	0.0	0.0
	6	0.0	3.7
	8	0.0	4.8
	10	0.0	4.8
	12	0.0	4.8
NSA 30	2	0.0	22.2
	4	0.0	25.0
	6	0.0	34.4
	8	0.0	35.6
	10	0.0	35.6
	12	0.0	35.6
NSA 31	2	0.0	24.5

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	4	0.0	27.3
	6	0.0	36.7
	8	0.0	38.0
	10	0.0	38.0
	12	0.0	38.0
NSA 32	2	0.0	17.3
	4	0.0	20.1
	6	0.0	29.5
	8	0.0	30.8
	10	0.0	30.8
	12	0.0	30.8
NSA 33	2	0.0	0.0
	4	0.0	0.5
	6	0.0	9.9
	8	0.0	10.8
	10	0.0	10.8
	12	0.0	10.8
NSA 34	2	1.6	1.7
	4	4.4	4.5
	6	13.8	13.9
	8	15.1	14.6
	10	15.1	14.6
	12	15.1	14.6
NSA 35	2	0.8	1.0
	4	3.6	3.8
	6	13.0	13.2
	8	14.3	13.9
	10	14.3	13.9
	12	14.3	13.9
NSA 36	2	1.5	1.6
	4	4.3	4.4
	6	13.7	13.8
	8	15.0	14.5
	10	15.0	14.5
	12	15.0	14.5
NSA 37	2	4.2	4.3
	4	7.0	7.1

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	6	16.4	16.5
	8	17.7	17.2
	10	17.7	17.2
	12	17.7	17.2
NSA 38	2	4.5	4.6
	4	7.3	7.4
	6	16.7	16.8
	8	17.9	17.5
	10	17.9	17.5
	12	17.9	17.5
NSA 39	2	4.5	4.6
	4	7.3	7.4
	6	16.7	16.8
	8	18.0	17.5
	10	18.0	17.5
	12	18.0	17.5
NSA 40	2	17.0	17.1
	4	19.8	19.9
	6	29.2	29.3
	8	30.4	30.0
	10	30.4	30.0
	12	30.4	30.0
NSA 41	2	17.4	17.5
	4	20.2	20.3
	6	29.6	29.7
	8	30.8	30.3
	10	30.8	30.3
	12	30.8	30.3
NSA 42	2	18.1	18.2
	4	20.9	21.0
	6	30.3	30.4
	8	31.6	31.1
	10	31.6	31.1
	12	31.6	31.1
NSA 43	2	13.6	13.6
	4	16.4	16.4
	6	25.8	25.8

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	8	27.1	26.5
	10	27.1	26.5
	12	27.1	26.5
NSA 44	2	4.3	4.3
	4	7.1	7.1
	6	16.5	16.5
	8	17.7	17.2
	10	17.7	17.2
	12	17.7	17.2
NSA 45	2	7.7	8.0
	4	10.5	10.8
	6	19.9	20.2
	8	21.1	20.9
	10	21.1	20.9
	12	21.1	20.9
NSA 46	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 47	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 48	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 49	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	10	0.0	0.0
	12	0.0	0.0
NSA 50	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 51	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.3	0.0
	10	0.3	0.0
	12	0.3	0.0
NSA 52	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.2	0.0
	10	0.2	0.0
	12	0.2	0.0
NSA 53	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 54	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 55	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	12	0.0	0.0
NSA 56	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 57	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 58	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 59	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 60	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 61	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
NSA 62	2	0.0	0.0
	4	0.0	0.0
	6	6.3	4.7
	8	7.5	5.3
	10	7.5	5.3
	12	7.5	5.3
NSA 63	2	0.0	0.0
	4	0.0	0.0
	6	6.1	4.6
	8	7.4	5.3
	10	7.4	5.3
	12	7.4	5.3
NSA 64	2	10.1	9.1
	4	12.9	11.9
	6	22.3	21.3
	8	23.6	22.0
	10	23.6	22.0
	12	23.6	22.0
NSA 65	2	7.4	6.5
	4	10.2	9.3
	6	19.6	18.7
	8	20.8	19.4
	10	20.8	19.4
	12	20.8	19.4
NSA 66	2	3.7	2.8
	4	6.5	5.6
	6	15.9	15.0
	8	17.2	15.7
	10	17.2	15.7
	12	17.2	15.7
NSA 67	2	3.5	2.9
	4	6.3	5.7
	6	15.7	15.1
	8	17.0	15.8
	10	17.0	15.8
	12	17.0	15.8
NSA 68	2	2.0	1.5

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	4	4.8	4.3
	6	14.1	13.7
	8	15.4	14.4
	10	15.4	14.4
	12	15.4	14.4
NSA 69	2	0.9	0.5
	4	3.7	3.3
	6	13.1	12.7
	8	14.4	13.4
	10	14.4	13.4
	12	14.4	13.4
NSA 70	2	24.2	23.8
	4	27.0	26.6
	6	36.3	36.0
	8	37.6	36.7
	10	37.6	36.7
	12	37.6	36.7
NSA 71	2	24.5	24.5
	4	27.3	27.3
	6	36.7	36.7
	8	38.0	37.4
	10	38.0	37.4
	12	38.0	37.4
NSA 72	2	12.7	10.1
	4	15.5	12.9
	6	24.8	22.3
	8	26.1	22.9
	10	26.1	22.9
	12	26.1	22.9
NSA 73	2	13.7	13.7
	4	16.5	16.5
	6	25.9	25.9
	8	27.2	26.5
	10	27.2	26.5
	12	27.2	26.5
NSA 74	2	16.3	13.2
	4	19.1	16.0

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	6	28.5	25.4
	8	29.8	26.1
	10	29.8	26.1
	12	29.8	26.1
NSA 75	2	16.7	13.6
	4	19.5	16.4
	6	28.9	25.8
	8	30.2	26.5
	10	30.2	26.5
	12	30.2	26.5
NSA 76	2	18.2	14.9
	4	21.0	17.7
	6	30.4	27.1
	8	31.7	27.8
	10	31.7	27.8
	12	31.7	27.8
NSA 77	2	14.8	12.0
	4	17.6	14.8
	6	27.0	24.2
	8	28.3	24.9
	10	28.3	24.9
	12	28.3	24.9
NSA 78	2	14.5	11.8
	4	17.3	14.6
	6	26.7	24.0
	8	28.0	24.6
	10	28.0	24.6
	12	28.0	24.6
NSA 79	2	2.0	0.2
	4	4.8	3.0
	6	14.2	12.4
	8	15.4	13.0
	10	15.4	13.0
	12	15.4	13.0
NSA 80	2	3.5	1.7
	4	6.3	4.5
	6	15.7	13.9

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	8	17.0	14.6
	10	17.0	14.6
	12	17.0	14.6
NSA 81	2	2.8	1.3
	4	5.6	4.1
	6	15.0	13.5
	8	16.3	14.2
	10	16.3	14.2
	12	16.3	14.2
NSA 82	2	3.1	1.7
	4	5.9	4.5
	6	15.3	13.9
	8	16.6	14.6
	10	16.6	14.6
	12	16.6	14.6
NSA 83	2	9.8	8.7
	4	12.6	11.5
	6	22.0	20.9
	8	23.3	21.5
	10	23.3	21.5
	12	23.3	21.5
NSA 84	2	4.4	4.5
	4	7.2	7.3
	6	16.6	16.7
	8	17.8	17.4
	10	17.8	17.4
	12	17.8	17.4
NSA 85	2	0.0	0.0
	4	0.4	0.4
	6	9.8	9.8
	8	11.0	10.5
	10	11.0	10.5
	12	11.0	10.5
NSA 86	2	0.0	0.0
	4	0.0	0.0
	6	5.1	5.1
	8	6.4	5.8

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	10	6.4	5.8
	12	6.4	5.8
NSA 87	2	0.0	0.0
	4	0.0	0.0
	6	6.8	6.8
	8	8.0	7.5
	10	8.0	7.5
	12	8.0	7.5
NSA 88	2	0.0	0.0
	4	0.0	0.0
	6	4.9	4.9
	8	6.1	5.6
	10	6.1	5.6
	12	6.1	5.6
NSA 89	2	0.0	0.0
	4	0.0	0.0
	6	9.3	9.3
	8	10.5	10.0
	10	10.5	10.0
	12	10.5	10.0
NSA 90	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 91	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 92	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
	12	0.0	0.0
NSA 93	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 94	2	0.9	0.9
	4	3.7	3.7
	6	13.1	13.1
	8	14.4	13.8
	10	14.4	13.8
	12	14.4	13.8
NSA 95	2	0.0	0.0
	4	0.0	0.0
	6	7.0	7.1
	8	8.3	7.8
	10	8.3	7.8
	12	8.3	7.8
NSA 96	2	0.0	0.0
	4	0.0	0.0
	6	6.9	7.0
	8	8.2	7.7
	10	8.2	7.7
	12	8.2	7.7
NSA 97	2	0.0	0.0
	4	0.0	0.0
	6	7.2	7.3
	8	8.4	7.9
	10	8.4	7.9
	12	8.4	7.9
NSA 98	2	0.0	0.0
	4	0.0	0.0
	6	6.2	6.3
	8	7.5	7.0
	10	7.5	7.0
	12	7.5	7.0

Receiver	Wind speed [m/s]	Only Witberg WTG Operational [dB(A)]	Cumulative From All WTGs on 8 Windfarms [dB(A)]
NSA 99	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 100	2	0.0	0.0
	4	0.0	0.0
	6	0.0	0.0
	8	0.0	0.0
	10	0.0	0.0
	12	0.0	0.0
NSA 101	2	2.6	2.6
	4	5.4	5.4
	6	14.8	14.8
	8	16.1	15.5
	10	16.1	15.5
	12	16.1	15.5
NSA 102	2	2.4	2.4
	4	5.2	5.2
	6	14.6	14.6
	8	15.9	15.3
	10	15.9	15.3
	12	15.9	15.3
NSA 103	2	1.8	1.8
	4	4.6	4.6
	6	14.0	14.0
	8	15.3	14.7
	10	15.3	14.7
	12	15.3	14.7
NSA 104	2	0.9	0.9
	4	3.7	3.7
	6	13.1	13.1
	8	14.4	13.8
	10	14.4	13.8
	12	14.4	13.8

11. Discussion & Summary

The modelling results indicate that the SANS 10103:2008 day/night limit of 45 dB(A) will not be exceeded at any of the noise sensitive areas. The Witberg Wind Farm along with any of the alternatives currently proposed may therefore proceed and the proposed amendment is acceptable and can be authorised by the Competent Authority.

Cumulative Impacts

The cumulative impact modelling results indicate that the SANS 10103:2008 day/night limit of 45 dB(A) will not be exceeded at any of the noise sensitive areas. This includes the cumulative impacts from the other seven windfarms that were modelled. The cumulative impact is such that the Witberg Wind Farm along with any of the alternatives currently proposed may therefore proceed and the proposed amendment is acceptable and can be authorised by the Competent Authority.

Summary

It is highly likely that the wind noise will provide a masking effect. Furthermore, the modelling assumes the receiver is outdoors at all times.

If the final number of turbines is reduced or the layout changed such that no turbine is moved closer to a noise sensitive area, then remodelling will not be required, provided the final turbine choice sound power level is not greater than that that was used in this report (108.1 dBA).

12. Impact Statement

The overall environmental impact of the changes made to the project scope is rated as low and has not changed from the original noise impact assessment. No additional mitigation measures are required. In addition, there are no additional advantages or disadvantages in relation to the project impacts. The entire site as proposed may be developed with no constraints. The above statement is also applicable to the cumulative impact of other windfarms in the area.

13. Conclusion

The overall environmental noise impact significance remains low taking into account the changes to the turbine specifications and layout. The amended project description does not exceed the SANS 10103:2008 limit of 45 dB(A) at any of the noise sensitive receptors using the data that was modelled. It is my recommendation that based

on the results presented here, the granting of an Amended Environmental Authorisation with respect to the noise impacts is deemed acceptable and recommended.

Please feel free to contact us should you have any further requirements. Assuring you of our best attention at all times.

Yours sincerely



Dr Brett Williams

Annexure A – WTG Positions

Rietkloof			Brandvalley			Karreebosch		
Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]
20°26'24.18"	33°04'57.38"	1198	20°23'36.20"	33°01'11.11"	1322	20°30'33.18"	32°47'27.95"	938
20°26'47.81"	33°04'48.70"	1200	20°23'37.82"	33°00'58.26"	1321	20°30'30.35"	32°47'39.93"	970
20°26'44.27"	33°04'27.49"	1180	20°23'45.84"	33°00'47.17"	1289	20°30'25.50"	32°46'06.06"	970
20°27'13.28"	33°04'47.13"	1240	20°23'50.44"	32°58'20.63"	1190	20°30'37.28"	32°45'58.37"	940
20°27'23.56"	33°04'38.07"	1211	20°24'00.40"	32°59'35.37"	1280	20°30'37.67"	32°47'08.43"	930
20°27'42.27"	33°04'52.59"	1210	20°24'11.92"	33°01'09.07"	1309	20°30'16.42"	32°48'01.50"	1026
20°28'06.39"	33°04'55.28"	1182	20°24'25.27"	32°58'16.83"	1210	20°30'18.08"	32°46'16.71"	998
20°26'12.35"	33°03'50.84"	1203	20°24'24.81"	33°01'01.27"	1300	20°30'30.19"	32°49'30.59"	1120
20°26'23.02"	33°03'41.61"	1230	20°24'33.36"	32°57'59.95"	1308	20°29'33.58"	32°48'06.46"	1010
20°26'31.96"	33°03'31.15"	1216	20°24'33.87"	32°57'47.06"	1320	20°30'21.79"	32°47'49.92"	989
20°27'16.77"	33°03'36.50"	1180	20°24'35.10"	32°57'21.60"	1369	20°30'14.51"	32°46'29.04"	990
20°30'05.02"	33°05'08.34"	1205	20°24'37.58"	32°57'34.56"	1320	20°32'33.58"	32°50'59.29"	1058
20°30'29.33"	33°05'02.09"	1219	20°24'42.25"	32°57'10.20"	1345	20°30'42.55"	32°49'08.53"	1060
20°30'38.06"	33°04'37.14"	1211	20°24'57.51"	32°55'29.35"	1420	20°30'36.72"	32°49'19.68"	1110
20°30'43.65"	33°04'50.27"	1258	20°24'59.69"	32°55'51.45"	1378	20°29'34.59"	32°47'53.21"	1030
20°31'30.21"	33°04'31.37"	1228	20°25'19.74"	33°01'12.67"	1220	20°32'41.00"	32°50'08.37"	1076
20°31'27.45"	33°03'35.42"	1226	20°25'23.79"	32°55'32.32"	1400	20°30'39.56"	32°49'47.42"	1110
20°31'19.84"	33°03'19.55"	1250	20°25'33.17"	33°01'04.80"	1210	20°32'35.96"	32°50'46.60"	1062
20°31'30.90"	33°03'02.63"	1220	20°25'44.10"	32°59'03.38"	1280	20°30'44.22"	32°50'01.99"	1128
20°31'38.99"	33°02'51.75"	1240	20°26'03.36"	32°56'43.86"	1340	20°30'40.19"	32°50'14.05"	1110
20°31'50.02"	33°02'42.32"	1210	20°26'17.05"	32°56'23.90"	1390	20°29'21.94"	32°48'13.97"	983
20°31'45.25"	33°02'25.62"	1210	20°26'43.07"	32°55'44.03"	1405	20°30'28.72"	32°50'36.44"	1187
20°31'41.31"	33°02'13.06"	1238	20°26'46.09"	32°56'11.32"	1410	20°30'30.87"	32°50'50.87"	1147
20°31'53.12"	33°02'04.89"	1250	20°27'06.33"	32°55'54.69"	1416	20°30'18.28"	32°51'13.52"	1200
20°32'03.71"	33°01'55.61"	1260	20°27'24.88"	32°59'06.20"	1290	20°30'23.77"	32°51'02.14"	1176
20°32'17.02"	33°01'49.29"	1290	20°27'50.99"	32°58'55.95"	1363	20°32'38.21"	32°50'20.89"	1070
20°32'25.08"	33°01'38.36"	1320	20°28'03.52"	32°58'48.59"	1386	20°32'40.22"	32°50'34.94"	1091
20°32'20.27"	33°01'21.93"	1320	20°28'24.33"	32°59'27.91"	1308	20°28'35.49"	32°49'52.89"	1020
20°32'19.90"	33°01'09.03"	1330	20°28'24.15"	32°59'49.80"	1288	20°28'39.78"	32°50'17.15"	1113
20°32'31.75"	33°01'00.93"	1318	20°28'39.12"	32°58'36.92"	1427	20°28'40.92"	32°50'40.74"	1040
20°31'58.05"	33°00'40.83"	1328	20°28'54.42"	32°58'01.90"	1510	20°28'45.91"	32°50'53.34"	1040
20°32'08.84"	33°00'31.66"	1316	20°29'05.61"	32°58'50.45"	1409	20°28'45.03"	32°51'06.00"	1058
20°31'11.16"	32°59'46.78"	1351	20°29'06.72"	32°57'54.29"	1478	20°28'30.52"	32°49'28.62"	980
20°30'45.54"	32°59'46.97"	1380	20°29'11.42"	32°58'17.90"	1455	20°29'39.51"	32°47'39.85"	980
20°30'20.05"	32°59'45.72"	1369	20°29'32.94"	32°57'53.95"	1409	20°25'45.28"	32°54'17.49"	1160
20°29'46.43"	32°59'42.49"	1350	20°30'20.44"	32°57'48.80"	1380	20°25'54.12"	32°54'07.72"	1160
20°30'08.70"	33°00'14.48"	1288	20°30'41.46"	32°58'10.73"	1394	20°25'56.55"	32°53'55.13"	1204
20°30'01.91"	33°00'26.02"	1297	20°30'54.18"	32°58'03.59"	1369	20°26'00.52"	32°53'43.07"	1239
20°29'55.99"	33°00'38.00"	1260	20°31'44.49"	32°57'55.13"	1355	20°25'59.73"	32°53'29.83"	1230
20°29'50.86"	33°00'50.12"	1260	20°31'56.28"	32°57'46.89"	1400	20°26'15.92"	32°52'41.15"	1140
20°29'53.20"	33°01'02.82"	1246	20°32'08.84"	32°57'39.50"	1366	20°26'18.04"	32°52'28.99"	1135
20°29'57.14"	33°01'15.29"	1221	20°24'24.73"	32°59'41.10"	1270	20°26'08.04"	32°51'44.25"	1051
20°30'04.93"	33°01'37.92"	1200	20°24'29.38"	32°59'28.86"	1280	20°26'09.70"	32°51'31.34"	1077

Rietkloof			Brandvalley			Karreebosch		
Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]
20°30'11.58"	33°02'15.16"	1170	20°24'41.92"	32°59'21.55"	1270	20°26'11.71"	32°51'18.42"	1110
20°30'11.14"	33°02'33.92"	1147	20°24'53.56"	32°59'11.12"	1266	20°26'20.20"	32°51'08.49"	1114
20°29'01.92"	33°02'22.86"	1156	20°25'17.86"	32°59'04.74"	1286	20°26'26.39"	32°50'57.28"	1081
20°28'23.90"	33°01'15.40"	1280	20°28'30.60"	32°58'47.67"	1420	20°26'52.78"	32°49'30.37"	940
20°28'29.59"	33°01'03.43"	1231	20°28'46.68"	32°58'13.03"	1453	20°26'59.04"	32°49'19.29"	950
20°28'23.60"	33°00'44.44"	1280	20°28'51.75"	32°58'29.66"	1450	20°27'03.74"	32°49'04.99"	943
20°28'32.36"	33°00'33.88"	1260	20°24'36.81"	33°00'53.24"	1243	20°27'00.48"	32°48'50.66"	960
20°29'00.01"	33°02'42.77"	1120	20°23'48.07"	32°59'42.92"	1282	20°27'03.92"	32°48'38.36"	979
20°33'02.47"	33°03'28.28"	1205	20°24'06.86"	32°59'23.72"	1240	20°27'12.12"	32°48'28.27"	966
20°33'05.59"	33°03'15.57"	1199	20°25'19.90"	32°58'21.05"	1270	20°30'57.15"	32°49'02.99"	1028
20°33'01.45"	33°03'01.41"	1209	20°28'21.75"	32°58'17.34"	1394	20°30'15.51"	32°49'36.06"	1081
20°32'59.88"	33°02'48.54"	1204	20°29'27.48"	32°58'07.75"	1423	20°32'42.30"	32°49'55.32"	1010
20°33'03.34"	33°02'35.90"	1215	20°28'50.03"	32°59'24.72"	1336	20°25'37.40"	32°54'27.75"	1145
20°27'57.12"	33°00'36.62"	1242	20°28'36.43"	32°59'06.60"	1370	20°26'17.47"	32°52'09.33"	1080
20°32'19.70"	33°00'21.35"	1290	20°25'44.81"	33°00'55.98"	1184	20°26'48.20"	32°49'42.23"	937
20°31'28.69"	33°04'54.31"	1184				20°27'11.87"	32°48'13.14"	1000
20°28'27.72"	33°01'27.87"	1226				20°28'34.86"	32°50'05.16"	1086
						20°30'33.63"	32°50'24.87"	1147
						20°26'10.75"	32°52'54.62"	1150
						20°28'49.93"	32°49'43.05"	972
						20°28'45.93"	32°51'19.95"	1053
						20°26'00.02"	32°53'11.41"	1210

Witberg			Esizayo			Roggeveld		
Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]
20°28'08.82"	33°16'59.07"	1442.7	20°33'40.64"	32°57'30.35"	1380	20°29'48.80"	32°56'31.84"	1392
20°28'09.84"	33°17'07.88"	1450	20°35'09.27"	32°57'22.54"	1335	20°29'59.40"	32°56'24.35"	1423
20°27'58.98"	33°17'09.71"	1450	20°33'59.92"	32°57'25.55"	1370	20°30'12.40"	32°56'18.53"	1410
20°27'48.42"	33°17'11.90"	1437.6	20°38'07.36"	33°01'29.88"	1200	20°30'19.68"	32°56'08.68"	1383
20°27'29.38"	33°17'22.74"	1412.8	20°37'22.97"	33°01'44.37"	1201	20°30'26.37"	32°55'58.45"	1370
20°27'16.41"	33°17'24.43"	1410	20°38'24.73"	33°01'23.44"	1180	20°30'20.28"	32°55'44.74"	1401
20°27'02.33"	33°17'21.48"	1400	20°34'50.00"	32°57'24.09"	1333	20°30'25.43"	32°55'34.16"	1420
20°26'49.53"	33°17'19.94"	1381.7	20°38'28.65"	33°01'07.22"	1140	20°30'30.49"	32°55'23.53"	1418
20°26'51.87"	33°17'30.93"	1400	20°38'47.93"	33°01'05.65"	1120	20°30'34.79"	32°55'12.02"	1387
20°26'39.57"	33°17'31.76"	1380.9	20°38'52.28"	32°59'00.64"	1218	20°30'49.65"	32°55'24.78"	1375
20°27'07.29"	33°17'36.05"	1380	20°35'28.53"	32°57'22.60"	1294	20°31'00.62"	32°55'17.37"	1350
20°26'28.02"	33°17'32.85"	1352.2	20°36'31.06"	33°01'13.36"	1222	20°31'08.87"	32°55'08.31"	1310
20°26'15.98"	33°17'45.06"	1346.2	20°37'48.06"	33°01'36.33"	1190	20°30'31.77"	32°54'58.90"	1328
20°26'31.76"	33°18'00.94"	1340	20°34'28.82"	32°57'22.40"	1328	20°30'33.25"	32°54'45.24"	1340
20°26'18.51"	33°17'58.18"	1353.5	20°38'34.92"	32°59'07.08"	1205	20°30'47.32"	32°54'40.94"	1340
20°26'05.34"	33°17'55.46"	1370	20°36'17.80"	33°00'21.36"	1170	20°30'59.89"	32°54'34.73"	1320
20°25'51.44"	33°17'57.28"	1343.1	20°35'08.37"	33°00'34.12"	1199	20°31'07.55"	32°54'25.18"	1320
20°27'28.41"	33°16'59.33"	1378.8	20°36'54.18"	33°01'16.68"	1199	20°31'20.88"	32°54'19.25"	1301

Witberg			Esizayo			Roggeveld		
Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]
20°27'14.18"	33°17'00.46"	1387.1	20°38'07.45"	33°01'08.78"	1139	20°31'29.89"	32°54'10.58"	1291
20°26'59.96"	33°17'00.88"	1369.3	20°39'15.22"	32°59'47.79"	1120	20°31'30.66"	32°53'56.88"	1260
20°22'22.34"	33°17'49.96"	1230	20°35'41.12"	33°00'37.48"	1180	20°31'35.77"	32°53'45.18"	1230
20°21'59.66"	33°17'54.29"	1220	20°38'32.57"	33°00'50.99"	1077	20°31'41.21"	32°53'34.61"	1194
20°21'45.50"	33°17'54.78"	1220	20°35'58.51"	33°00'26.17"	1160	20°31'47.35"	32°53'24.44"	1200
20°21'31.88"	33°17'54.92"	1220	20°37'46.52"	33°00'03.77"	1100	20°31'55.36"	32°53'15.25"	1230
20°28'23.16"	33°17'04.97"	1424.4	20°37'03.75"	33°01'31.32"	1190	20°32'04.80"	32°53'06.84"	1218
20°25'38.42"	33°17'59.93"	1320.1	20°38'09.70"	32°59'49.23"	1120	20°32'14.43"	32°52'57.72"	1173
20°26'44.72"	33°17'59.29"	1340	20°39'11.54"	32°59'02.32"	1200	20°32'23.56"	32°52'49.13"	1180
			20°38'21.34"	32°59'29.78"	1128	20°32'29.26"	32°52'38.65"	1188
			20°37'05.80"	33°01'03.72"	1145	20°32'48.91"	32°52'22.79"	1230
			20°38'32.85"	32°59'42.80"	1119	20°32'57.06"	32°52'13.58"	1205
			20°39'48.11"	32°59'12.16"	1180	20°32'36.70"	32°52'27.87"	1240
			20°36'45.10"	32°59'08.38"	1165	20°30'05.26"	32°54'21.85"	1304
			20°40'51.63"	32°59'26.94"	1174	20°29'51.83"	32°54'06.01"	1298
			20°35'08.94"	32°58'32.35"	1196	20°30'03.85"	32°54'00.56"	1313
			20°38'15.65"	32°59'07.03"	1179	20°30'10.80"	32°53'50.33"	1286
			20°37'19.56"	32°59'58.82"	1105	20°30'13.89"	32°53'38.86"	1270
			20°35'05.32"	32°57'42.00"	1251	20°30'21.01"	32°53'26.18"	1270
			20°37'21.71"	32°59'06.87"	1158	20°30'25.68"	32°53'15.42"	1261
			20°36'35.18"	33°00'14.92"	1120	20°30'24.66"	32°53'04.04"	1236
			20°35'40.16"	32°57'06.40"	1197	20°30'18.27"	32°52'44.60"	1270
			20°35'24.40"	32°58'22.66"	1210	20°32'25.36"	32°51'34.69"	1100
			20°36'56.46"	32°59'53.88"	1111	20°32'28.27"	32°51'23.15"	1089
			20°35'07.17"	32°57'58.25"	1221	20°32'33.48"	32°51'12.61"	1087
			20°35'21.92"	33°00'22.80"	1161	20°30'34.11"	32°52'41.54"	1240
			20°36'40.63"	33°01'28.00"	1160	20°30'05.02"	32°52'46.81"	1230
			20°39'40.12"	33°00'25.20"	1060	20°29'29.70"	32°56'43.50"	1410
			20°39'28.85"	32°59'08.86"	1182	20°29'30.70"	32°56'58.59"	1419
			20°37'21.56"	32°59'42.59"	1118			
			20°36'58.31"	33°00'11.74"	1104			
			20°34'53.49"	32°58'42.04"	1171			
			20°38'11.37"	33°00'52.55"	1083			
			20°36'27.28"	33°00'57.11"	1142			
			20°35'34.50"	32°56'40.40"	1141			
			20°34'46.05"	32°57'45.19"	1246			
			20°35'31.94"	32°58'58.40"	1160			

Soetwater			Karusa		
Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]
20°42'02.34"	32°44'33.40"	1420	20°37'51.20"	32°46'50.73"	1310
20°41'15.97"	32°44'03.45"	1395	20°37'43.61"	32°46'58.09"	1310
20°40'51.47"	32°43'54.06"	1408	20°38'45.89"	32°47'29.63"	1315
20°40'28.05"	32°43'46.64"	1410	20°38'38.17"	32°47'36.42"	1340
20°40'25.19"	32°43'55.65"	1394	20°38'30.19"	32°47'42.67"	1333
20°40'10.60"	32°43'58.52"	1390	20°38'13.19"	32°47'44.41"	1309
20°40'05.60"	32°44'06.40"	1390	20°37'58.00"	32°47'49.47"	1231
20°39'54.17"	32°44'10.83"	1384	20°37'43.41"	32°47'52.40"	1241
20°39'38.74"	32°44'12.97"	1370	20°37'29.87"	32°47'55.90"	1260
20°39'23.12"	32°44'14.92"	1347	20°37'18.09"	32°48'00.65"	1256
20°39'05.72"	32°44'15.58"	1360	20°37'09.37"	32°48'17.43"	1250
20°38'58.76"	32°44'30.92"	1316	20°37'05.78"	32°48'29.30"	1250
20°38'53.65"	32°44'38.90"	1310	20°37'03.39"	32°48'38.68"	1263
20°38'44.38"	32°44'44.99"	1320	20°37'01.31"	32°48'48.00"	1286
20°38'34.41"	32°44'50.65"	1320	20°37'05.58"	32°49'00.08"	1280
20°38'24.65"	32°44'56.35"	1310	20°37'08.81"	32°49'11.83"	1238
20°38'13.37"	32°45'12.42"	1293	20°37'05.55"	32°49'39.38"	1212
20°37'59.92"	32°45'15.87"	1290	20°37'01.28"	32°49'47.88"	1244
20°37'43.52"	32°45'17.59"	1320	20°36'57.13"	32°49'56.41"	1270
20°37'32.83"	32°45'22.59"	1314	20°36'54.97"	32°50'05.91"	1260
20°37'36.62"	32°45'34.30"	1308	20°36'49.90"	32°50'14.04"	1260
20°37'40.40"	32°45'46.10"	1330	20°36'46.66"	32°50'23.60"	1264
20°44'16.41"	32°46'12.27"	1364	20°36'30.49"	32°50'48.94"	1240
20°43'52.03"	32°46'28.21"	1308	20°36'18.84"	32°50'53.80"	1206
20°42'34.39"	32°47'23.36"	1150	20°36'03.62"	32°51'32.40"	1226
20°41'47.31"	32°47'53.19"	1189	20°35'52.88"	32°51'37.49"	1246
20°41'50.47"	32°48'08.06"	1213	20°35'42.80"	32°51'43.27"	1227
20°41'40.83"	32°48'13.55"	1237	20°37'48.68"	32°52'51.08"	1230
20°41'54.15"	32°44'39.15"	1379	20°38'12.30"	32°52'52.82"	1211
20°38'48.16"	32°44'16.36"	1360	20°38'31.47"	32°52'50.99"	1210
20°38'21.03"	32°45'05.39"	1300	20°38'38.54"	32°52'43.53"	1213
20°37'50.74"	32°46'02.55"	1275	20°38'41.70"	32°52'33.65"	1180
20°43'50.02"	32°45'45.80"	1370	20°38'45.44"	32°52'24.46"	1160
20°43'37.55"	32°45'51.04"	1370	20°38'47.29"	32°52'14.22"	1150
20°44'18.42"	32°46'02.09"	1390	20°37'32.90"	32°46'24.23"	1301
20°43'56.76"	32°46'06.28"	1366	20°37'34.92"	32°46'36.21"	1304
20°42'26.69"	32°47'33.01"	1212	20°38'00.19"	32°47'11.17"	1339
20°42'19.71"	32°47'39.68"	1243	20°37'58.80"	32°47'21.36"	1347
20°42'11.23"	32°47'45.05"	1248	20°39'43.02"	32°47'33.21"	1285
20°41'58.19"	32°47'48.04"	1208	20°39'36.53"	32°47'40.47"	1326

Soetwater			Karusa		
Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]
20°41'33.74"	32°48'20.42"	1250	20°39'29.70"	32°47'47.63"	1333
20°41'21.77"	32°48'22.99"	1267	20°39'12.94"	32°47'45.63"	1321
20°41'15.33"	32°48'30.06"	1270	20°37'09.81"	32°48'06.67"	1240
