



APPENDIX 12-2

***Noise Modelling Assumptions
and Parameters***

APPENDIX 12-2. NOISE MODELLING PARAMETERS

Prediction calculations for turbine noise have been conducted in accordance with ISO 9613: *Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation*, 1996. Guidance in terms of the calculation settings has been obtained from the *Institute of Acoustics (IOA) Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (2013) (IOA GPG) and its associated supplementary guidance notes. The following are the main aspects that have been considered in terms of the noise predictions presented in this instance.

Ground Effect:

Ground effect is the result of sound reflected by the ground interfering with the sound propagating directly from source to receiver. The prediction of ground effects is inherently complex and depend on source height receiver height propagation height between the source and receiver and the ground conditions.

The ground conditions are described according to a variable defined as G, which varies between 0.0 for hard ground (including paving, ice concrete) and 1.0 for soft ground (includes ground covered by grass trees or other vegetation).

Noise predictions have been carried out using a source height corresponding to the hub height of the proposed turbines, a receiver height of 4m and a ground effect factor of G=0.5.

Geometrical Divergence

This term relates to the spherical spreading in the free-field from a point sound source resulting in an attenuation depending on distance according to the following equation:

$$A_{geo} = 10 \log(d) - 11 \text{ dB}$$

where d = distance from the source

A wind turbine may be considered as a point source beyond a distance corresponding to one rotor diameter.

Atmospheric Adsorption

Sound propagation through the atmosphere is attenuated by the conversion of the sound energy into heat. This attenuation is dependent on the temperature and relative humidity of the air through which the sound is travelling and is frequency dependent with increasing attenuation towards higher frequencies.

In accordance with the guidance set out in the IOA GPG for calculations, a temperature of 10°C and a relative humidity of 70% have been used, which give relatively low levels of atmosphere attenuation and corresponding worst case noise predictions.

Topographic Screening

In the IOA GPG, section 4.3.11 the following is stated: "*Topographic screening effects of the terrain (ISO 9613-2, Equation 12) should be limited to a reduction of no more than 2 dB, and then only if there is no direct line of sight between the highest point on the turbine rotor*

and the receiver location." The modelling software takes account of these limitations on the degree of screening from terrain. The "valley correction" from section 4.3.9 of the IOA GPG is also applied where relevant.

The atmospheric attenuation outlined in Table A12-1 were used for all calculations in accordance with the guidance outlined in the IOA GPG. No meteorological corrections were applied to all calculations.

Table A12-1 Atmospheric Attenuation Assumed for Noise Calculations (dB per km)

Temp (°C)	% Humidity	Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
10	70	0.12	0.41	1.04	1.92	3.66	9.70	33.06	118.4

Table A12-2 Coordinates (ITM) for Noise Sensitive Locations (NSLs)

ID	ITM X	ITM Y	Nearest Turbine (m)	ID	ITM X	ITM Y	Nearest Turbine (m)
H001	528,694	777,342	644.4	H171	528,065	780,854	2227
H002	529,804	777,953	646.9	H172	526,314	779,597	2228
H003	527,848	779,108	657.4	H173	528,297	775,589	2271.3
H004	528,917	779,078	657.8	H174	526,276	779,638	2280.2
H005	529,816	777,993	666.9	H175	526,266	779,652	2295.2
H006	528,868	779,097	671.8	H176	528,933	780,867	2306.1
H007	527,714	778,927	676	H177	531,311	776,910	2306.2
H008	529,816	778,026	681.4	H178	528,363	780,975	2332.9
H009	529,382	777,109	696.1	H179	526,237	779,716	2349.5
H010	529,703	778,548	698.3	H180	531,372	776,912	2362.4
H011	529,044	779,092	712.6	H181	526,550	776,233	2394.6
H012	529,897	777,641	725.1	H182	526,218	779,794	2402.9
H013	529,936	777,876	740.7	H183	526,442	780,144	2409.7
H014	529,771	778,511	743.7	H184	528,341	775,413	2448
H015	529,278	778,991	752.5	H185	526,127	779,744	2460.1
H016	527,575	778,087	755	H186	530,843	779,957	2487.7
H017	529,860	778,118	756.4	H187	530,830	779,973	2489.7
H018	527,616	778,349	758.6	H188	530,816	779,987	2490.5
H019	527,555	777,999	759	H189	530,788	780,020	2495.2
H020	529,417	777,048	759.2	H190	531,241	779,467	2496.3
H021	528,466	779,390	760.3	H191	531,268	779,433	2502.4
H022	527,621	778,967	765.9	H192	531,504	778,923	2515
H023	527,535	777,784	767.5	H193	531,334	779,339	2515.2
H024	527,873	777,219	774.1	H194	531,487	778,989	2519.1
H025	529,397	778,913	777	H195	528,249	781,171	2530.3
H026	527,641	779,047	790.3	H196	526,040	779,732	2533.3
H027	527,702	779,138	792	H197	531,521	778,936	2534.9
H028	527,680	779,112	793.8	H198	526,095	779,848	2537.3

H029	529,936	777,524	798.7	H199	525,897	779,377	2538.8
H030	529,837	778,511	798.9	H200	530,993	779,876	2540.3
H031	528,313	779,455	812.6	H201	531,537	778,948	2553.7
H032	529,924	778,237	818.5	H202	531,454	779,176	2554.7
H033	529,923	778,286	824.8	H203	528,246	781,203	2561.5
H034	529,957	777,473	830.9	H204	531,304	779,496	2565.7
H035	528,228	779,511	868.6	H205	528,176	781,209	2571.7
H036	529,880	778,582	870.3	H206	531,355	779,426	2574.9
H037	528,382	776,985	874.3	H207	531,557	778,966	2578.3
H038	529,415	776,932	876	H208	526,075	779,904	2580.9
H039	529,984	777,380	898.8	H209	526,068	779,898	2584.7
H040	528,330	776,957	899.1	H210	526,028	779,827	2586.2
H041	527,486	777,460	903.2	H211	526,078	779,923	2587.9
H042	529,223	779,223	904.5	H212	526,072	779,932	2597.2
H043	529,476	776,898	920.8	H213	526,486	780,477	2599.2
H044	528,397	776,932	928.6	H214	530,232	780,582	2599.9
H045	529,238	779,241	932.5	H215	526,050	779,903	2602.6
H046	527,485	777,390	938.3	H216	526,060	779,939	2611.6
H047	527,401	777,541	952.2	H217	526,019	779,866	2612.5
H048	530,009	777,260	978.1	H218	525,814	779,360	2613
H049	527,378	778,223	979.6	H219	526,090	779,993	2613.6
H050	528,598	776,905	989.4	H220	526,084	780,005	2624.5
H051	528,356	779,644	1001.9	H221	526,051	779,952	2626.5
H052	528,513	776,860	1021.6	H222	526,048	779,957	2630.6
H053	528,540	776,844	1043	H223	531,601	779,000	2631.1
H054	527,757	776,972	1044.5	H224	526,079	780,011	2632.1
H055	530,061	777,195	1060.9	H225	531,611	778,987	2636.4
H056	528,565	776,815	1077	H226	531,527	779,229	2642.7
H057	529,301	779,370	1080.1	H227	530,711	780,278	2643.6
H058	527,912	779,652	1091.4	H228	526,061	780,006	2644.9
H059	527,427	777,210	1093.6	H229	526,057	780,001	2646.1
H060	528,341	779,748	1105.6	H230	526,038	779,970	2646.4
H061	527,404	777,174	1133.6	H231	531,630	778,968	2648.6
H062	528,452	779,774	1138.4	H232	526,034	779,975	2651.9
H063	530,097	777,086	1153	H233	525,686	778,282	2654.2
H064	527,555	776,982	1155.8	H234	526,044	779,997	2654.9
H065	530,124	778,747	1168.7	H235	526,038	779,993	2657.6
H066	527,544	776,959	1180.5	H236	530,013	780,788	2666.6
H067	527,396	777,101	1185.4	H237	531,629	779,067	2678.6
H068	528,503	779,816	1186.6	H238	526,872	780,899	2685
H069	529,145	776,591	1186.8	H239	531,660	779,022	2694
H070	529,234	779,524	1191.3	H240	525,691	777,201	2697.5
H071	530,348	778,046	1204	H241	530,703	780,356	2701.2
H072	527,386	777,065	1216.3	H242	531,674	779,005	2701.9
H073	527,584	779,607	1217.3	H243	525,674	777,238	2705
H074	527,120	778,142	1219.1	H244	525,629	778,246	2705.1

H075	527,534	776,901	1231.6	H245	525,673	779,167	2705.3
H076	530,080	778,977	1261.4	H246	525,689	777,171	2706.8
H077	527,881	776,662	1271.6	H247	525,637	777,406	2708.2
H078	529,190	776,502	1275.5	H248	525,651	777,307	2712.1
H079	527,102	779,029	1284.3	H249	531,697	778,990	2718.6
H080	529,227	776,485	1293.5	H250	531,898	777,725	2724.9
H081	530,151	776,926	1295.7	H251	525,686	777,085	2732.5
H082	529,275	776,452	1329.2	H252	525,962	780,026	2740.2
H083	530,102	779,062	1333.1	H253	528,468	775,125	2740.9
H084	527,031	778,967	1335.8	H254	525,566	778,030	2745.8
H085	527,049	777,375	1347.6	H255	525,588	778,850	2746.5
H086	527,916	776,550	1367.3	H256	525,586	777,472	2748.2
H087	526,972	778,920	1382.9	H257	525,622	777,268	2749.1
H088	526,999	777,387	1390.2	H258	525,581	777,494	2749.8
H089	529,344	776,385	1402.7	H259	525,557	777,937	2750.7
H090	526,887	777,846	1419.2	H260	525,557	777,937	2750.7
H091	527,257	779,584	1425.1	H261	525,574	777,532	2752.5
H092	528,090	780,052	1429.2	H262	531,791	778,771	2753.6
H093	527,221	776,929	1430.1	H263	531,757	778,908	2753.7
H094	526,977	777,331	1430.7	H264	525,550	777,830	2756.5
H095	526,857	777,826	1449.5	H265	529,614	781,088	2763.8
H096	526,855	777,890	1451.4	H266	529,614	781,088	2763.8
H097	526,854	778,028	1461.8	H267	529,985	780,911	2764.6
H098	526,836	777,937	1472.1	H268	529,875	780,967	2769.9
H099	528,704	780,068	1474.5	H269	525,563	778,309	2779.9
H100	530,632	778,060	1484.8	H270	525,524	777,999	2786.2
H101	526,861	778,885	1485.7	H271	531,961	777,676	2788.5
H102	526,822	778,746	1508.3	H272	529,785	781,026	2791.4
H103	526,828	778,187	1513.8	H273	525,522	777,643	2793.4
H104	526,822	778,810	1514.1	H274	525,525	778,122	2793.8
H105	527,150	776,876	1518.5	H275	529,814	781,019	2795.3
H106	527,170	779,631	1521.6	H276	527,554	775,164	2800
H107	527,630	776,495	1523.7	H277	525,510	777,700	2800.7
H108	527,119	779,580	1528.9	H278	527,096	781,161	2803.2
H109	529,983	779,439	1536.1	H279	531,868	776,987	2807.9
H110	528,616	780,167	1551.7	H280	525,527	778,411	2809.7
H111	526,793	778,914	1557.6	H281	529,718	781,083	2809.7
H112	529,697	776,302	1565.3	H282	526,634	775,596	2815.2
H113	526,765	778,466	1571.7	H283	531,876	778,663	2816.1
H114	526,968	779,574	1647.4	H284	527,728	781,398	2820.1
H115	527,541	780,116	1669.9	H285	525,514	778,288	2824.5
H116	529,681	776,180	1675.8	H286	528,602	781,463	2834.5
H117	526,668	778,922	1682.2	H287	527,143	781,222	2837.8
H118	529,232	776,096	1682.4	H288	531,901	778,647	2838.3
H119	526,729	777,228	1699.2	H289	530,878	775,506	2840
H120	527,442	776,385	1709.9	H290	531,943	778,416	2842

H121	526,596	778,633	1730.8	H291	531,907	776,992	2843.5
H122	526,615	778,941	1737.6	H292	528,019	781,471	2845.7
H123	529,808	776,154	1742.7	H293	525,951	780,223	2853.7
H124	529,660	776,103	1743.4	H294	527,450	781,363	2858.5
H125	526,590	778,825	1746.3	H295	531,932	778,620	2864.2
H126	529,851	776,161	1752.3	H296	525,958	780,261	2869.8
H127	529,630	776,068	1769.1	H297	527,613	781,425	2872.4
H128	526,529	778,472	1805.8	H298	526,264	775,840	2873
H129	530,953	778,096	1807	H299	527,743	781,460	2877.6
H130	526,537	778,937	1813.8	H300	528,450	774,986	2878.3
H131	529,621	776,019	1814.3	H301	527,701	781,458	2884.6
H132	527,361	780,208	1839.4	H302	525,456	778,364	2884.9
H133	527,148	780,065	1847.4	H303	527,888	781,494	2885.7
H134	528,775	780,442	1854.5	H304	527,859	781,490	2885.7
H135	526,440	777,985	1870.3	H305	530,964	775,511	2888.2
H136	529,618	775,954	1876.6	H306	525,956	780,292	2888.5
H137	526,690	779,581	1886.7	H307	525,432	777,483	2899.1
H138	530,974	778,424	1888.2	H308	527,939	781,516	2899.6
H139	528,400	775,967	1895.8	H309	531,961	778,671	2901.8
H140	528,348	775,954	1906.9	H310	531,993	778,508	2910.7
H141	531,011	778,351	1917.1	H311	531,962	778,719	2910.8
H142	528,322	775,933	1927.5	H312	531,976	778,656	2913.7
H143	530,028	776,034	1941.2	H313	531,993	778,634	2927.2
H144	530,216	779,806	1970.4	H314	529,905	781,132	2934
H145	529,856	775,924	1974.8	H315	532,007	778,617	2938.4
H146	528,666	780,594	1980.7	H316	532,107	777,596	2938.9
H147	531,019	778,683	1982.1	H317	528,583	781,575	2944.4
H148	527,150	776,229	1999.6	H318	525,389	777,424	2950.1
H149	530,018	780,023	2021.5	H319	532,022	778,604	2951.8
H150	531,133	777,245	2029.9	H320	527,503	781,477	2952.4
H151	527,989	780,652	2037.7	H321	526,429	780,908	2956
H152	526,268	777,916	2039.2	H322	529,927	781,148	2957.3
H153	530,429	776,166	2042.3	H323	525,536	779,672	2974.6
H154	526,374	779,310	2064.4	H324	529,943	781,162	2976.4
H155	528,034	780,689	2067.8	H325	532,058	778,567	2981.8
H156	526,220	777,730	2090.8	H326	532,057	777,004	2984.9
H157	526,346	779,329	2096.4	H327	532,072	778,553	2994.5
H158	528,257	775,763	2097.9	H328	529,340	781,464	2998.7
H159	526,366	779,415	2107.8	H329	529,621	778,722	749.8
H160	531,223	777,216	2124.2	H330	529,113	779,015	678.7
H161	531,200	777,136	2125.1	H331	530,555	777,934	1389.4
H162	526,334	779,397	2130.8	H332	530,497	777,927	1331.4
H163	528,046	780,759	2135.4	H333	530,592	777,918	1425.1
H164	526,337	779,431	2140	H334	530,078	779,409	1569.2
H165	529,570	780,446	2172.7	H335	528,809	779,934	1379.2
H166	530,256	775,883	2181.7	H336	526,430	778,264	1919.3

H167	528,300	775,675	2185.5	H337	526,816	778,056	1502.8
H168	528,378	780,848	2206.2	H338	526,759	777,244	1665.7
H169	526,294	779,513	2211.7	H339	530,509	776,437	1892.5
H170	526,294	779,513	2211.7	H340	528,553	780,261	1634.7

Table A12-3 presents the proposed wind turbines locations in Irish Transverse Mercator coordinates system.

Table A12-3 Turbine Coordinates in Irish Transverse Mercator

Turbine ID	ITM X	ITM Y
T1	528,306	777,860
T2	528,467	778,197
T3	528,831	777,975
T4	529,101	778,181
T5	529,174	777,777
T6	528,789	778,419
T7	528,327	778,643

Table A12-4 present the turbine sound power noise emission values used for the wind farm development in the noise prediction model.

Table A12-4 L_{WA} Levels Used for Prediction Model – Vestas V136-4.5MW at 92 m Hub Height

Wind Speed (m/s at 10m Standardised Height)	Octave Bank Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
3	70.9	79.0	84.3	86.6	86.0	82.5	76.1	66.7	91.6
4	74.5	82.7	87.9	90.2	89.3	85.4	78.6	68.5	95.0
5	79.3	87.5	92.8	95.0	94.3	90.5	83.7	73.9	99.9
6	82.8	91.1	96.3	98.6	97.7	93.8	87.0	76.9	103.4
7	83.2	91.5	96.7	99.0	98.3	94.6	87.9	78.2	103.9
8	82.6	90.8	96.2	98.7	98.5	95.4	89.6	80.9	103.9