RENEWABLE
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Noise Assessment

Land West of The Energy Coast Business Park Wind Turbine Repowering

Windlend (Cumbria) Ltd

Document Information		
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Version	Date	Purpose of amendment
V1.0	*27/11/2023*	Completed draft for Client review
V2.0	*30/11/2023*	*Final report*

Summary

Locogen were commissioned by Windlend (Cumbria) Limited ('The Client') to produce a Noise Assessment to support a planning application for the repowering of a single Wind Turbine and associated infrastructure on Land West of The Energy Coast Business Park, Haile, Cumbria in Cumberland Council ('The Proposed Development).

Noise modelling was completed for the Project using ReSoft Windfarm software and the measured noise levels + applied uncertainty for the proposed wind farm at normal operation. This model work was based on the ISO 9613 calculation methodology.

The following conclusions can be made regarding noise considerations and the proposed development:

- A cumulative noise assessment has been carried out for wind developments in vicinity of the Project. The assessment has been carried out in accordance with Institute of Acoustics, A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise; and,
- The assessments have shown that the individual impact of the proposed repowering turbine and cumulative impact with other assessed operational developments would not exceed the simple ETSU limits at the nearest sensitive receptors.

It is therefore considered that no further background noise monitoring will be necessary for this development and that simplified noise limits (applicable to financially involved and non-financially involved receptors separately) can be conditioned for the operation of the wind turbine.

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1. Introduction

1.1. Background

Locogen have been commissioned by Windlend (Cumbria) Limited ('The Client') to produce a Noise Assessment to support a planning application for the repowering of a single Wind Turbine and associated infrastructure on Land West of The Energy Coast Business Park, Haile, Cumbria in Cumberland Council ('The Proposed Development).

The Proposed Development is not considered to be an Environmental Impact Assessment (EIA) development as agreed through consultation with Cumberland Council.

The aim of the development of is to maximise the generation of renewably sourced electricity from the Site through re-powering the asset at the Site by installing a larger dimensioned replacement wind turbine.

The Proposed Development Site is located Ordnance Survey Grid Reference - 302357E 508321N. It is the expectation being that any new turbine would be located within c.20m from the existing turbine to allow for construction to take place alongside operation of the existing turbine to minimise operational downtime. It is sited adjacent to a pre-existing industrial park associated with the West Cumbria Energy Coast.

The project will comprise the re-powering of an existing 46.5m high (blade to tip) Turbowind 400kW wind turbine which has been in operation since 2015. This will involve replacing it with a taller three bladed wind turbine measuring 77m high (base to tip) along with associated infrastructure for a further period of '30 years to reflect the operational life of the proposed repowered wind turbine.

1.2. Report structure

This report assesses whether the Project is likely to cause a noise disturbance to the nearest residential dwellings. The report initially provides an overview of the operational turbine, relevant policy, wind turbine noise and site context before assessing the extent of individual and cumulative wind turbine derived noise on the nearest residents.

The purpose of this assessment is to determine whether the predicted noise level from the Project and any nearby wind developments will exceed the ETSU noise limit criteria at the nearest sensitive receptors[1]. If the desk-based noise model shows that ETSU limits are not exceeded, then no further noise monitoring is considered necessary.

This noise impact assessment focuses on the operational stage of the proposed repowering development.

[1] Limit of 35dB L_{A90} at 10m/s or 5dB above the prevailing background noise level

2. Existing development

The existing turbine was granted planning permission with the below condition (Condition 5) relating to operational turbine noise limits:

'*The noise emissions from the wind turbine shall not exceed a sound pressure level of 35dB LA90,10min at the curtilage of any dwelling lawfully existing at the time of this consent at wind speeds up to and including 10ms-1 at 10m height. Any measurement shall be made at a height of 1.2m and at a minimum distance of 3.5m from any façade or acoustically reflective surface.*

For the purpose of this condition, curtilage is defined as "the boundary of a lawfully existing domestic garden area" '

The existing operational turbine is a Turbowind 400kW turbine which was demonstrated to achieve the above through completion of a desk-based noise assessment that was completed by Acia Engineering Acoustics[2]. For the avoidance of doubt this assessment has assumed that the above Turbowind turbine will be decommissioned and removed from side prior to the proposed repowering turbine (discussed further in Section 4.2 being commissioned).

The Acia report also included a cumulative assessment with an operational micro development comprising of 3 turbines (details provided in Table 1 below). These turbines are still in operation and have been considered within the cumulative impact assessment in Section 4.7.

Table 1: Existing cumulative development

Turbine type	Location		Sound power level at 10m/s
	Easting	Northing	
Proven 35-2 (T1)	302479	508006	85.4
Proven 35-2 (T2)	302510	507989	85.4
Proven 35-2 (T3)	302540	507971	85.4

The stated sound power level for these operational turbines was provided from updated noise information sourced by Locogen for this make and model and is based on the octave specific data set out in Table 2 below.

Table 2: Proven 35-2 Turbine octave data and Broadband SPL at 10m/s

Wind speed (m/s)	10
Freq (Hz)	Sound power level dB
Broadband SPL	**85.4**
63	67.0
125	74.0
250	77.4
500	80.0
1000	79.8
2000	76.9
4000	72.1
8000	62.6

[2] Report number: 2617.01

3. Relevant Legislation, Policy and Guidance

The following policy and guidance documents were utilised in the completion of this chapter:

- The revised National Planning Policy Framework (2023);
- Overarching National Policy Statement for Energy (EN-1);
- National Policy Statement for Renewable Energy Infrastructure (EN-3);
- BS 5228 Parts 1 & 2 – Code of Practice for Noise and Vibration Control on Construction and Open Sites;
- ETSU-R-97 The Assessment and Rating of Noise from Wind Farms; and,
- Institute of Acoustics 'Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise'.

The National Policy Statement for Renewable Energy Infrastructure (EN-3), published in November 2023, states:

"Operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance."

ETSU-R-97 is still considered to be the most relevant document relating to wind energy and suggests that current practice on controlling wind farm noise should be by the application of noise limits at the nearest noise-sensitive properties. These noise limits should be applied to external locations and should apply only to those areas frequently used for relaxation or activities for which a quiet environment is highly desirable. The report suggests that noise limits should be set at a $LA90_{10min}$ of no more than 5 dB(A) above background, subject to a minimum of 35 dB(A) for daytime and 43 dB(A) for night-time. These limits are applicable up to a wind speed of 12 m/s measured at 10 m height on the site.

However, the report also states both day and night-time lower fixed limits can be increased to 45 dB(A) to increase the permissible margin above background where the occupier of the property has some financial interest in the wind farm.

4. Assessment

4.1. Potential Effects

During the construction and decommissioning phases there will be a number of short-term noise impacts of varying intensity, and these include:

- The transportation of abnormal loads (equipment and materials) to site will require the use of Heavy Goods Vehicles (HGV's). The majority of the transport route is likely to be via motorways and other busy regional roads so there is unlikely to be significant additional noise impacts for sensitive receptors along the majority of this route.
- The construction/excavation of the foundations and ancillary structures (including the excavation of earth to lay foundations and underground cabling) is likely to have short-term noise impacts higher than background levels. It is considered that all of this construction work will take place during daylight hours to ensure minimal disturbance to nearby residential dwellings.

There will also be short-term noise impact from construction traffic and turbine components coming to and from site along local roads although the baseline traffic movements from the adjacent industrial park will mean this is unlikely to be significant.

During the operational phase there are typically two potential sources of noise from a wind turbine; aerodynamic noise from the movement of the blades through the air, and mechanical noise from the operation of turbine engine components (e.g. gearbox and generator) in the nacelle. The proposed candidate turbines do not have gearboxes and therefore operational noise is generally lower for these turbines due to reduced mechanical noise.

Modern wind turbines have been designed to be considerably quieter than earlier turbine models and significant progress has been made in recent years in achieving lower noise signatures. Well-designed modern wind turbines are generally quiet in operation and, compared to the noise of road traffic and construction activities in other locations, the noise from wind turbines is very low.

Aerodynamic noise can be minimised through careful attention to blade design, whilst mechanical noise can be minimised through innovative design and noise insulation materials within the nacelle.

4.2. Proposed wind turbine

The location and specific noise details for the Project are provided in Table 3 below. The noise data is provided from EWT documentation[3] for their Directwind 61 wind turbine (500kW configuration) and this document has been provided in the Appendices for reference. The maximum SPL has been taken from the octave data and Broadband SPL information replicated in Table 4 below.

Turbine type	Location		Max SPL up to 10m/s
	Easting	Northing	
EWT Directwind 61 (500kW)	302357	508321	101.5 dB(A)

Table 3: Repowering wind turbine details

[3] Specification Sound Power Levels DW61 (dated 04/02/21)

Table 4: DW61 (500kW) Turbine octave data and Broadband SPL across wind speeds

Wind speed (m/s)	5	6	7	8	9	10
Freq (Hz)	Sound power level dB					
Broadband SPL	**92.6**	**95.9**	**99.6**	**100.7**	**101.1**	**101.5**
63	79.5	80.1	80.0	81.0	80.7	81.8
125	83.0	86.3	86.9	88.3	88.0	88.8
250	87.3	90.4	93.9	94.8	95.1	95.6
500	86.5	90.7	95.5	96.2	96.7	97.0
1000	85.5	88.7	92.2	93.9	94.7	94.7
2000	82.0	85.2	88.3	90.0	90.8	90.8
4000	75.5	76.5	82.4	83.3	83.8	84.5
8000	63.5	67.0	71.1	72.5	73.0	74.1

4.3. Receptors

A noise impact assessment has been carried out on the nearest sensitive receptors to the Project. These are shown relative to the existing turbine and proposed turbine location in Figure 1 below and detailed in Table 5. This assessment has focused on the nearest residential dwellings to the Proposed Development.

Figure 1: Sensitive receptors surrounding the Project

The three properties at Yeorton hall farm have a * to signify that they have a financial involvement in the project. This is a relevant consideration when considering the applicable noise limits in line with ETSU guidance.

Table 5: Residential properties included in the assessment

Ref.	Name of location	Easting	Northing	Distance from proposed turbine (m)
R1	Yeorton Hall Farm (1)*	302639	507858	542
R2	Yeorton Hall Farm (2)*	302625	507836	545
R3	Yeorton Hall Farm (3)*	302681	507836	583
R4	Winscales	302186	508959	660
R5	Winscales House	302335	508963	642
R6	Vicarage	303062	508713	806
R7	Woodlands	303224	508507	886
R8	Weston	301950	507817	647
R9	Oaklands	301777	507948	689
R10	Woodlea	302125	507648	711
R11	Former reservoir	302105	508853	588

It should be noted that the house names and references are the same as for the original Acia report completed for the existing turbine. However the reference points have been amended to better reflect the definition of curtilage set out within the noise condition (as provided in Section 2).

4.4. Cumulative development

Other existing wind development in the vicinity of the Project have been considered as part of the noise impacts assessment. This additional operational development is shown in red in Figure 2 below and detailed in Table 6 below.

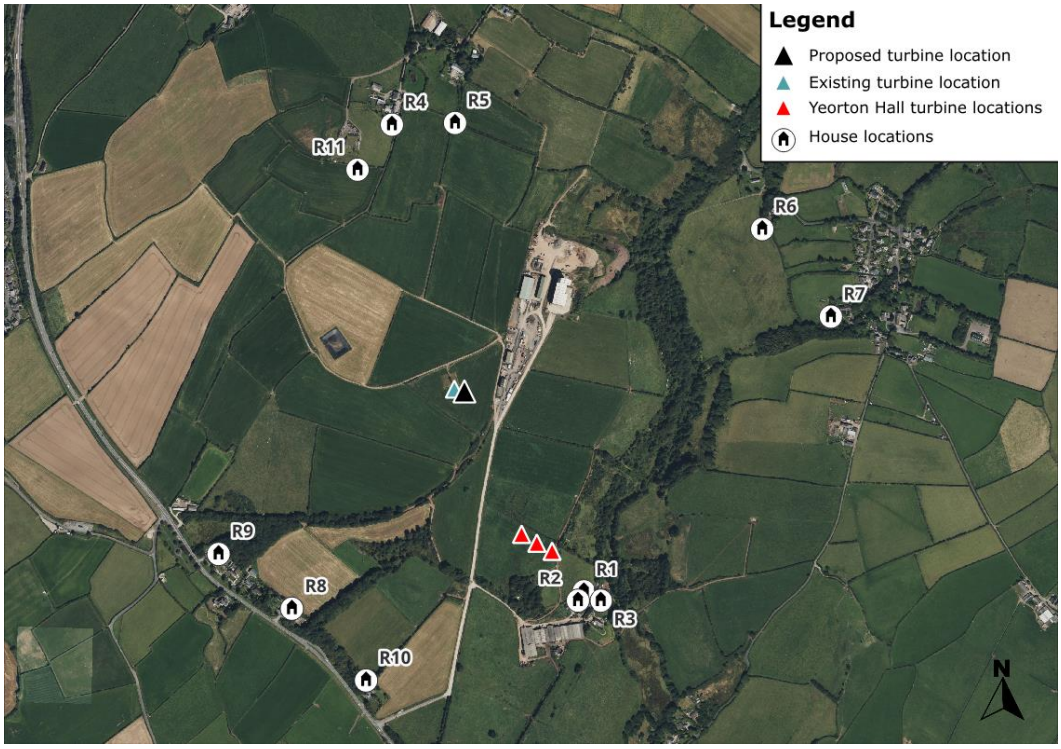

Figure 2: Wind developments included in the cumulative development

Table 6: Details of the wind developments included in the cumulative assessment

Development	No of Turbines	Turbine model	Distance from the proposed turbine (m)
Yeorton micro wind array	3	Proven 35-2	380

4.5. Operational noise assessment

Given the noted short-term effects of the construction and decommissioning works on noise set out above, this assessment has assessed the noise during the operational period. Predicted noise levels have been calculated based on information provided by the turbine manufacturers and have been compared with the noise limits set out within the Institute of Acoustics 'Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (2013). Within the guidance it is outlined that the following parameters should be set when calculating noise predictions:

- A ground factor of G=0.5;
- The use of warranted manufacturer data or, if warranted data is not available, the use of measured data plus an uncertainty factor. In the scenario where measured data is used, an uncertainty factor can be provided by the manufacturer, multiplied by a margin of 1.645, to ensure that suitable uncertainties have been incorporated. If no data on uncertainty is made available by the manufacturer, then an uncertainty factor of 2dB should be added. This is highlighted within the IEC 61400-11 standard and for the proposed turbines the 2dB uncertainty has been added;
- The adoption of a receiver height of 4.0m is recommended (regardless of time of day), as it has the effect of reducing the potential over-sensitivity of the calculation to the receiver region ground factor compared to lower receiver heights; and
- Atmospheric conditions of 10°C and 70% humidity are recommended to represent a reasonably low level of air absorption.

The extent of wind farm noise has been quantified using Resoft's Windfarm software in accordance with ISO 9613 'Acoustics – Attenuation of Sound during Propagation Outdoors' guidance.

Finally, the predicted wind farm noise L_{Aeq} has also been adjusted by subtracting 2dB to give the equivalent L_{A90} level as suggested in ETSU-R-97.

4.6. Individual assessment

Noise modelling was completed using Windfarm software to quantify the maximum operational turbine noise at the identified residential receptor locations. The results of this modelling work is presented in table format for each receptor point in Table 7 below and also demonstrated in map format within Figure 3 below.

Table 7: individual noise assessment demonstrating maximum turbine noise

Ref	Name of location	Applicable Noise limit dB(A)	Repowering wind project dB(A)LA90	Applicable headroom dB(A)
R1	Yeorton Hall Farm (1)	45	35.5	9.5
R2	Yeorton Hall Farm (2)	45	35.5	9.5
R3	Yeorton Hall Farm (3)	45	34.8	10.2
R4	Winscales	35	33.5	1.5

R5	Winscales House	35	33.8	1.2
R6	Vicarage	35	31.5	3.5
R7	Woodlands	35	30.5	4.5
R8	Weston	35	33.7	1.3
R9	Oaklands	35	33.1	1.9
R10	Woodlea	35	32.8	2.2
R11	former reservoir	35	34.7	0.3

The above modelling outputs demonstrates that the noise from the proposed repowering turbine would meet the simple noise limits set out in ETSU guidance for financially involved (Yeorton hall properties) and non-financially involved properties (R4-R11 inclusive).

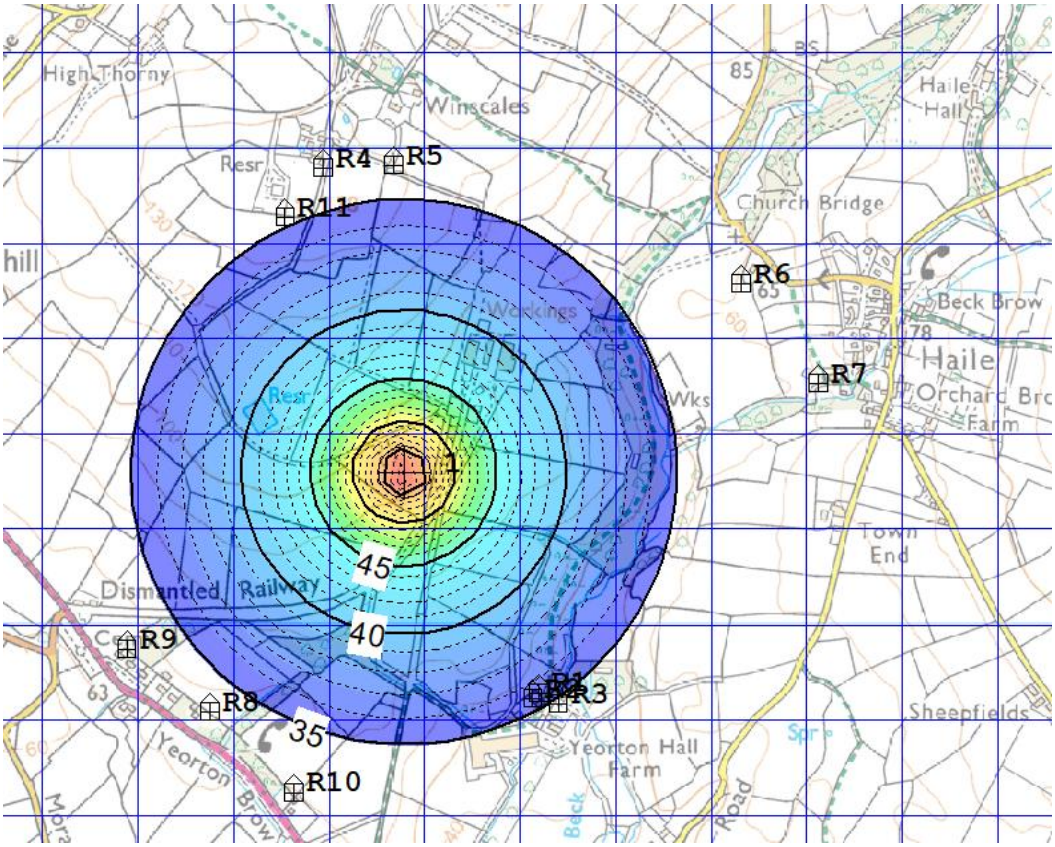

Figure 3: Map demonstrating individual turbine noise modelling outputs

4.7. Cumulative assessment

This section determines which properties would need to be assessed for a cumulative noise assessment and whether cumulative noise is likely to exceed applicable noise limits. Para 5.14. of the IOA guidance states the following with regards to cumulative assessment:

"During scoping of a new wind farm development consideration should be given to the cumulative noise impacts from any other wind farms in the locality. If the proposed wind farm produces noise levels within 10dB of any existing wind farm/s at the same receptor location, then a cumulative noise impact assessment is necessary.

Equally, in such cases where noise from the proposed wind farm is predicted to be 10 dB greater than that from the existing wind farm (but compliant with ETSU_R-97 in its own right), then a cumulative noise assessment would not be necessary."

This assessment will initially identify where cumulative noise assessment is necessary in accordance with the above statement.

Cumulative noise modelling has been carried out based on the methodology and turbine noise detailed above. Table 8 below initially shows the noise from each individual development at each assessed property. The green highlighted cells in Table 8 show where further cumulative assessment is required (where both developments have predicted noise levels within 10dB of the highest noise contributor).

Table 8: Cumulative noise assessment

Ref	Name of location	Noise limit dB(A)	Repowering wind project dB(A)LA90	3 x micro turbine project dB(A)LA90	Cumulative noise dB(A)LA90	Applicable headroom dB(A)
R1	Yeorton Hall Farm (1)	45	35.5	36.7	**39.1**	**5.9**
R2	Yeorton Hall Farm (2)	45	35.5	36.6	**39.1**	**5.9**
R3	Yeorton Hall Farm (3)	45	34.8	34.0	**37.4**	**7.6**
R4	Winscales	35	33.5	17.7	33.7	
R5	Winscales House	35	33.8	18.0	33.9	
R6	Vicarage	35	31.5	19.0	31.7	
R7	Woodlands	35	30.5	19.4	30.8	
R8	Weston	35	33.7	23.0	34.1	
R9	Oaklands	35	33.1	20.9	33.4	
R10	Woodlea	35	32.8	24.5	**33.4**	**1.6**
R11	former reservoir	35	34.7	18.3	34.8	

As is shown in the table above, a cumulative noise assessment was deemed necessary at 4 properties (R1-R3 and R10). This has demonstrated that the worst-case cumulative noise would not exceed the simple noise limits as set out in ETSU guidance pertaining to non-financially involved and financially involved receptors.

5. Conclusion

The following conclusions have been made regarding noise considerations and the Project:

- Noise modelling was completed for the Project using ReSoft Windfarm software and the measured noise levels + applied uncertainty for the proposed wind farm at normal operation. This model work was based on the ISO 9613 calculation methodology;
- A cumulative noise assessment has been carried out for wind developments in vicinity of the Project. The assessment has been carried out in accordance with Institute of Acoustics, A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise; and,
- The assessments have shown that the individual impact of the proposed repowering turbine and cumulative impact with other assessed operational developments would not exceed the simple ETSU limits at the nearest sensitive receptors.

It is therefore considered that no further background noise monitoring will be necessary for this development and that simplified noise limits (applicable to financially involved and non-financially involved receptors separately) can be conditioned for the operation of the proposed wind turbine.

Appendix A. Candidate turbine noise information

Please see the separate document ‘Appendix A - DW61 Sound Power Level information’.

	Emergya Wind Technologies B.V.
	Engineering

Category:	Specification	Page 1 / 8
Doc code:	S-1005035	

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Specification

Sound Power Levels DW61

Revision	Date	Author	Approved	Description of changes
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-

Emergya Wind Technologies B.V.
Lindeboomseweg 51 – 3825 AL Amersfoort - The Netherlands
T +31 (0)33 454 0520 - F +31 (0)33 456 3092 - www.ewtdirectwind.com

Contents

1 Introduction

This document presents the sound power levels (SPLs) of the DW61 wind turbine models. The information in this document is derived from analysis of multiple sound measurements performed by an independent noise measurement institute according to the methodology set out in International Standard IEC 61400-11.

2 Sound Power Levels

2.1 Turbine Data

Hub height (m)	46 / 59 / 69 / 84
Rotor diameter (m)	61
Rated power output (kW)	500 750 900 1000
Rated rotor (rpm)	22 23 24 24

2.2 Sound power levels versus wind speed at hub height

The following A-weighted sound power levels for the presented configurations are valid for integer wind speeds at hub height and are only valid for the normal operation mode at rated rotor speed and power. Data below is valid for hub heights of 84m, 69m, 59m & 46m. The SPLs for the various DW61 configurations are also plotted after the tabular data.

2.2.1 1000kW configuration (24rpm)

Wind speed at hub height V_{HH} [m/s]	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Sound Power Level L_{WA} [dB(A)]	92.6	95.9	99.6	102.5	103.8	104.5	104.5	104.5	104.4	104.3

2.2.2 900kW configuration (24rpm)

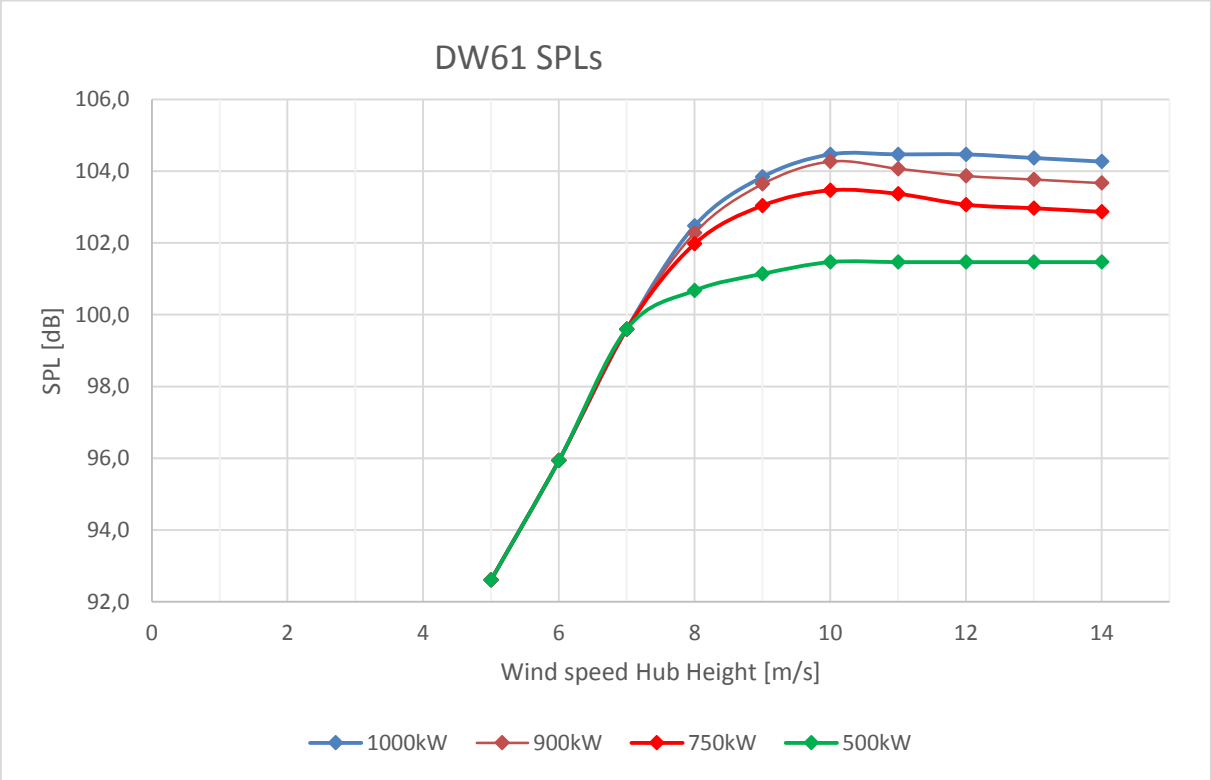
Wind speed at hub height V_{HH} [m/s]	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Sound Power Level L_{WA} [dB(A)]	92.6	95.9	99.6	102.3	103.6	104.3	104.1	103.9	103.8	103.7

2.2.3 750kW configuration (23rpm)

Wind speed at hub height V_{HH} [m/s]	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Sound Power Level L_{WA} [dB(A)]	92.6	95.9	99.6	102.0	103.0	103.5	103.4	103.1	103.0	102.9

2.2.4 500kW configuration (22rpm)

Wind speed at hub height V_{HH} [m/s]	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Sound Power Level L_{WA} [dB(A)]	92.6	95.9	99.6	100.7	101.1	101.5	101.5	101.5	101.5	101.5



2.3 Sound Power Levels versus wind speed at 10m height

Based on the Sound Power levels mentioned above in section 2.2, the Sound Power Levels at the 10m reference height can be derived. The results in the tables below have been converted to Reference Conditions by using a logarithmic wind profile and a Reference Roughness Length Z_{0ref} = 0,05 metres, and are based on a neutral atmosphere.

2.3.1 1000kW configuration (24rpm)

Wind speed at reference height V_{10} [m/s]		**4**	**5**	**6**	**7**	**8**	**9**	**10**
Sound Power Level L_{WA} [dB(A)]	Hub Height: **84m**	94.6	99.6	103.0	104.3	104.5	104.4	104.3
Sound Power Level L_{WA} [dB(A)]	Hub Height: **69m**	94.1	98.9	102.7	104.2	104.5	104.4	104.3
Sound Power Level L_{WA} [dB(A)]	Hub Height: **59m**	93.7	98.4	102.5	104.1	104.5	104.5	104.3
Sound Power Level L_{WA} [dB(A)]	Hub Height: **46m**	93.1	97.5	101.7	103.8	104.5	104.5	104.4

2.3.2 900kW configuration (24rpm)

Wind speed at reference height V_{10} [m/s]		**4**	**5**	**6**	**7**	**8**	**9**	**10**
Sound Power Level L_{WA} [dB(A)]	Hub Height: **84m**	94.6	99.6	102.8	104.1	104.0	103.8	103.7
Sound Power Level L_{WA} [dB(A)]	Hub Height: **69m**	94.1	98.9	102.5	104.0	104.1	103.8	103.7
Sound Power Level L_{WA} [dB(A)]	Hub Height: **59m**	93.7	98.4	102.3	103.9	104.1	103.9	103.7
Sound Power Level L_{WA} [dB(A)]	Hub Height: **46m**	93.1	97.5	101.5	103.6	104.2	103.9	103.8

2.3.3 750kW configuration (23rpm)

Wind speed at reference height V_{10} [m/s]		**4**	**5**	**6**	**7**	**8**	**9**	**10**
Sound Power Level L_{WA} [dB(A)]	Hub Height: **84m**	94.6	99.6	102.4	103.4	103.3	103.0	102.9
Sound Power Level L_{WA} [dB(A)]	Hub Height: **69m**	94.1	98.9	102.2	103.3	103.4	103.0	102.9
Sound Power Level L_{WA} [dB(A)]	Hub Height: **59m**	93.7	98.4	102.0	103.2	103.4	103.1	102.9
Sound Power Level L_{WA} [dB(A)]	Hub Height: **46m**	93.1	97.5	101.3	103.0	103.4	103.2	103.0

2.3.4 500kW configuration (22rpm)

Wind speed at reference height V_{10} [m/s]		**4**	**5**	**6**	**7**	**8**	**9**	**10**
Sound Power Level L_{WA} [dB(A)]	Hub Height: **84m**	94.6	99.6	100.9	101.4	101.5	101.5	101.5
Sound Power Level L_{WA} [dB(A)]	Hub Height: **69m**	94.1	98.9	100.8	101.3	101.5	101.5	101.5
Sound Power Level L_{WA} [dB(A)]	Hub Height: **59m**	93.7	98.4	100.7	101.2	101.5	101.5	101.5
Sound Power Level L_{WA} [dB(A)]	Hub Height: **46m**	93.1	97.5	100.4	101.1	101.5	101.5	101.5

2.4 Octave Data

The Octave Data below is representative of the noise pectrum at hub height. This is shown for all the configurations.

2.4.1 1000kW configuration (24rpm)

Wind speed at hub height V_{HH} [m/s]		**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Octave Band Centre Frequencies [Hz]	**63**	79.5	80.1	80.0	82.8	83.4	84.8	84.8	84.8	84.7	84.6
	125	83.0	86.3	86.9	90.1	90.7	91.8	91.8	91.8	91.7	91.6
	250	87.3	90.4	93.9	96.6	97.8	98.6	98.6	98.6	98.5	98.4
	500	86.5	90.7	95.5	98.0	99.4	100.0	100.0	100.0	99.9	99.8
	1000	85.5	88.7	92.2	95.7	97.4	97.7	97.7	97.7	97.6	97.5
	2000	82.0	85.2	88.3	91.8	93.2	93.8	93.8	93.8	93.7	93.6
	4000	75.5	76.5	82.4	85.1	86.5	87.5	87.5	87.5	87.4	87.3
	8000	63.5	67.0	71.1	74.3	75.7	77.1	77.1	77.1	77.0	76.9
Sound Power Level L_{WA} [dB(A)]		**92.6**	**95.9**	**99.6**	**102.5**	**103.8**	**104.5**	**104.5**	**104.5**	**104.4**	**104.3**

2.4.2 900kW configuration (24rpm)

Wind speed at hub height V_{HH} [m/s]		**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Octave Band Centre Frequencies [Hz]	**63**	79.5	80.1	80.0	82.6	83.2	84.6	84.4	84.2	84.1	84.0
	125	83.0	86.3	86.9	89.9	90.5	91.6	91.4	91.2	91.1	91.0
	250	87.3	90.4	93.9	96.4	97.6	98.4	98.2	98.0	97.9	97.8
	500	86.5	90.7	95.5	97.8	99.2	99.8	99.6	99.4	99.3	99.2
	1000	85.5	88.7	92.2	95.5	97.2	97.5	97.3	97.1	97.0	96.9
	2000	82.0	85.2	88.3	91.6	93.0	93.6	93.4	93.2	93.1	93.0
	4000	75.5	76.5	82.4	84.9	86.3	87.3	87.1	86.9	86.8	86.7
	8000	63.5	67.0	71.1	74.1	75.5	76.9	76.7	76.5	76.4	76.3
Sound Power Level L_{WA} [dB(A)]		**92.6**	**95.9**	**99.6**	**102.3**	**103.6**	**104.3**	**104.1**	**103.9**	**103.8**	**103.7**

2.4.3 750kW configuration (23rpm)

Wind speed at hub height V_{HH} [m/s]		**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Octave Band Centre Frequencies [Hz]	**63**	79.5	80.1	80.0	82.3	82.6	83.8	83.7	83.4	83.3	83.2
	125	83.0	86.3	86.9	89.6	89.9	90.8	90.7	90.4	90.3	90.2
	250	87.3	90.4	93.9	96.1	97.0	97.6	97.5	97.2	97.1	97.0
	500	86.5	90.7	95.5	97.5	98.6	99.0	98.9	98.6	98.5	98.4
	1000	85.5	88.7	92.2	95.2	96.6	96.7	96.6	96.3	96.2	96.1
	2000	82.0	85.2	88.3	91.3	92.4	92.8	92.7	92.4	92.3	92.2
	4000	75.5	76.5	82.4	84.6	85.7	86.5	86.4	86.1	86.0	85.9
	8000	63.5	67.0	71.1	73.8	74.9	76.1	76.0	75.7	75.6	75.5
Sound Power Level L_{WA} [dB(A)]		**92.6**	**95.9**	**99.6**	**102.0**	**103.0**	**103.5**	**103.4**	**103.1**	**103.0**	**102.9**

2.4.4 500kW configuration (22rpm)

Wind speed at hub height V_{HH} [m/s]		**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Octave Band Centre Frequencies [Hz]	**63**	79.5	80.1	80.0	81.0	80.7	81.8	81.8	81.8	81.8	81.8
	125	83.0	86.3	86.9	88.3	88.0	88.8	88.8	88.8	88.8	88.8
	250	87.3	90.4	93.9	94.8	95.1	95.6	95.6	95.6	95.6	95.6
	500	86.5	90.7	95.5	96.2	96.7	97.0	97.0	97.0	97.0	97.0
	1000	85.5	88.7	92.2	93.9	94.7	94.7	94.7	94.7	94.7	94.7
	2000	82.0	85.2	88.3	90.0	90.5	90.8	90.8	90.8	90.8	90.8
	4000	75.5	76.5	82.4	83.3	83.8	84.5	84.5	84.5	84.5	84.5
	8000	63.5	67.0	71.1	72.5	73.0	74.1	74.1	74.1	74.1	74.1
Sound Power Level L_{WA} [dB(A)]		**92.6**	**95.9**	**99.6**	**100.7**	**101.1**	**101.5**	**101.5**	**101.5**	**101.5**	**101.5**

2.5 Tonal Audibility

A Tonal Audibility $\Delta L_{a,k}$ of less than 2 dB(A) may be expected at the Reference Distance R_0 of the turbine. Tonal Audibility has been assessed according to IEC 61400-11 and is not comparable with tonal assessments under e.g. FGW, ETSU-R-97, DIN-45681 or Joint Nordic Method, and is only valid for the Reference Distance R_0. The tonality determined here is not giving information on the tonality at other distances.

3 Important Notice

EWT reserves the right to make modifications to or adjust settings of the EWT DW61 wind turbine models. The values presented in this document do not include measurement uncertainty.

Reduced sound power levels can be achieved by operating the wind turbine in noise restricted mode involving changes in controller settings. This can, however, reduce the power performance of the turbine. The 900kW and 1MW configurations can also be fitted with trailing edge serrations. Please contact EWT for further information on this option.

The sound power levels contained in this document do not constitute an express or implied warranty or representation and are supplied for information only.