SIC Guidance - Noise Assessment & Rating for Small Wind Turbines in Shetland

The guidance document provides advice to developers and aims to protect the amenities of properties in Shetland from small wind turbine noise. A small wind turbine is defined as generating power up to 50kW with a maximum rotor system swept area 200m^2. Small wind turbines can raise significant noise issues at existing or proposed developments. Scottish Government 'PAN 1/2011: Planning and Noise' provides advice on the methods used for noise impact assessment in development planning. The Environmental Health department has written this guidance document to provide a simplified noise impact assessment for developments involving small wind turbines in Shetland which adheres to the advice given in PAN 1/2011.

This methodology is designed to be used in conjunction with 'ETSU-R-97 The Assessment & Rating of Noise from Wind Farms' and the Institute of Acoustics 'A Good Practice Guide To The Application Of ETSU-R-97 For The Assessment And Rating Of Wind Turbine Noise' (GPG).

Key points to be established before conducting a noise assessment

- Competency of the assessor

The noise assessment must be undertaken by a suitability qualified person. This will depend on the complexity of the assessment (e.g. cumulative / directivity assessments). Non-complex assessments involving a single small wind turbine can be assessed using the SIC calculator available on the SIC website.

- External amenity area

From ETSU-R-97 "The noise limits applied to protect the external amenity should only apply to those areas of the property which are frequently used for relaxation or activities for which a quiet environment is highly desirable. For example, if a farm house is one of the noise-sensitive properties it would probably not be appropriate to apply limits to all the land belonging to the farm."

The Planning department defines the external amenity of the property as the area within the amenity boundary. The distance from the turbine to the amenity boundary can be measured using online mapping sites (for example Google Maps or Bing Maps).

- Financial involvement

From the GPG "ETSU-R-97 considers it appropriate to allow a higher level of incident noise associated with turbine operation for properties with occupants that have an interest in the development, both as a higher fixed level (45 dB) and/or a higher level above the prevailing background noise level. It is considered that the occupants of a financially involved property should be direct beneficiaries to allow an increase to the fixed limit noise levels."

'Financial involvement' should be discussed and agreed with the Planning department at the pre-planning stage, before the assessment is completed.

- Screening and barriers

ISO 9613-2 Paragraph 7.4 describes the requirements needed for an effective screening obstacle (often called a barrier). As detailed in the GPG "screening effects should be limited to a reduction of no more than 2 dB" unless in exceptional circumstances. Tools like the MAS Environmental Sound Propagation Level Calculator can be used to show the effectiveness of a screening obstacle.

- For multiple turbines, is a cumulative noise impact assessment / directivity assessment required

Cumulative noise / directivity assessments must be carried out by a competent person. The GPG provides detailed guidance for such assessments.

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ETSU-R-97 Noise prediction calculation

$$L_{p,Xm} = L_W + S_{dB}(V-8) + P - 20\log_{10}(X) - 8 - X/1000$$

Where

$L_{p,Xm}$	Sound Pressure Level at noise sensitive receptor, L_{Aeq} dB
L_W	Wind turbine sound power level, L_{Aeq} dB
S_{dB}	Wind turbine noise slope (dB,ms^{-1})
V	Wind speed (ms^{-1})
P	Tonal noise penalty, P=0 when NO, P=5 when YES, dB
X	Distance from the source to the receptor amenity boundary rounded to the nearest whole number, m

When L_W is in terms of L_{Aeq} a -2dB correction is applied for L_{A90} noise limits – GPG Paragraph 4.2.5

ETSU-R-97 Noise limits

For large wind developments site specific background noise surveys are required when conducting a full noise assessment. For developments involving small wind turbines a simplified version should be used. Representative background noise values have been determined by taking the logarithmic average (calculation in Appendix B) of 29 noise surveys conducted in Shetland between 2015 and 2018. These noise surveys comply with ETSU-R-97. The results of the 29 surveys are contained in Appendix A. The applicant can elect to conduct a site specific or representative background noise survey in accordance with ETSU-R-97. Background noise surveys must be undertaken by a suitably qualified person. When conducting a representative survey the location must be agreed with the department in advance.

As with large wind developments in Shetland, the day-time noise limit is limited to 40 dB L_{A90}. The night-time noise limit is limited to 43 dB L_{A90}. The day-time limits are highlighted in Table 1 and the night-time limits are highlighted in Table 2.

Table 1: Day-time noise limit (limited to 40 dB L_{A90}), rounded to be nearest whole number

Wind speed	0	1	2	3	4	5	6	7	8	9	10	11	12
Bgd Av	-	-	27	27	28	29	31	33	34	36	38	40	41
Bgd Av +5	-	-	32	32	33	34	36	38	39	41	43	45	46
Limited value	40	40	40	40	40	40	40	40	40	40	40	40	40
Limit (Highest)	40	40	40	40	40	40	40	40	40	41	43	45	46

Table 2: Night-time noise limit (limited to 43 dB L_{A90}), rounded to be nearest whole number

Wind speed	0	1	2	3	4	5	6	7	8	9	10	11	12
Bgd Av	-	-	22	22	23	24	26	28	30	33	35	37	39
Bgd +5	-	-	27	27	28	29	31	33	35	38	40	42	44
Limited value	43	43	43	43	43	43	43	43	43	43	43	43	43
Limit (Highest)	43	43	43	43	43	43	43	43	43	43	43	43	44

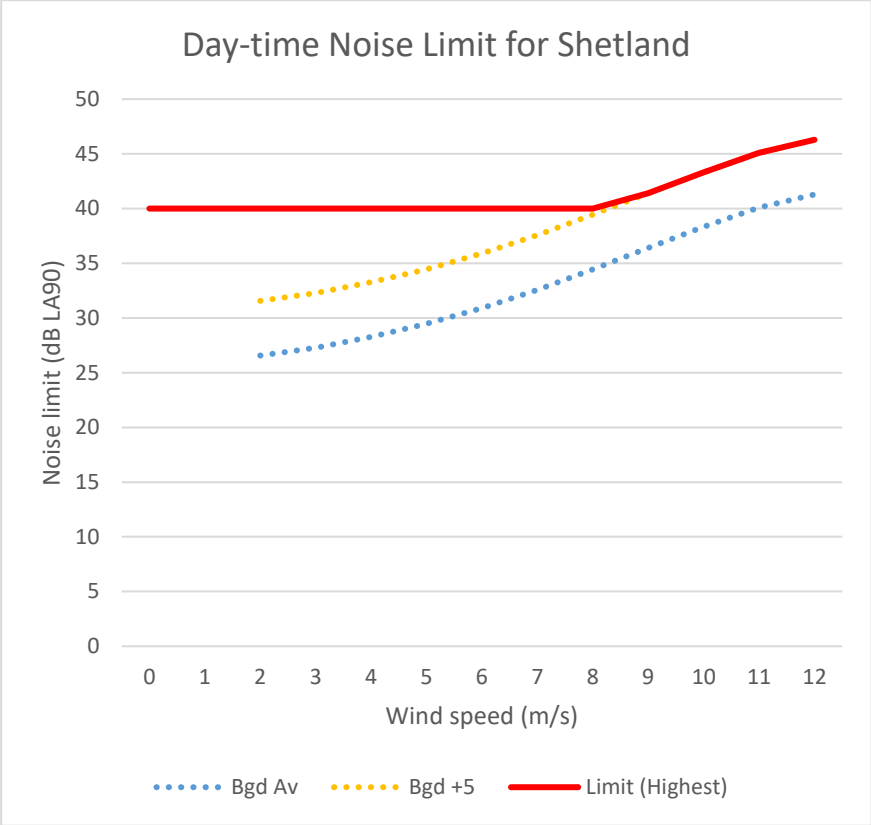
Financial involvement

The minimum noise limit level is raised to 45 dB L_{A90} for properties with a direct financial involvement with a wind turbine.

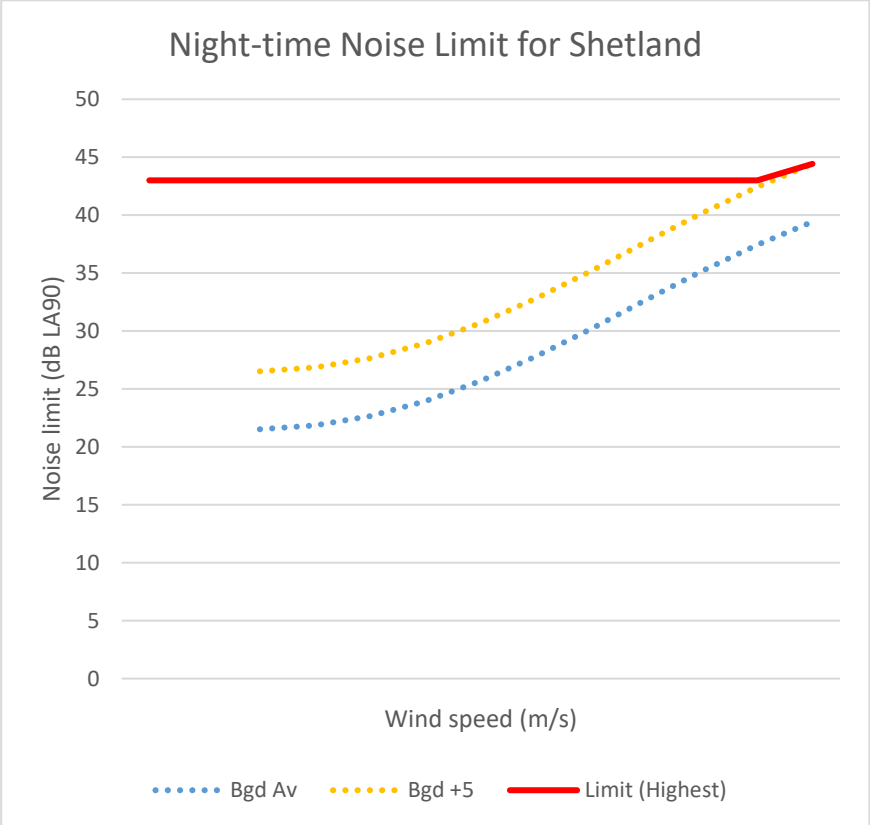
Significant noise impact

A significant noise impact is shown when the predicted Sound Pressure Level of the turbine at noise sensitive receptor $(L_{p,Xm})$ is greater than the day-time or night-time noise limit. Exceedances should be rounded to the nearest whole number.

Graph 1: Day-time noise limit (limited to 40 dB L_{A90})



Graph 2: Night-time noise limit (limited to 43 dB L_{A90})



1. Appendix A

Location	Planning Ref	Date	Time	0	1	2	3	4	5	6	7	8	9	10	11	12
Yell- Nessview	2016/098/ECUCON	20/01/2016	Daytime	-	-	22.7	23.2	24.9	27.4	30.4	33.6	36.8	39.6	41.8	43.0	-
Yell- Whirliegarth	2016/098/ECUCON	20/01/2016	Daytime	-	-	24.5	24.5	25.0	26.3	28.1	30.4	32.9	35.5	37.9	-	-
Yell- Easterlee	2016/098/ECUCON	20/01/2016	Daytime	-	-	24.5	25.3	26.7	28.4	30.5	32.7	35.0	37.4	39.6	41.7	-
Yell- Lower Holligarth	2016/098/ECUCON	20/01/2016	Daytime	-	-	25.2	25.2	26.1	27.9	30.3	32.8	35.1	36.9	37.7	37.2	-
Yell- Heatherlea	2016/098/ECUCON	20/01/2016	Daytime	-	-	25.7	26.4	28.0	30.4	33.2	36.3	39.4	42.2	44.6	46.3	-
Mossy Hill-South Califf	2018/186/PPF	12/06/2018	Daytime	-	19.1	19.1	20.6	22.3	24.0	25.9	27.8	29.8	31.8	33.7	35.7	37.6
Mossy Hill-Decca	2018/186/PPF	12/06/2018	Daytime	-	22.4	22.4	22.6	23.7	25.4	27.5	29.9	32.3	34.6	36.6	38.1	38.9
Mossy Hill-Rocklea	2018/186/PPF	12/06/2018	Daytime	-	28.3	28.3	29.0	30.0	31.1	32.2	33.4	34.6	35.8	36.8	37.7	38.3
Mossy Hill-Easterhoull	2018/186/PPF	12/06/2018	Daytime	-	31.2	31.2	31.6	32.3	33.3	34.6	36.1	37.7	39.5	41.3	43.0	44.7
Mossy Hill-Veensgarth	2018/186/PPF	12/06/2018	Daytime	-	31.8	31.8	33.1	34.3	35.2	36.1	36.9	37.7	38.7	39.9	41.3	43.1
Mossy Hill-Scalloway	2018/186/PPF	12/06/2018	Daytime	-	33.8	33.8	34.6	35.2	35.6	36.1	36.6	37.2	38.0	39.0	40.3	42.0
Mossy Hill-Frakkafield	2018/186/PPF	12/06/2018	Daytime	-	34.1	34.1	34.4	35.2	36.2	37.4	38.6	39.7	40.6	41.1	41.1	41.1
Yell2-Cullivoe	2019/127/ECUCON	15/08/2018	Daytime	-	-	18.3	20.9	23.3	25.4	27.4	29.4	31.5	33.8	36.3	39.3	42.7
Yell2-Gloup	2019/127/ECUCON	15/08/2018	Daytime	-	-	18.5	22.4	25.1	26.9	28.0	28.9	29.8	31.2	33.2	36.3	40.8
Yell2-Hill of Breckon	2019/127/ECUCON	15/08/2018	Daytime	-	-	21.1	20.2	20.7	22.2	24.5	27.4	30.6	33.9	37	39.7	41.7
Yell2-Sellafirth	2019/127/ECUCON	15/08/2018	Daytime	-	-	23.4	25.2	26.9	29.1	31.2	33.2	34.9	36.3	37.2	37.3	36.8
Viking-NML1-HaaButtons	2018/335	25/10/2018	Daytime	-	21.9	22.9	24.0	25.1	26.3	27.6	29.0	30.3	31.8	33.3	34.8	36.4
Viking-NML2–Grunnafirth	2018/335	25/10/2018	Daytime	-	22.0	22.0	22.5	23.6	25.2	27.1	29.3	31.6	33.8	35.9	37.6	38.9
Viking-NML3–Hamelea	2018/335	25/10/2018	Daytime	-	19.6	19.6	19.9	21.1	23.1	25.6	28.5	31.6	34.7	37.8	40.5	42.9
Viking-NML4-SouthNewing	2018/335	25/10/2018	Daytime	-	18.9	18.9	19.6	20.9	22.6	24.6	26.8	29.1	31.5	33.7	35.6	37.2
Viking-NML5–Vergan	2018/335	25/10/2018	Daytime	-	23.0	23.5	24.8	26.5	28.6	31.1	33.7	36.3	38.9	41.2	43.3	44.9
Viking-NML6–Sandwater	2018/335	25/10/2018	Daytime	-	24.6	24.6	25.4	26.7	28.5	30.7	33.1	35.6	38.1	40.5	42.7	44.5
Viking-NML7-SetterHouse	2018/335	25/10/2018	Daytime	-	24.6	24.6	24.6	25.0	25.9	27.1	28.7	30.6	32.7	35.0	37.5	40.0
Viking-NML8–Langerview	2018/335	25/10/2018	Daytime	-	21.8	22.8	23.9	25.1	26.5	28.0	29.7	31.4	33.3	35.3	37.4	39.6
Viking-NML9–Gruids	2018/335	25/10/2018	Daytime	-	19.9	19.9	20.2	20.8	21.9	23.3	25.2	27.4	30.1	33.2	36.6	40.5
Viking-NML10–Naelea	2018/335	25/10/2018	Daytime	-	20.5	21.3	22.2	23.3	24.6	26.2	28.0	30.2	32.7	35.7	39.1	43.0
Viking-NML11–Hoddins	2018/335	25/10/2018	Daytime	-	22.7	23.7	24.6	25.4	26.3	27.4	28.6	30.1	31.9	34.2	37.0	40.3
Viking-NML12*-Setter	2018/335	25/10/2018	Daytime	-	20.5	22.4	24.0	25.5	26.8	28.2	29.5	31.0	32.6	34.4	36.6	39.1
Viking-NML13–Moustoft	2018/335	25/10/2018	Daytime	-	25.0	25.1	25.5	26.1	26.9	27.9	29.2	30.7	32.5	34.6	36.9	39.4

Location	Planning Ref	Date	Time	0	1	2	3	4	5	6	7	8	9	10	11	12
Yell- Whirliegarth	2016/098/ECUCON	20/01/2016	Night-time	-	-	21.8	21.8	22.7	24.7	27.3	30.3	33.2	35.9	37.8	38.7	-
Yell- Easterlee	2016/098/ECUCON	20/01/2016	Night-time	-	-	21.4	22.2	23.7	25.6	27.9	30.4	33.0	35.6	38.0	40.1	-
Yell- Nessview	2016/098/ECUCON	20/01/2016	Night-time	-	-	21.1	22.4	24.2	26.3	28.8	31.3	34.0	36.6	39.0	41.1	-
Yell- Heatherlea	2016/098/ECUCON	20/01/2016	Night-time	-	-	21.3	22.9	25.1	27.7	30.5	33.5	36.5	39.5	42.3	44.8	46.8
Yell- Lower Holligarth	2016/098/ECUCON	20/01/2016	Night-time	-	-	23.5	24.3	25.5	27.0	28.7	30.6	32.6	34.5	36.3	37.8	39.0
Mossy Hill-Scalloway	2018/186/PPF	12/06/2018	Night-time	-	27.8	27.8	27.8	27.8	28.2	28.9	30.0	31.3	32.9	34.7	36.6	38.7
Mossy Hill-Frakkafield	2018/186/PPF	12/06/2018	Night-time	-	27.3	27.3	28.3	29.5	30.7	32.0	33.4	34.8	36.1	37.5	37.5	37.5
Mossy Hill-Rocklea	2018/186/PPF	12/06/2018	Night-time	-	23.8	23.8	23.8	23.8	24.1	24.9	26.1	27.6	29.6	31.8	34.3	37.1
Mossy Hill-Decca	2018/186/PPF	12/06/2018	Night-time	-	20.2	20.2	20.2	20.6	21.8	23.5	25.6	28.0	30.4	32.8	34.9	36.6
Mossy Hill-Easterhoull	2018/186/PPF	12/06/2018	Night-time	-	20.2	20.2	20.2	20.6	21.8	23.5	25.6	28.0	30.4	32.8	34.9	36.6
Mossy Hill-Veensgarth	2018/186/PPF	12/06/2018	Night-time	-	21.2	21.2	21.3	22.1	23.5	25.3	27.3	29.5	31.6	33.5	35.0	36.1
Mossy Hill-South Califf	2018/186/PPF	12/06/2018	Night-time	-	20.1	20.1	20.1	20.5	21.3	22.5	23.9	25.5	27.1	28.8	30.4	31.8
Yell2-Sellafirth	2019/127/ECUCON	15/08/2018	Night-time	-	-	17.7	18.0	19.8	22.4	25.6	29.1	32.3	35.2	37.4	38.8	39.3
Yell2-Cullivoe	2019/127/ECUCON	15/08/2018	Night-time	-	-	21.6	20.1	19.7	20.3	21.7	23.6	26.0	28.7	31.5	34.2	36.7
Yell2-Hill of Breckon	2019/127/ECUCON	15/08/2018	Night-time	-	-	19.1	19.8	20.8	22.0	23.4	24.9	26.6	28.4	30.2	32.1	33.9
Yell2-Gloup	2019/127/ECUCON	15/08/2018	Night-time	-	-	22.1	22.4	22.8	23.4	24.2	25.0	26.0	26.9	28.0	29.0	30.0
Viking-NML7-SetterHouse	2018/335	25/10/2018	Night-time	-	18.8	18.8	18.9	19.7	21.0	22.9	25.4	28.4	31.8	35.7	40.0	44.7
Viking-NML10–Naelea	2018/335	25/10/2018	Night-time	-	17.8	17.8	17.9	19.0	21.0	23.7	26.9	30.4	34.0	37.6	40.8	43.6
Viking-NML9–Gruids	2018/335	25/10/2018	Night-time	-	18.6	18.6	18.6	19.7	21.8	24.7	28.1	31.5	34.9	37.8	39.9	41.1
Viking-NML8–Langerview	2018/335	25/10/2018	Night-time	-	18.4	18.5	18.8	19.5	20.5	21.9	23.8	26.0	28.8	32.1	35.9	40.4
Viking-NML12*-Setter	2018/335	25/10/2018	Night-time	-	18.8	18.8	19.0	19.7	20.9	22.6	24.7	27.1	29.9	32.9	36.2	39.6
Viking-NML2–Grunnafirth	2018/335	25/10/2018	Night-time	-	20.9	20.9	20.9	21.2	21.8	22.7	24.0	25.8	28.1	31.0	34.5	38.7
Viking-NML6–Sandwater	2018/335	25/10/2018	Night-time	-	21.2	20.9	21.1	21.7	22.7	24.1	25.8	27.8	30.1	32.7	35.4	38.4
Viking-NML4-SouthNewing	2018/335	25/10/2018	Night-time	-	19.5	19.5	19.5	19.5	20.0	21.1	22.8	25.0	27.7	30.7	34.1	37.7
Viking-NML1-HaaButtons	2018/335	25/10/2018	Night-time	-	17.1	17.1	17.1	18.0	19.5	21.5	24.0	26.7	29.6	32.5	35.2	37.6
Viking-NML3–Hamelea	2018/335	25/10/2018	Night-time	-	18.4	18.4	18.4	18.7	19.6	21.1	23.1	25.5	28.1	30.8	33.6	36.3
Viking-NML11–Hoddins	2018/335	25/10/2018	Night-time	-	17.9	17.9	17.9	18.2	19.1	20.5	22.4	24.6	27.1	29.7	32.5	35.2
Viking-NML5–Vergan	2018/335	25/10/2018	Night-time	-	20.6	21.0	21.3	21.8	22.5	23.3	24.3	25.6	27.1	28.9	31.1	33.6
Viking-NML13–Moustoft	2018/335	25/10/2018	Night-time	-	18.3	18.3	18.5	18.8	19.4	20.2	21.3	22.6	24.1	26.0	28.1	30.4

2. Appendix B

From IoA - Diploma in Acoustics and Noise Control – General Principles of Acoustics – Unit 1

Averaging sound pressure levels

Sometimes it is necessary to find the average value of a number of sound level measurements. A good example would be in building acoustics where in order to find a representative value of the sound level in a room a number of measurements are taken at different positions within the room, and an average value is calculated.

The appropriate average value, L_{Av}, is that which corresponds to the average sound intensity, or the average value of p^2. The average value, L_{Av}, of several levels, L_1 , L_2 ,L_3 , ...L_N may also be calculated using the formula:

$$L_{Av} = 10\log[(10^{L_1/10} + 10^{L_2/10} + 10^{L_3/10} + 10^{L_4/10} \ldots\ldots\ldots + 10^{L_N/10})\times(1/N)]$$