
Springbok Wind Energy Facility
Noise Impact Assessment
Addendum 3
(Proposed Amended Option)

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1 INTRODUCTION

The Department of Environmental Affairs (DEA) on the 27th of July 2011 granted Environmental Authorisation (EA) for the Springbok Wind Power Generation Facility near Springbok in the Northern Cape Province. The applicant's preferred Alternative 1 (hereafter referred to as authorised project) comprised of 37 wind turbine generators (WTG), with a generating capacity of 1.5 MW per turbine and a total generation capacity of 55.5 MW.

Mulilo Springbok Wind Power (Pty) Ltd (Applicant) proposes to amend the project description of the Wind Energy Facility (WEF). This amendment (hereafter referred to as proposed amended option) will increase the generating size of the WTG's, in order to align to current international WTG models while reducing the number of WTGs at the WEF. The authorised project and the proposed amended option wind turbine characteristics can be found in Table 1-1. The following main changes to the WTG parameters are proposed:

- Increasing hub heights from 80 m to 140 m;
- Increasing blade diameters from 88 m to 160 m;
- Increasing WTG generation size from 1.5 MW to between 2.0 MW and 4.5 MW;

The total generation capacity will remain 55.5 MW. For the impact assessment of this proposed amended option, the worst-case scenario of 25 turbines of 2.2 MW generating capacity each, will be used.

It is understood that should the Applicant use 4.5 MW turbines, which would have the same maximum dimensions as the 2.2 MW ones, then the number of turbines will be reduced to 12.

Table 1-1. Wind Turbine Characteristics

Component	Authorised Project	Proposed Amended Option
Number of turbines	37	Maximum of 25 (i.e. potential range of 12 turbines @ 4.5 MW to 25 turbines @ 2.2 MW)
Generation capacity per turbine	1.5 MW	2.0 MW – 4.5 MW
Generation capacity of the WEF	55.5 MW	55.5 MW
Rotor / blade diameters	88 m	Maximum of 160 m
Hub height	80 m	Maximum of 140m
Temporary construction pad	40 x 20 m	40 x 40 m
Permanently affected area (foundation size)	16 x 16 m and 2 m deep	16 x 16m and 3 m deep

Demos Dracoulides and Associates Environmental Engineers (DDA) was appointed by Holland & Associates Environmental Consultants, to provide input regarding noise to the Proposed Amended Option for the Springbok WEF.

1.1 Terms of Reference

The main aims of this addendum are to address the following:

- The implications of the proposed amendments in terms of the potential impact(s);

- Re-assessment of the significance of the identified impact(s), in accordance with the 2014 EIA Regulations, before and after mitigation, including consideration of the following:
 - Cumulative impacts;
 - The nature, significance and consequence of the impact;
 - The extent and duration of the impact;
 - The probability of the impact occurring;
 - The degree to which the impact can be reversed;
 - The degree to which the impact may cause irreplaceable loss of resources;
 - The degree to which the impact can be avoided, managed or mitigated;
- An outline of the potential advantages and disadvantages of the proposed amendments in terms of potential impacts.
- Indication whether or not the proposed amendments will result in a change to the significance of the impact(s) assessed in the original EIA for the proposed project, and if so, how the significance would change.
- Confirmation as to whether or not the proposed amendments will require any changes or additions to the mitigation measures recommended in the original specialist report.
- Potential measures to ensure avoidance, management and mitigation of impacts associated with the proposed changes.

1.2 Proposed Amended Option WTG Locations

The Springbok WEF is situated north-east of Springbok in the Northern Cape. Figure 1-1 shows the proposed wind turbine positions for the proposed amended option, together with the site boundary and the local residential communities. It is evident that some of the WTG positions have changed from the locations of the authorised project. The sensitive receptors within the study area are the communities in Carolusberg, Concordia, Okiep, Bergsig and Springbok.

The project's new map, as well as the WTG coordinates were provided by the Applicant and can be seen in APPENDIX A and APPENDIX B respectively. These coordinates were utilised in the noise modelling setup and noise contour generation.

1.3 WTG Sound Emissions

The selection of the wind turbine manufacturer has not been finalised yet. Currently, two manufacturers are being considered, i.e. Acciona and Siemens. The sound power data for two turbine types from each manufacturer were available. According to the Applicant, one of these turbines, or a very similar one, will be finally selected. The relevant manufacturer's documents provided are attached in APPENDIX C.

As a worst-case scenario, the highest sound power of these turbines of 108.4 dB(A) for a wind speed of 15 m/s at hub height was used for the noise modelling (see Table 1-2).

The sound power spectrum for the above-mentioned wind speed that was used in the calculations was also based on the same manufacturer's document (see Table 1-3).

Table 1-2. WTG Sound Power Levels for various Wind Speeds

Wind speed at 10m height (m/s)	6	7	8	9	10
Wind speed at 120m height (m/s) [$z_0=0.05m$]*	8.8	10.3	11.8	13.2	14.7
Sound power level (dB(A))	107.3	108.4	108.4	108.4	108.4

* Roughness length of 0.05m was used for the wind speed extrapolation to the hub height, in accordance with the IEC 61400-11.

Table 1-3. Highest Sound Power Spectrum Levels

	Octave Band (Hz)							
	63	125	250	500	1000	2000	4000	8000
Sound power level (dB(A))	77.4	85.3	94.7	101.2	103.8	103.3	98.2	87.6

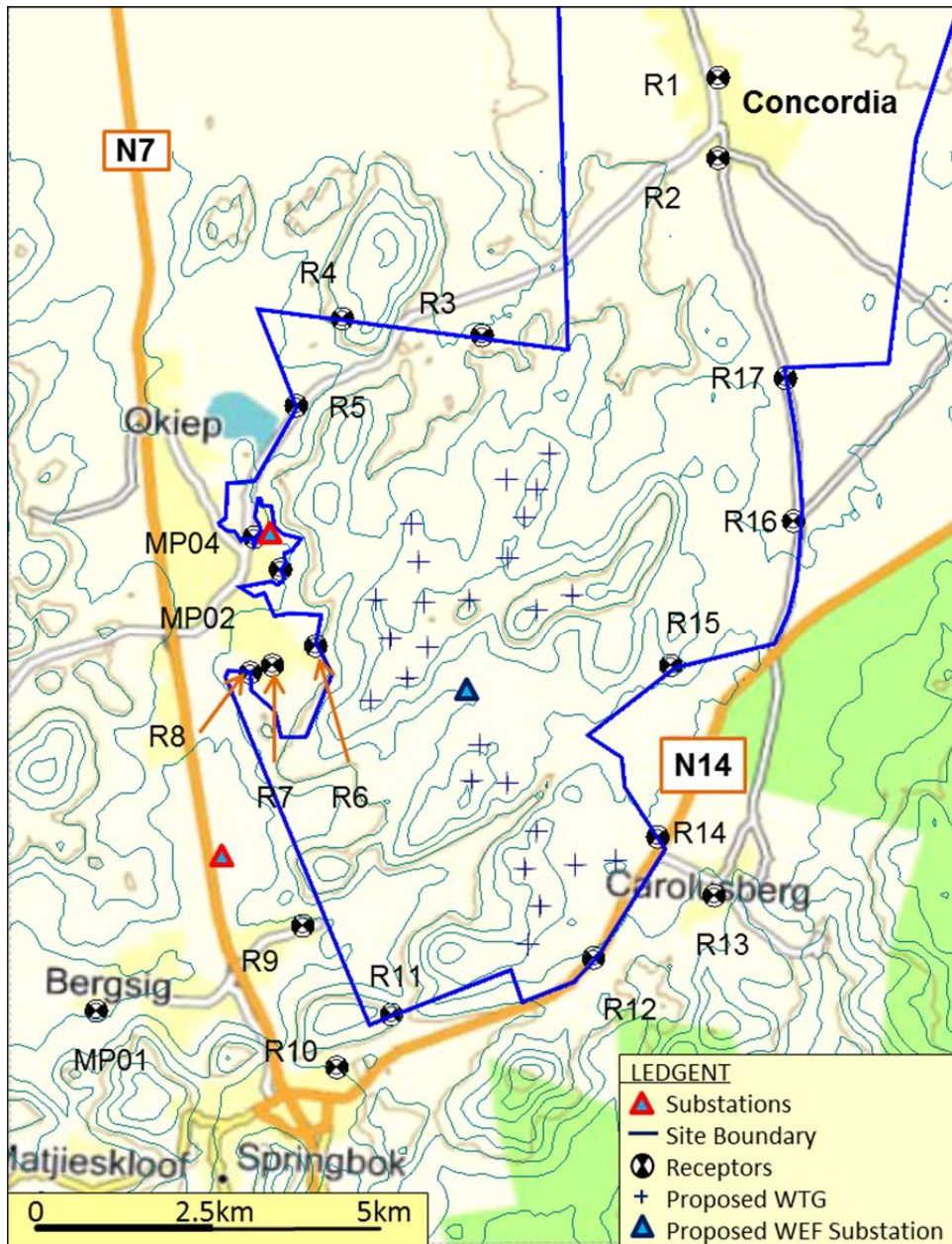


Figure 1-1. Locality Map

2 NOISE MODELLING AND IMPACT ASSESSMENT

2.1 Wind Farm Construction Phase

The construction activities will remain the same, and as such the findings of the main impact study are expected to be applicable to the proposed amended option.

The duration of the impact, however, is expected to be shorter, since instead of 37 turbines only 25 or less will be constructed.

2.2 Operational Noise Modelling Assumptions

For the noise modelling of the proposed amended option, the same assumptions as in the main study were used:

- The ground was considered partially noise-reflective.
- No mitigation measures in place.
- Daytime temperature and humidity 20°C and 50% respectively.
- Night-time temperature and humidity 10°C and 70% respectively.
- The screening of noise due to ground elevations was taken into consideration.
- All WTGs operating continuously and simultaneously.

2.3 Predicted Noise Levels

Based on the new sound emission details and the above-mentioned methodology, the noise contours around the site were estimated for the proposed amended option, i.e. a 55.5 MW total generation capacity with 25 WTGs. The noise contours for daytime and night-time conditions are depicted in Figure 2-1 and Figure 2-2 respectively.

From Figure 2-1 it can be seen that the turbines' operation generated 40 dB(A) noise levels at approximately 500 m from the turbine locations. Beyond 1,200 m, the noise levels were below 30 dB(A). The noise levels which exceeded 40 dB(A) were contained within the site boundaries and did not reach any of the surrounding communities of Carolusberg, Concordia, Okiep, Bergsig and Springbok.

During night-time the noise contour lines were found to extend approximately 5% further than the daytime ones. Similar to the daytime conditions, the 35 dB(A) noise levels were well contained within the site boundaries, except for some small areas close to Okiep and Carolusberg. However, the 35 dB(A) level did not reach these residential areas (see Figure 2-2).

In addition to the above-mentioned modelled noise levels, additional comparisons were produced comparing the noise level decrease or increase due to the shift from the authorised project to the proposed amended option. These comparisons are shown in

Figure 2-3 and Figure 2-4 for the daytime and the night-time respectively. Negative values indicate noise reductions due to the fact that some of the WTGs will be moved, and positive values indicate noise level increases due to the utilisation of larger WTGs and due to location shift.

As it is evident from Figure 2-3, for daytime conditions a noise level increase of 4 dB(A) above the daytime guideline of 45 dB(A) for rural areas will be well contained within the site boundaries and will not reach any communities around the site.

Similarly, a noise level increase of 4 dB(A) above the night-time guideline of 35 dB(A) for rural areas will be primarily contained within the site boundaries and will not reach any communities around the site, apart from the south-eastern site boundary close to Carolusberg. However, no noise level increase above the 35 dB(A) is expected at the Carolusberg community receptors (see Figure 2-4).

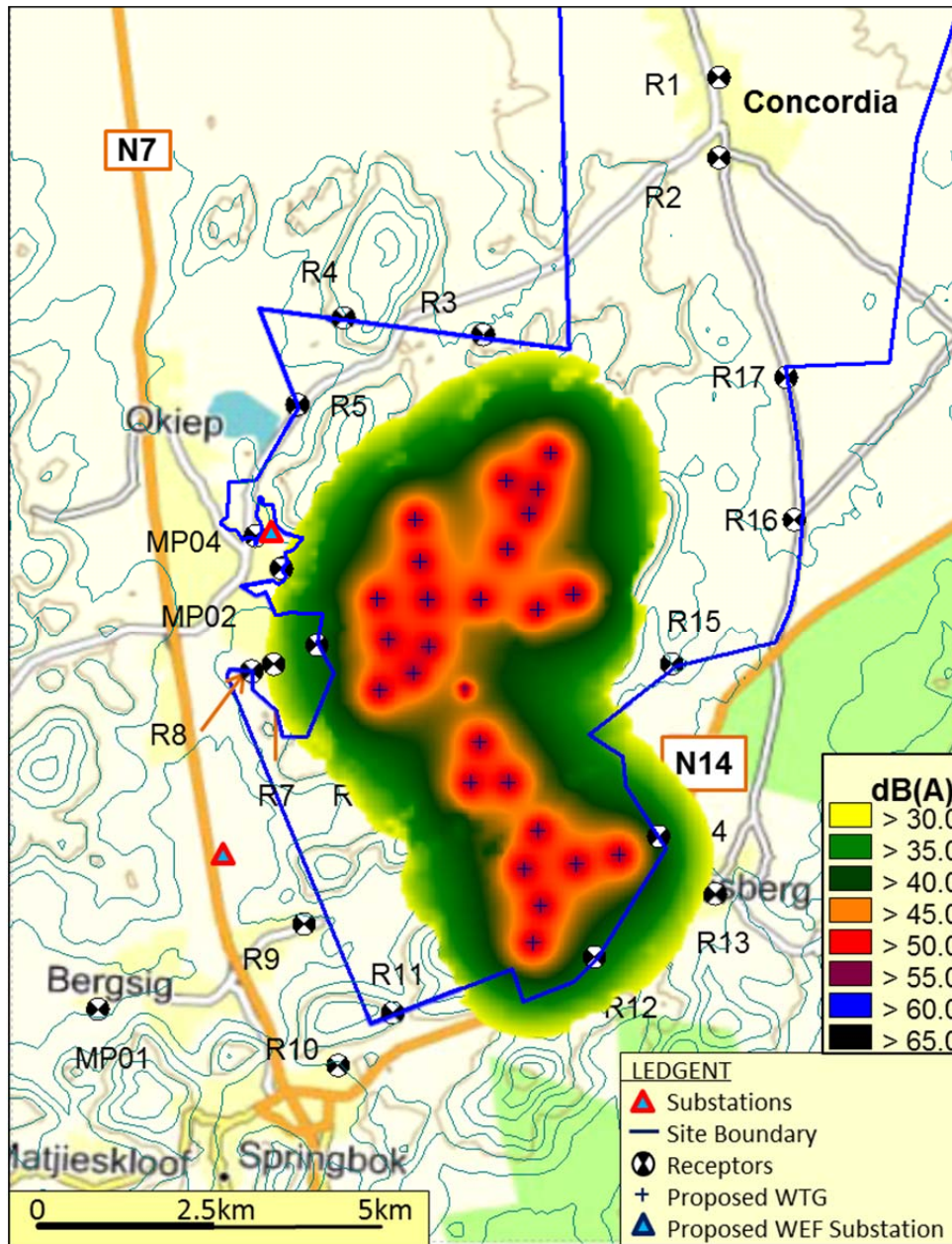


Figure 2-1. Proposed Amended Option: Daytime Noise Level Contours

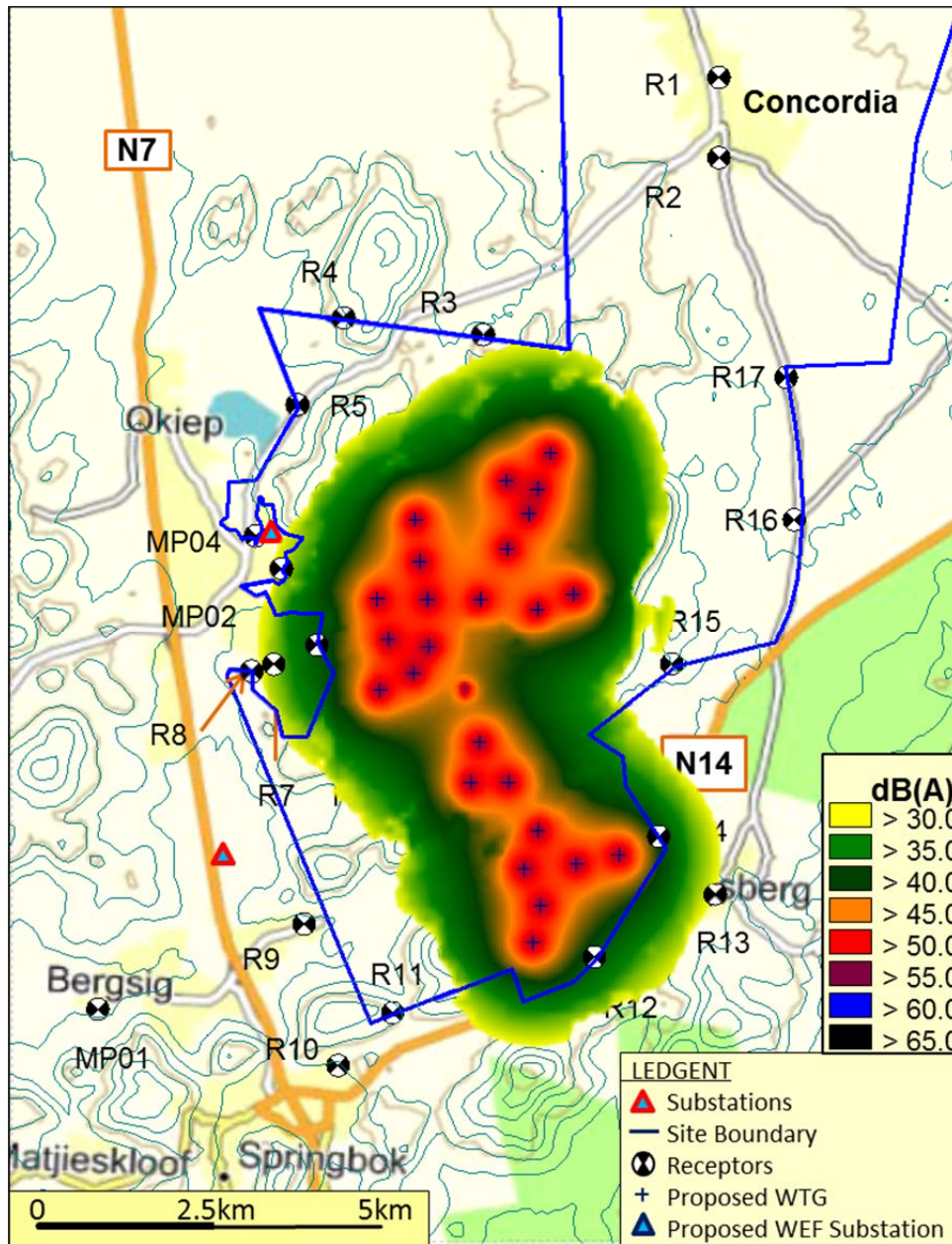


Figure 2-2. Proposed Amended Option: Night-time Noise Level Contours

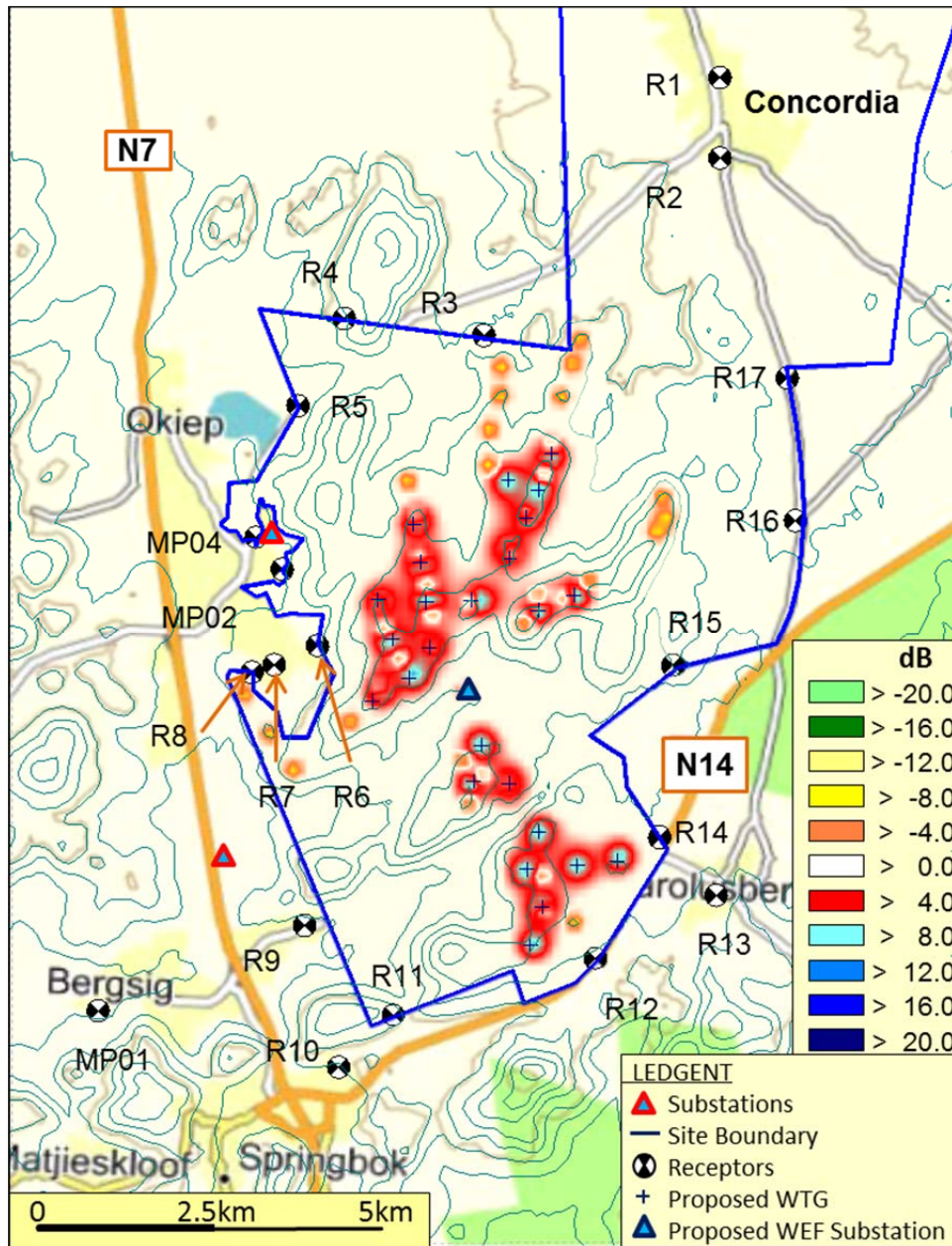


Figure 2-3. Authorised Project vs Proposed Amended Option: Daytime Noise Levels

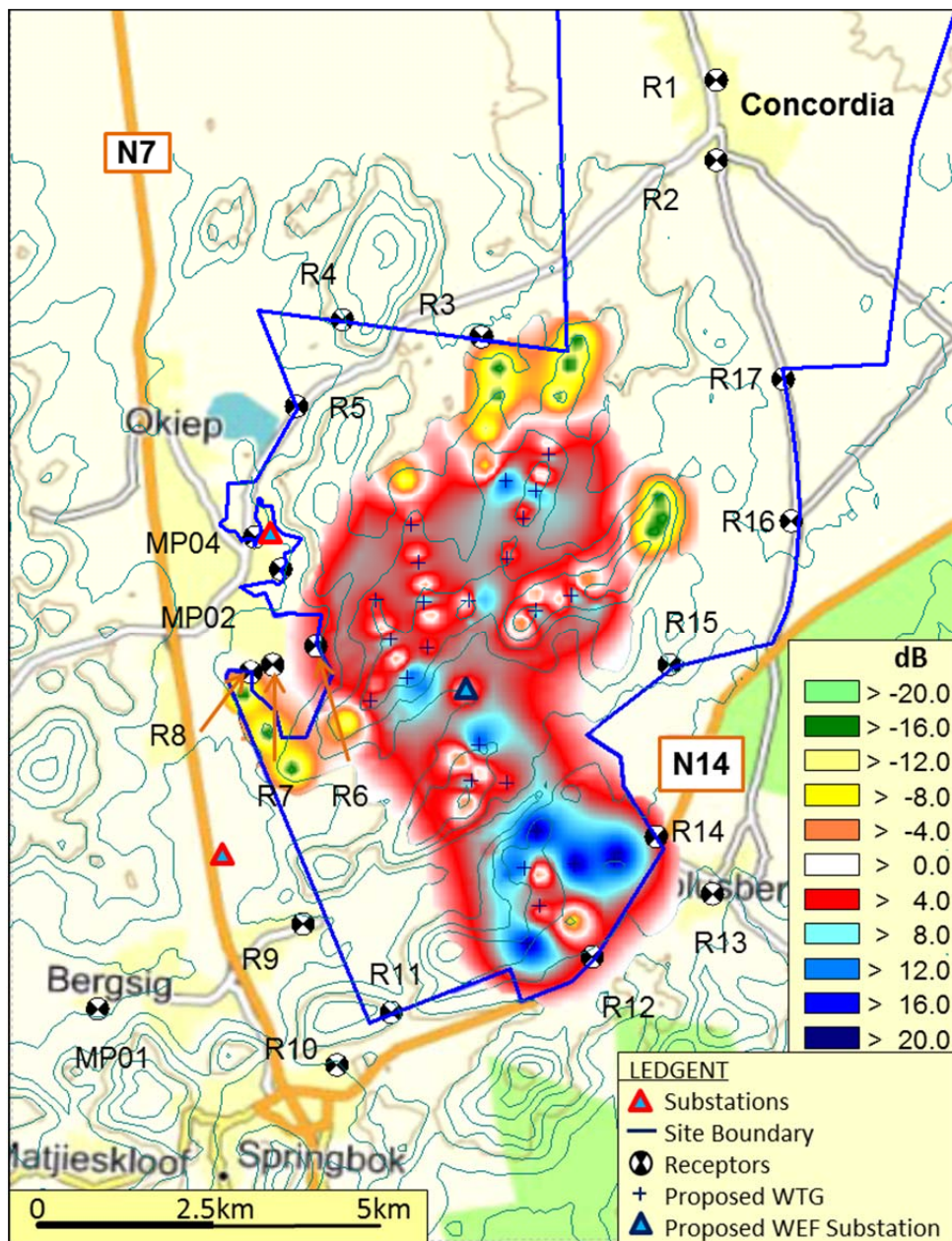


Figure 2-4. Authorised Project vs Proposed Amended Option: Night-time Noise Levels

2.3.1 Noise Levels at Discrete Receptors

In addition to the noise contour maps, the noise levels were calculated at several discrete receptors along the site's boundaries, at noise-sensitive receptors and at the noise monitoring positions (MP01, MP02 and MP04). The calculated noise levels, due to the operation of the WTGs, are shown in Table 2-1 below.

Table 2-1. Calculated Noise Levels at Discrete Receptors: Proposed Amended Option

Point	Location	Coordinates			Proposed Amended Option	
		x	y	z	Day	Night
		(m)			(dB(A))	
MP01	Bergsig community	777300	6716290	852	< 20	< 20
MP02	Okiep community	779758	6722200	952	29.2	29.9
MP04	Okiep community	779408	6722630	952	21.9	22.8
R 1	Concordia community	785600	6728769	824.1	< 20	< 20
R 2	Concordia community	785600	6727693	1015	< 20	< 20
R 3	Northern boundary	782450	6725324	969.9	24.6	25.6
R 4	Northern boundary	780585	6725551	1042.4	< 20	< 20
R 5	Western boundary	779968	6724390	952	< 20	< 20
R 6	Western boundary	780230	6721165	996.3	35.5	36.1
R 7	Okiep community	779653	6720910	976	29.8	30.7
R 8	Western boundary	779357	6720810	965.3	26.7	27.6
R 9	Bergsig community	780056	6717429	902	< 20	< 20
R 10	Springbok community	780510	6715539	952	< 20	< 20
R 11	Southern boundary	781241	6716244	1006.9	< 20	< 20
R 12	Southern boundary	783937	6717000	1049.7	35.6	36.2
R 13	Carolusberg community	785550	6717832	1052	27.2	28
R 14	Eastern boundary	784794	6718613	1056.7	36.1	36.6
R 15	Eastern boundary	784970	6720907	1102	25.7	26.6
R 16	Eastern boundary	786608	6722847	1052	< 20	< 20
R 17	Eastern boundary	786500	6724754	1052	< 20	< 20

As can be seen, the predicted daytime sound levels at all receptors were below the SANS daytime guideline for rural districts of 45 dB(A).

Similarly, the night-time noise levels were below the relevant rural guideline of 35 dB(A) for most receptors, except for receptors R6, R12 and R14, due to their close proximity to the wind turbines. These exceedances, however, are not considered significant, since firstly they were between 2 and 4 dB(A), and secondly due to the fact that noise levels at the closest communities of Okiep and Carolusberg were well below 32 dB(A) and 30 dB(A) respectively.

From Table 2-1, it can also be seen that the predicted noise levels at certain locations, such as Concordia, Bergsig and Springbok, were below 20 dB(A). This indicates that there will be no influence on the existing noise levels in these areas, and the impact there will be negligible.

It should be noted that the resulting noise levels represent a worst-case scenario, as the turbine with the higher sound emissions was utilised for the modelling. If a turbine with lower sound emissions is chosen, the resulting noise levels will be lower by 1 to 3 dB.

3 CONCLUSIONS AND RECOMMENDATIONS

Based on the new WTG number, sound emissions and resulting noise levels, the following can be concluded:

- The construction impact of the proposed amended option for the Springbok Wind Energy Facility will be the same as in the main noise impact report.
- The proposed amended option for the wind energy facility will have no or very little effect on the existing noise levels in the local communities of Bergsig ,Concordia, Carolusberg, Springbok and Okiep.
- The overall impact rating for the proposed amended option is considered to be *LOW*.

The general recommendations in the main report regarding construction and operation, including the noise monitoring should be adhered to.

In addition, if less number of turbines than 25 are finally used at the Springbok WEF, the ones that should be first eliminated are those closer to Okiep, i.e. No 23: (X=781071, Y=6720563) and No 10 (X=781182, Y=6721242).

4 IMPACT RATING TABLE

The operational impact rating table for the authorised project and this proposed amended option is presented below for the operational phase of the project.

As can be seen from Table 4-1, it is evident that the significant rating of the original EIA for the proposed project will be reduced to *LOW* for the amended option, due to the reduction of the turbine number and their positioning to locations further away from residential areas.

Table 4-1. Operational Impact Rating Table

<u>Option</u>	<u>Nature of impact</u>	<u>Extent of impact</u>	<u>Duration of impact</u>	<u>Intensity</u>	<u>Probability of occurrence</u>	<u>Status of the impact</u>	<u>Degree of confidence</u>	<u>Level of significance</u>	<u>Mitigation measure</u>	<u>Significance after mitigation</u>
OPERATIONAL PHASE										
<u>Authorised Project</u>	Noise	Local	Long-term	Medium	Probable	Negative	High	Low-Medium	Relocation of WTGs	Low
<u>Proposed Amended Option</u>	Noise	Local	Long-term	Low	Probable	Negative	High	Low	N/A	Low

APPENDIX A Springbok Wind Energy Facility Map (Proposed Amended Option)

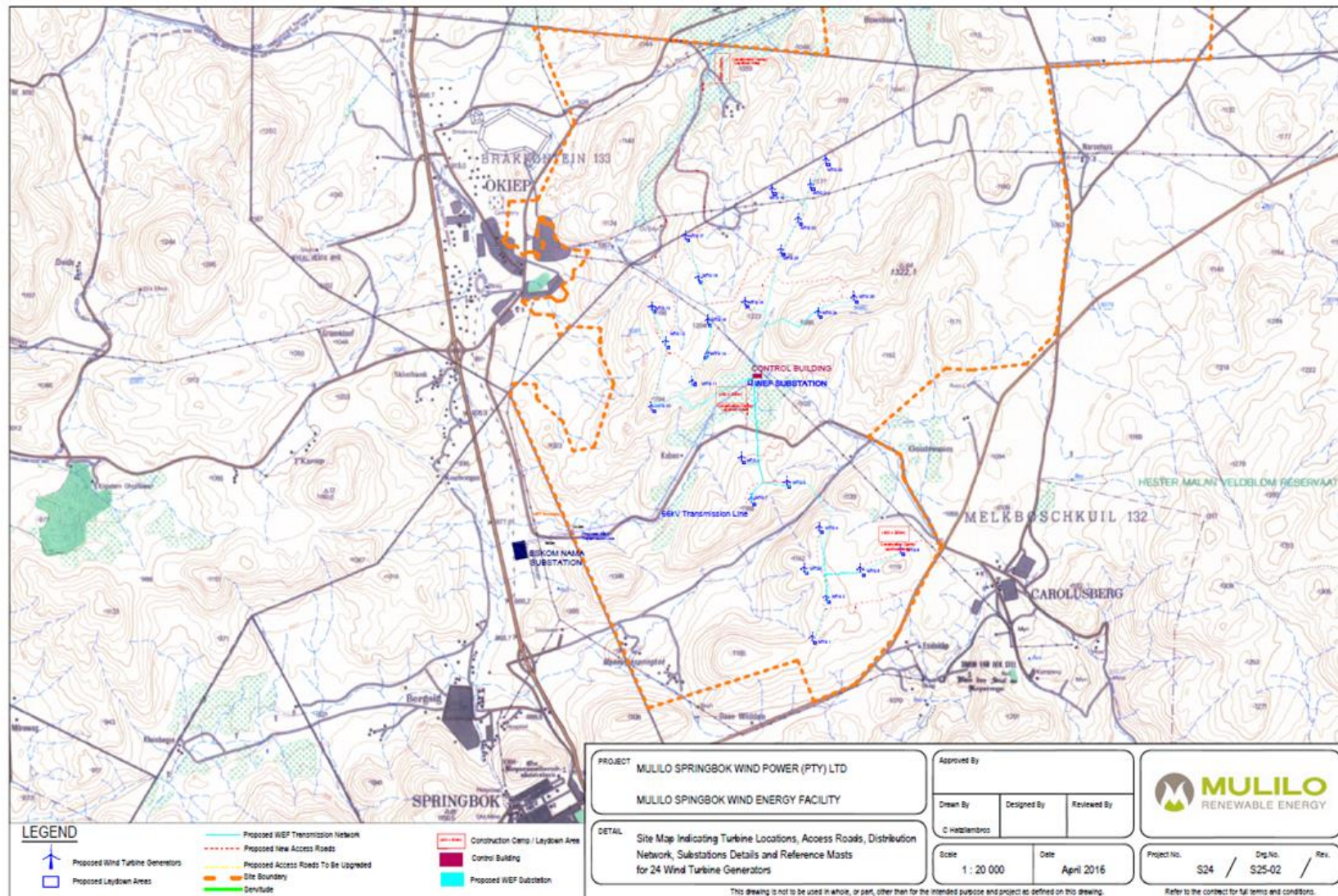





Figure A-5. Springbok Wind Energy Facility Proposed Amended Option

APPENDIX B Proposed Amended Option WTG Positions**Table B-1. Proposed Amended Option WTG Positions**

No.	Coordinates	
	X (m)	Y (m)
1	783699	6718239
2	783121	6717190
3	782769	6722464
4	782287	6719333
5	781607	6722299
6	784265	6718365
7	782756	6723373
8	783059	6722933
9	781706	6721790
10	781182	6721242
11	783184	6723264
12	783224	6717687
13	783356	6723745
14	781546	6722856
15	781726	6721145
16	783180	6718686
17	781516	6720791
18	782421	6721789
19	783003	6718171
20	782403	6719865
21	783657	6721851
22	781039	6721794
23	781071	6720563
24	783182	6721650
25	782790	6719328
25	783699	6718239

APPENDIX C WTG Sound Power Documentation



Rev	Fecha Date	Descripción de la revisión Description of the revision
"A"	20/10/15	Initial version
"B"	02/05/16	Included noise levels for the T87.5, noise levels updated.
Realizado / Done		Aprobado / Approved
 04-05-2016		 05-05-2016
Revisado / Reviewed		
 05-05-2016		

1. Introducción

Los niveles de Potencia Sonora Estimados (L_{wa}) se muestran para la turbina AW125/3150.

Estos valores de potencia sonora son válidos solo para las siguientes condiciones

- Tensión de red por debajo del +2.5% del valor nominal
- Generación de potencia reactiva y los algoritmos de control del parque desactivados
- Temperatura dentro del rango entre -20°C y +40°C
- Sin condiciones de hielo, esto es, temperatura mayor que +5°C y humedad relativa menor del 80%
- Puertas de góndola y base de torre cerradas tanto para la turbina medida como todas aquellas que se encuentren a la vista.

Las velocidades de viento representadas están referidas a la altura de 10 metros sobre el nivel del suelo. Para extrapolar a otras velocidades a altura de buje se debe aplicar la IEC61400-11:2006 ed. 2.1 Un valor típico de la longitud de rugosidad es 0.05m, aunque dicho valor depende del terreno concreto.

1. Introduction

Estimated Sound Power levels (L_{wa}) are provided for the AW125/3150 wind turbine.

These sound power levels are valid only for the following conditions:

- Grid voltage below +2.5% of nominal value
- Generation of reactive power and wind farm algorithms deactivated
- Temperature inside a range between -20°C and +40°C
- No iced conditions. Temperature above +5°C and relative humidity below 80%
- Nacelle and ground doors closed for either measured wind turbine and everyone in sight

The represented wind speeds are referenced to a height of 10 meters above ground level. For the extrapolation to other hub height wind speed IEC 61400-11:2006 ed. 2.1 has to be applied. A typical value of roughness length is 0.05m; however, it depends on the site terrain.

2. Niveles de Potencia Sonora

2. Sound Power Levels

Wind speed at 10m height (m/s)	6	7	8	9	10
Wind speed at 120m height (m/s) [$z_0=0.05m$]	8.8	10.3	11.8	13.2	14.7
Sound Power Level (dBA) TH120	107.3	108.4	108.4	108.4	108.4

Wind speed at 10m height (m/s)	6	7	8	9	10
Wind speed at 100m height (m/s) [$z_0=0.05m$]	8.6	10.0	11.5	12.9	14.3
Sound Power Level (dBA) TH100	107.3	108.4	108.4	108.4	108.4

Wind speed at 10m height (m/s)	6	7	8	9	10
Wind speed at 87.5m height (m/s) [$z_0=0.05m$]	8.5	9.9	11.3	12.7	14.1
Sound Power Level (dBA) T87.5	107.3	108.4	108.4	108.4	108.4

NOTA: Se asume una longitud de rugosidad de 0.05m para la extrapolación de la velocidad a altura de buje

NOTE: Roughness length of 0.05m is assumed to the hub height wind speed extrapolation

3. Nivel de Potencia Sonora Aparente

3. Apparent Sound Power Level Guarantee

Garantizado

El nivel máximo de potencia Sonora aparente garantizado incluirá una tolerancia para tener en cuenta la incertidumbre de medida. La tolerancia es igual a la incertidumbre estándar combinada definida en la norma IEC 61400-11:2006 ed. 2.1 y se aplica al nivel de potencia sonora reportado en la sección 2 y a los resultados del ensayo. Como valor de referencia, un valor típico de incertidumbre estándar combinada es $\leq 1dB$.

The guaranteed max apparent sound power level will include a tolerance to account for measurement uncertainty. The tolerance is equal to the standard combined uncertainty defined in IEC 61400-11:2006 ed. 2.1 and is applied to both the sound power level reported in section 2 *and* the test result. For reference purposes, a typical standard combined uncertainty is $\leq 1dB$.

Las medidas se realizarán en las posiciones definidas en la norma IEC 61400-11 Ed. 2.1. El análisis de los datos se llevará a cabo según la norma IEC 61400-11 Ed.2.1.

Measurements are to be carried out at the reference position as defined in IEC 61400-11 Ed. 2.1. The data analysis must be carried out according to IEC 61400-11 Ed. 2.1

4. Tonalidad

Se puede suponer una audibilidad tonal de $\Delta L_a \leq 2\text{dB}$ a lo largo de todo el rango operacional

5. Bandas de Octava

Solo a propósito informativo se muestran el espectro máximo de banda de octava esperado (no garantizado)

4. Tonality

A tonal audibility of $\Delta L_a \leq 2\text{dB}$ can be expected over the entire operational range.

5. Octave Bands

Maximum expected octave band spectra are provided for informational purposes only (not guaranteed).




Octave Band (Hz)	31.5	63	125	250	500	1000	2000	4000	8000
L_{wa} (dBA)	77.4	85.3	94.7	101.2	103.8	103.3	98.2	87.6	81.3

Valores representativos de la velocidad de viento asociada al mayor nivel de potencia sonora //

Values represented for the wind speed bin associated with the highest sound power levels



Rev	Fecha Date	Descripción de la revisión Description of the revision
"A"	30/09/14	Initial release
"B"	11/05/15	T84 wind turbine model added. Validity conditions updated.
"C"	10/06/16	Noise levels updated, guidelines updated.
"D"		
"E"		

Realizado / Done  10-06-2016	Revisado / Reviewed  10-06-2016	Aprobado / Approved  10-06-2016
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1. Introducción

Los niveles de Potencia Sonora Estimados (L_{wa}) se muestran para la turbina AW132/3000.

Estos valores de potencia sonora son válidos solo para las siguientes condiciones

- Tensión de red por debajo del +2.5% del valor nominal
- Generación de potencia reactiva y los algoritmos de control del parque desactivados
- Temperatura dentro del rango entre -20°C y +40°C
- Sin condiciones de hielo, esto es, temperatura mayor que +5°C y humedad relativa menor del 80%
- Puertas de góndola y base de torre cerradas tanto para la turbina medida como todas aquellas que se encuentren a la vista.

Las velocidades de viento representadas están referidas a la altura de 10 metros sobre el nivel del suelo. Para extrapolar a otras velocidades a altura de buje se debe aplicar la IEC61400-11:2002 Ed.2.1. Un valor típico de la longitud de rugosidad es 0.05m, aunque dicho valor depende del terreno concreto.

1. Introduction

Estimated Sound Power levels (L_{wa}) are provided for the AW132/3000 wind turbine.

These sound power levels are valid only for the following conditions:

- Grid voltage below +2.5% of nominal value
- Generation of reactive power and wind farm algorithms deactivated
- Temperature inside a range between -20°C and +40°C
- No iced conditions. Temperature above +5°C and relative humidity below 80%
- Nacelle and ground doors closed for either measured wind turbine and everyone in sight

The represented wind speeds are referenced to a height of 10 meters above ground level. For the extrapolation to other hub height wind speed IEC 61400-11:2002 Ed.2.1 has to be applied. A typical value of roughness length is 0.05m; however, it depends on the site terrain.

2. Niveles de Potencia Sonora

2. Sound Power Levels

Wind speed at 10m height (m/s)	6	7	8	9	10
Wind speed at 120m height (m/s) [$z_0=0.05m$]	8.8	10.3	11.8	13.2	14.7
Sound Power Level (dBA) TH120	107.1	107.1	107.1	107.1	107.1

Wind speed at 10m height (m/s)	6	7	8	9	10
Wind speed at 84m height (m/s) [$z_0=0.05m$]	8.4	9.8	11.2	12.6	14.0
Sound Power Level (dBA) T84	107.1	107.1	107.1	107.1	107.1

NOTA: Se asume una longitud de rugosidad de 0.05m para la extrapolación de la velocidad a altura de buje

NOTE: Roughness length of 0.05m is assumed to the hub height wind speed extrapolation

3. Nivel de Potencia Sonora Aparente

Garantizado

El nivel máximo de potencia sonora aparente garantizado incluirá una tolerancia para tener en cuenta la incertidumbre de medida. La tolerancia es igual a la incertidumbre estándar combinada definida en la norma IEC 61400-11:2002 Ed.2.1 y se aplica al nivel de potencia sonora reportado en la sección 1 y a los resultados del ensayo. Como valor de referencia, un valor típico de incertidumbre estándar combinada es $\leq 1dB$.

Las medidas se realizarán en las posiciones definidas en la norma IEC 61400-11 Ed. 2.1. El análisis de los datos se llevará a cabo según la norma IEC 61400-11 Ed.2.1.

3. Apparent Sound Power Level Guaranteed

The guaranteed max apparent sound power level will include a tolerance to account for measurement uncertainty. The tolerance is equal to the standard combined uncertainty defined in IEC 61400-11:2002 Ed.2.1 and is applied to both the sound power level reported in section 1 *and* the test result. For reference purposes, a typical standard combined uncertainty is $\leq 1dB$.

Measurements are to be carried out at the reference position as defined in IEC 61400-11 Ed. 2.1. The data analysis must be carried out according to IEC 61400-11 Ed. 2.1

4. Tonalidad

Se puede suponer una audibilidad tonal de $\Delta L_a \leq 2\text{dB}$ a lo largo de todo el rango operacional

5. Bandas de Octava

Solo a propósito informativo se muestran el espectro máximo de banda de octava esperado (no garantizado)

4. Tonality

A tonal audibility of $\Delta L_a \leq 2\text{dB}$ can be expected over the entire operational range.

5. Octave Bands

Maximum expected octave band spectra are provided for informational purposes only (not guaranteed).

Octave Band (Hz)	32	63	125	250	500	1000	2000	4000	8000
L_{wa} (dBA)	73.6	84.7	96.7	102.4	101.6	98.1	96.5	94.5	87.9

Valores representativos de la velocidad de viento asociada al mayor nivel de potencia sonora

Values represented for the wind speed bin associated with the highest sound power level