FEHILY TIMONEY

CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
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APPENDIX 9.1

Baseline Noise Measurements

Baseline Noise Measurements

Baseline noise monitoring was undertaken at four Noise Sensitive Locations (NSLs), locations H1, H40, H48 and H71, to establish the existing background noise levels at these locations. These locations represent the nearest residential locations to the north, south east and west of the Proposed Wind Farm.

Selection of Monitoring Locations

Section 2.2.5 of the Institute of Acoustics', *A Good Practice Guide to the Application of ETUS-R-97 for the Assessment at Rating of Wind Turbine Noise* (2013) (IOA GPG) regarding use of proxy locations states "*When choosing a location that will serve as a proxy for others, the basis for selection is that it can reasonably be claimed, from inspection and observation, to be representative of the non-surveyed locations, in line with the criteria of Section 2.5. Measurement locations outside a property's curtilage (such as an adjacent field) may be used when access to a representative property cannot be obtained, provided that such a location can be justified as being representative. No general guidance can therefore be given on the number of measurement locations as this will be site-specific.*" Section 2.5 of the GPG is summarised in Table 7.1.1 with the applicability of the proxy locations selected for the Proposed Wind Farm.

Table 9.1.1: IOA GPG Section 2.5 Criteria and Applicability to Proposed Wind Farm Monitoring Locations

Requirements of Section 2.5	Proposed Wind Farm Monitoring Locations
2.5.1 *Where possible, measurements should be made in the vicinity of a dwelling in an area frequently used for rest and recreation.*	Location H1 was in a field south of an adjacent property. The noise monitoring location was approximately 80m from the property façade. This was chosen so that the noise monitoring location had direct line of sight to the Proposed Wind Farm and also was not blocked from the Proposed Wind Farm by farm buildings. Location H40 was in a field next to the property approximately 8m from the nearest building façade, in the direction of the Proposed Wind Farm. Location H48: The noise monitoring location was in a field to the rear of the property approximately 10m from the rear façade of the property. The noise monitoring location was chosen to have a line of sight to the Proposed Wind Farm. The amenity area at the property is south of the house. Location southeast of the proposed site was in a field opposite the nearest property, opposite location H71 and approximately 140m from the property. This represents the amenity area at the property.

Requirements of Section 2.5	Proposed Wind Farm Monitoring Locations
2.5.2 *Equipment should be placed at outdoor positions where noise levels are representative of typical 'low' levels likely to be experienced in the vicinity of a dwelling (or group of dwellings if the measurements are intended to be applied to more than one dwelling). The overriding consideration is that it can reasonably be claimed, from inspection and observation, that there are no other suitable noise-sensitive locations, in the vicinity of any selected location and close to a dwelling, where background noise levels would be expected to be consistently lower than the levels at the selected position.*	This was adhered to for all measurement locations.
2.5.3 *Ideally the position should be one which would be exposed to noise from the wind turbines whilst being best-screened from other noise sources such as nearby roads or vegetation.*	The locations were in open areas or within the curtilage of a dwelling, set back from local roads and vegetation/ forestry where possible. Locations were chosen to have a direct line of sight to the Proposed Wind Farm development.
2.5.4 *The background surveys provide the basis for setting both daytime and night-time noise limits: the measurement position must therefore reasonably represent external areas (for daytime noise) and also building façades containing windows (for night-time noise).*	The locations being used to derive limits are representative of external areas and façade locations.
2.5.5 *In most locations, background noise levels will be determined by wind in trees and vegetation and noise sources external to the property such as traffic noise. The presence of local noise sources such as boiler flues, garden fountains, domestic drains, watercourses and farm equipment should be identified.*	Noise sources are described in the following sections. Generally noise was from wind in trees and vegetation and noise from agricultural activities and light local traffic. No other local sources were noted during the survey.
2.5.6 *Where it is not possible to exclude the influence of variable local noise sources by selection of monitoring position, it is generally possible to identify such data from inspection of noise level time histories and therefore to exclude it from the data set used to derive noise limits*	Attendance at the monitoring location during installation, battery changes and equipment collection did not identify any variable noise sources. Non-typical data was removed from data analysis.
2.5.7 *In all cases, microphones should be supported at a height of 1.2 – 1.5 metres above the ground and no closer than 3.5 metres to any significant reflecting surface (such as a building or fence), except the ground. The position should be within 20 metres of the dwelling unless there are particular reasons for measuring at a more distant position (such as the presence of vegetation or denial of access); if so, the reasons should be explained.*	The microphones were mounted on tripods at approximate height of 1.5 m and at least 3.5 m from any significant reflecting surface other than the ground. Where possible the noise monitors were located within 20 m. When the noise monitors were located at more distant locations this to ensure the measurement location had a good line of sight to the Proposed Wind Farm and was avoiding trees.

Requirements of Section 2.5	Proposed Wind Farm Monitoring Locations
2.5.8 *A resident at a selected property may request that measurements are made at a position which is considered inappropriate; perhaps because the preferred location(s) are inconvenient (it might obstruct lawn mowing, for example). In this situation the consultant should explain clearly the reasons why the measurements could be compromised; if no agreement can be reached, an alternative property or location should be sought. The assistance of the EHO may help to resolve these situations.*	This was not an issue.

Monitoring Locations

Noise monitoring was conducted at four locations, selected for obtaining a detailed representation of the background noise levels at NSLs surrounding the Proposed Development. Details of the four noise monitoring locations are provided in Table 7.1.2. The position of the monitoring locations is shown in Figure 7.2.

Table 9.1.2: Details on the Noise Monitoring Locations

Location ID	Easting	Northing	Description	Photograph
H1	534934	563889	This location is north east of the Proposed Wind Farm. The noise monitor was in a field approximately 80m from the representative property, with direct line of sight to the Proposed Wind Farm.	Plate 7.1-1
H40	532783	563850	This location is north west of the Proposed Wind Farm. This location was in a field next to a property, approximately 8m from the property façade, in the direction of the Proposed Wind Farm.	Plate 7.1-2
H48	533193	562565	This location is south west of the Proposed Wind Farm. The noise monitoring location was in a field to the rear of the property approximately 10m from the rear façade of the property. The noise monitoring location was chosen to have a line of sight to the Proposed Wind Farm. The amenity area at the property is south of the house.	Plate 7.1-3
H71	534631	562467	This location is south east of the Proposed Wind Farm. Noise was monitored in a field opposite the property, in the direction of the Proposed Wind Farm, approximately 140m north west of the property.	Plate 7.1-4

Location H1, This location is north east of the Proposed Wind Farm. The noise monitor was in a field approximately 80m from the representative property, with direct line of sight to the Proposed Wind Farm. Noise sources observed occasional light traffic on the adjacent road and noise from livestock within shed.

Plate A9.1-1: Monitoring Location H1

Location H40, This location is north west of the Proposed Wind Farm. This location was in a field next to a property, approximately 8m from the property façade, in the direction of the Proposed Wind Farm.

Plate A9.1-2: Monitoring Location H40

Location H48, This location is south west of the Proposed Wind Farm. The noise monitoring location was in a field to the rear of the property approximately 10m from the rear façade of the property. The noise monitoring location was chosen to have a line of sight to the Proposed Wind Farm. The amenity area at the property is south of the house.

Plate A9.1-3: Monitoring Location H48

Location H71, This location is south east of the Proposed Wind Farm. Noise was monitored in a field opposite the property, in the direction of the Proposed Wind Farm, approximately 140m north west of the property.

Plate A9.1-4: Monitoring Location H71

Measurement Periods

The IOA GPG states "*The duration of a background noise survey is determined only by the need to acquire sufficient valid data over the range of wind speeds. It is unlikely that this requirement can be met in less than 2 weeks.*" If insufficient wind data is collected after two weeks, the monitoring period will be extended subject to acquiring sufficient valid data over the range of wind speeds. Sufficient data was captured at all monitoring locations with a minimum of two and a half weeks' worth of data captured at all monitoring locations.

Definition of Time Periods

The following periods were analysed for this report:

Amenity/Quiet Daytime hours	18:00 – 23:00 Monday to Friday 13:00 – 18:00 Saturday 07:00 – 18:00 Sunday
Night-time hours	23:00 – 07:00

Monitoring Equipment

Baseline noise monitoring was carried out using Svantek Svan 977 and Svantek 307 Class 1 sound level meters. Details of the noise monitoring equipment are presented in Table 7.1.3. The sound level meters were fitted with 1/2" microphones. The microphones connected to the Svantek sound level meters were fitted with a UA-0237 type wind shield made from open-pored polyurethane foam with a diameter of 90mm. The setup used is in keeping with the IOA Good Practice Guidelines, 2013. Calibration certificates for each sound level meter are provided in Appendix 7.2.

Table 9.1.3: Details of Noise Monitoring Equipment

Monitoring Location	Meter Type	Lot No.	Serial Number
H1	Svantek 977	Lot 1	34173
	Svantek 977	Lot 2	69552
H40	Svantek 307	Lot2	104990
H48	Svantek 977	Lot 1	34876
	Svantek 307	Lot 2	104985
H71	Svantek 977	Lot 2	34876

A CR800 Series data logger was used to record rainfall (ARG 100) and this was located at monitoring location H48 during the 2nd lot of measurements. This meteorological data was acquired every 10 minutes simultaneously with noise data.

Monitoring Protocol

Baseline noise measurements were undertaken at four locations near the Proposed Wind Farm. Equipment was installed in two lots:

Lot 1: 15th September to 13th October 2022
Lot 2: 25th October to 15th November 2022

The following monitoring protocol was carried out at each of the monitoring locations:

1. The sound level meters were calibrated on-site and set to log L_{A90} statistics on a fast time weighted response every ten minutes.
2. Each sound level meter microphone was mounted at 1.5 m above ground level and fitted with an enhanced windshield. Each microphone was placed at least 3.5 m from reflecting surfaces to obtain 'free field' conditions.
3. Wind speed and wind direction measurements were taken from permanent mast installed on site. Wind speed was measured at a range of heights and data from anemometers at 65 m and 72 m were used to extrapolate the wind speed data up to a hub height of 72.5 m.

   The standardised 10 m wind speed was obtained from the turbine hub height wind speed by correcting it to 10 m height using a ground roughness factor of 0.05 m. Roughness length (or logarithmic) shear profile:

$$U_1 = U_2 \frac{ln\left(H_1/z\right)}{ln\left(H_2/z\right)}$$

   where U_1 is the wind speed to be calculated, U_2 is the measured wind speed, H_1 is the height of the measured wind speed to be calculated (10m), H_2 is the height of the measured wind speed and z is the ground roughness length (m). A roughness length of 0.05m is used to standardise hub height wind speeds to 10m height in the IEC 61400-11:2012 standard.

4. The L_{A90} statistic measurements were synchronised with the 10 m standardised wind speeds derived from the on-site meteorological mast data.
5. A logging rain gauge was installed at all of the measurement locations during the first lot of measurements (Lot 1). This did not function correctly and therefore a second round of measurements was conducted (Lot 2). For the first lot of measurements noise data has been removed for days where rain was recorded at the nearby weather station at Cork Airport For lot 1 noise data for the 22nd, 27th and 30th September and the 3rd to 7th and 9th of October has been removed. For the second lot of measurements rain was logged at location H48 and noise data has been removed for logged rainfall events over successive 10-minute intervals, also synchronised to the noise level and wind speed measurements. All data for lot 2 was adjusted to take account of the time change due to daylight saving hours on the 30th October 2022.
6. After the monitoring was completed, the noise meters were re-tested using the calibration noise source to ensure that the meters had not drifted.

Analysis of the Baseline Data

Following collection of the site data, the following protocol was used to analyse the baseline data:

1. The raw baseline L_{A90} noise data was reviewed to determine whether there are any periods of non-consistent noise level due to equipment malfunction.
2. The raw noise level data was then correlated with the time synchronised wind speed and rainfall data. Preliminary data analysis was used to remove datasets (L_{A90}, wind speed and occurrence of rainfall event) which contain a rainfall event as these data sets are required to be removed from further analysis in line with best practice as outlined in the IOA Good Practice Guide and Supplementary Guidance Note 2 on Data Processing.
3. The prevailing background noise for daytime periods uses the amenity/quiet daytime hours. The prevailing background noise during night-time periods excludes early morning periods to remove the dawn chorus which is not prevalent through that whole year, with data recorded between 04:00 and 07:00 was removed from further analysis.
4. Once the rainfall events have been accounted for, the remaining data was plotted using a wind speed based plot to establish whether there are any remaining data outliers, representing atypical noise sources or events.
5. Once the remaining data sets were found to be representative of the noise environment, they were analysed to ensure that sufficient data remained to provide sufficient data coverage over the necessary wind speeds. The IOA GPG requires, as a minimum, no fewer than five valid data sets across each 1 m/s wind speed from turbine cut-in to rated power. Where integer wind speeds have less than five valid data sets, the prevailing background noise trend will not be extended beyond the range covered by adequate data sets. See Section 'Data Available for Determination of Prevailing Background Noise Levels' for details.
6. A 'best fit' trend (not higher than a fourth order polynomial) was then derived to present the assumed prevailing background noise level at each monitoring location. See Section 'Results' for details.

Data Available for Determination of Prevailing Background Noise Levels

The requirement for the survey duration is dictated by the range of wind speeds to be collected. The IOA Good Practice Guide to the Application of ETSU-R-97[1] for the Assessment and Rating of Wind Turbine Noise, (May 2013) states that *"As a guideline, no fewer than 200 data points should be recorded in each of the amenity hours and night-time periods with no fewer than 5 data points in any 1 m/s wind speed bin."*

The Wind Energy Development Guidelines (Department of Environment, Heritage and Local Government, 2006) do not provide the specific periods which are represented by daytime and night-time hours, therefore the definitions from ETSU-R-97 are taken as 07:00 to 23:00 hrs for daytime and 23:00 to 07:00 hrs for night-time.

Prevailing background noise levels were derived for daytime and night-time periods. The number of valid datasets are shown in Tables 7.1.4 and 7.1.5 with wind speed ranges greyed out which did not satisfy the criteria of at least 5 data points in any 1 m/s wind speed bin.

Table 9.1.4: Number of Valid Datasets: Noise Monitoring Locations - Daytime

Wind Speed (at standardised 10 m height), m/s				
	H1	H40	H48	H71
0	18	0	0	0
1	91	0	0	0
2	128	0	0	0
3	175	22	22	22
4	109	80	80	80
5	111	115	115	115
6	116	139	139	138
7	74	151	151	150
8	30	139	139	128
9	3	113	113	99
10	3	37	37	26
11	0	40	40	6
12	0	15	15	1
13	0	2	2	0
14	0	10	10	0
15	0	2	2	0
Total Number of Data Points	858	865	865	765

[1] Department of Trade and Industry (1996), The Assessment and Rating of Noise from Wind Farms Report ETSU-R-97

Table 9.1.5: Number of Valid Datasets: Noise Monitoring Locations– Night-time

Wind Speed (at standardised 10 m height), m/s	H1	H40	H48	H71
0	1	0	0	0
1	37	0	0	0
2	53	8	9	9
3	102	28	29	29
4	104	34	34	34
5	118	69	70	70
6	49	86	86	86
7	26	56	56	54
8	12	40	41	39
9	1	45	45	38
10	1	83	83	45
11	2	77	77	21
12	0	23	23	5
13	2	0	0	0
14	2	0	0	0
15	5	0	0	0
Total Number of Data Points	515	549	553	430

Results and Discussion

In this section, the prevailing background noise level in dB L_{A90} relative to standardised 10 m height wind speeds are provided for each monitoring location as per the requirements of the survey. The prevailing background noise level is plotted as a solid line for each daytime and night-time periods at each monitoring location. In all cases, the highest order of polynomial used is a fourth order polynomials provides lines of best fit to the scatter data.

Comparing the H1 data obtained during the lot 1 measurements with that measured in 2014, the 2022 prevailing daytime the noise levels were within 2dB of that measured 2014 up to 5m/s. At higher windspeeds there was a higher difference, which is to be expected. Both sets of data were below L_{A90} 30dB for the same range of windspeeds and therefore both sets of data would give similar noise limit criteria for the daytime period. The night time prevailing noise at H1 was slightly higher (up to 4dB) in 2022 compared to 2014.

It should be noted that the noise monitoring at H1 2022 was at a farm slightly southwest of the noise monitoring location in 2014. However, the prevailing noise gave similar results. The main effect of not having a rain gauge at this property, and limiting noise to exclude days where rain occurred is that rain occurs during windier weather so the highest valid windspeed was 8m/s. The second lot of noise measurements had a better range of windspeeds (up to 12m/s).

Regardless, the noise criteria for Barnadivane are based on the quietest noise monitored at the four locations, which was based on H40 and H71.

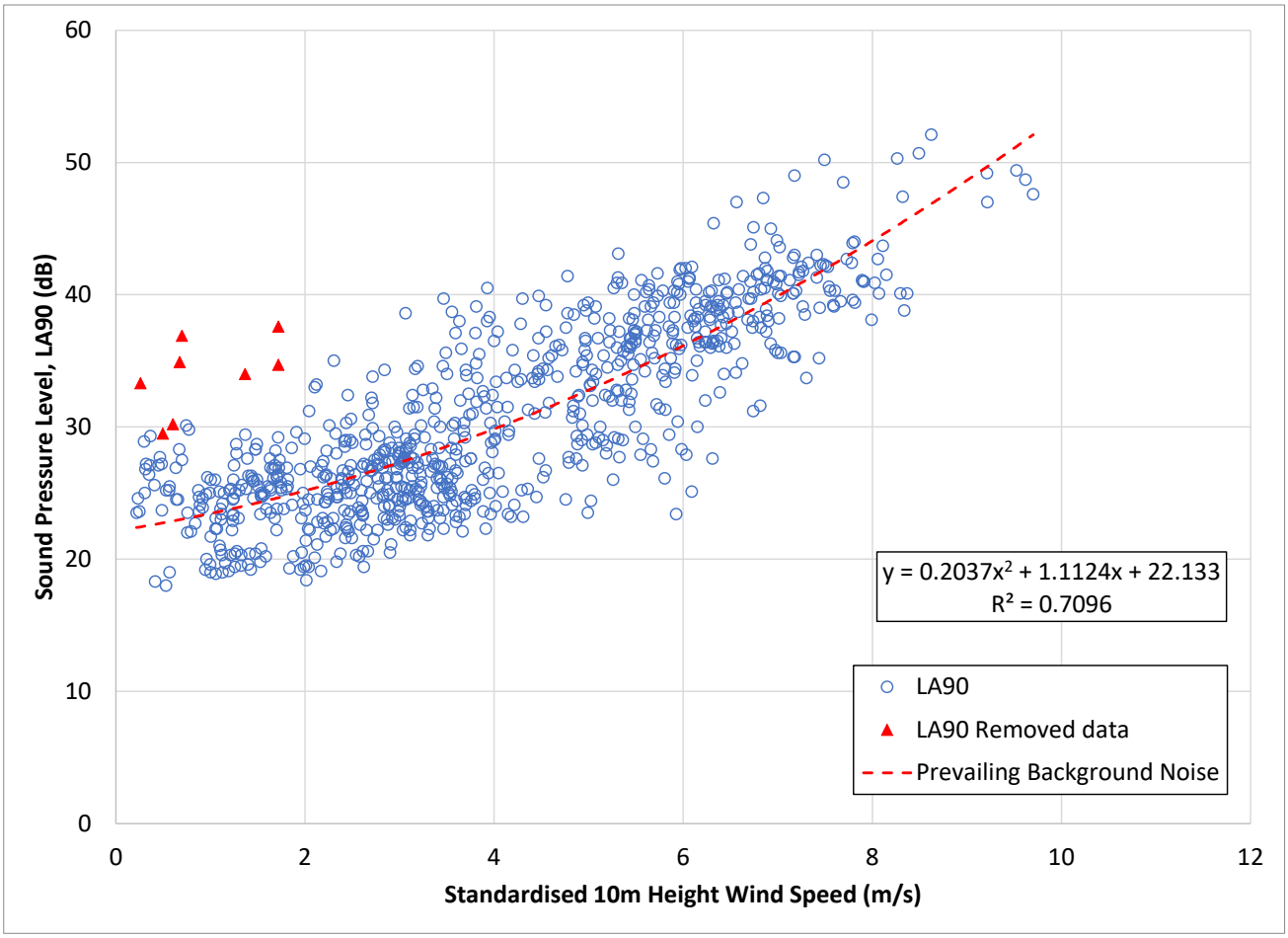

Figure A9.1: Prevailing Amenity/Daytime Background (L_{A90}) Noise Levels at H1

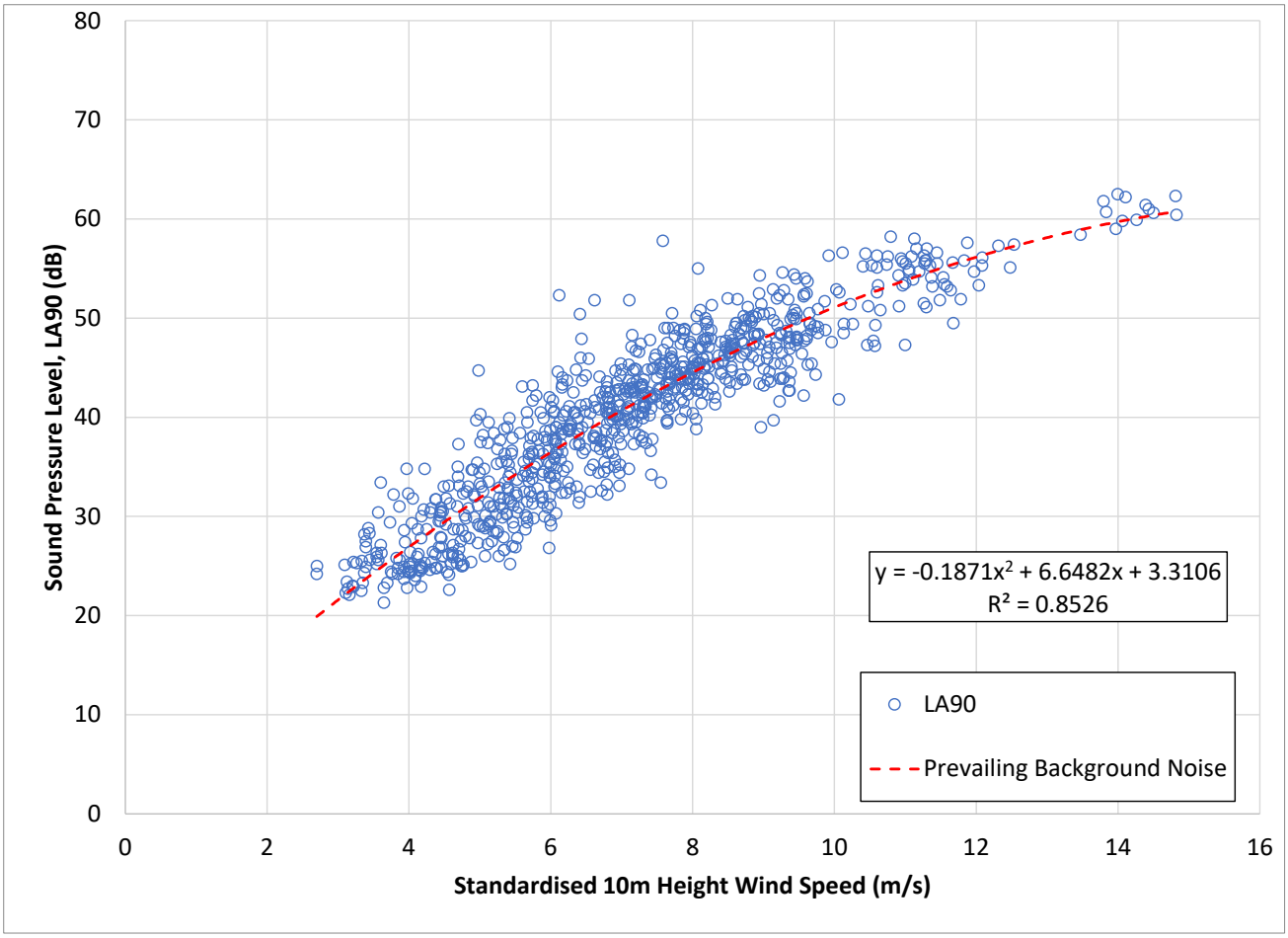

Figure A9.3: Prevailing Amenity/Daytime Background (L_{A90}) Noise Levels at H40

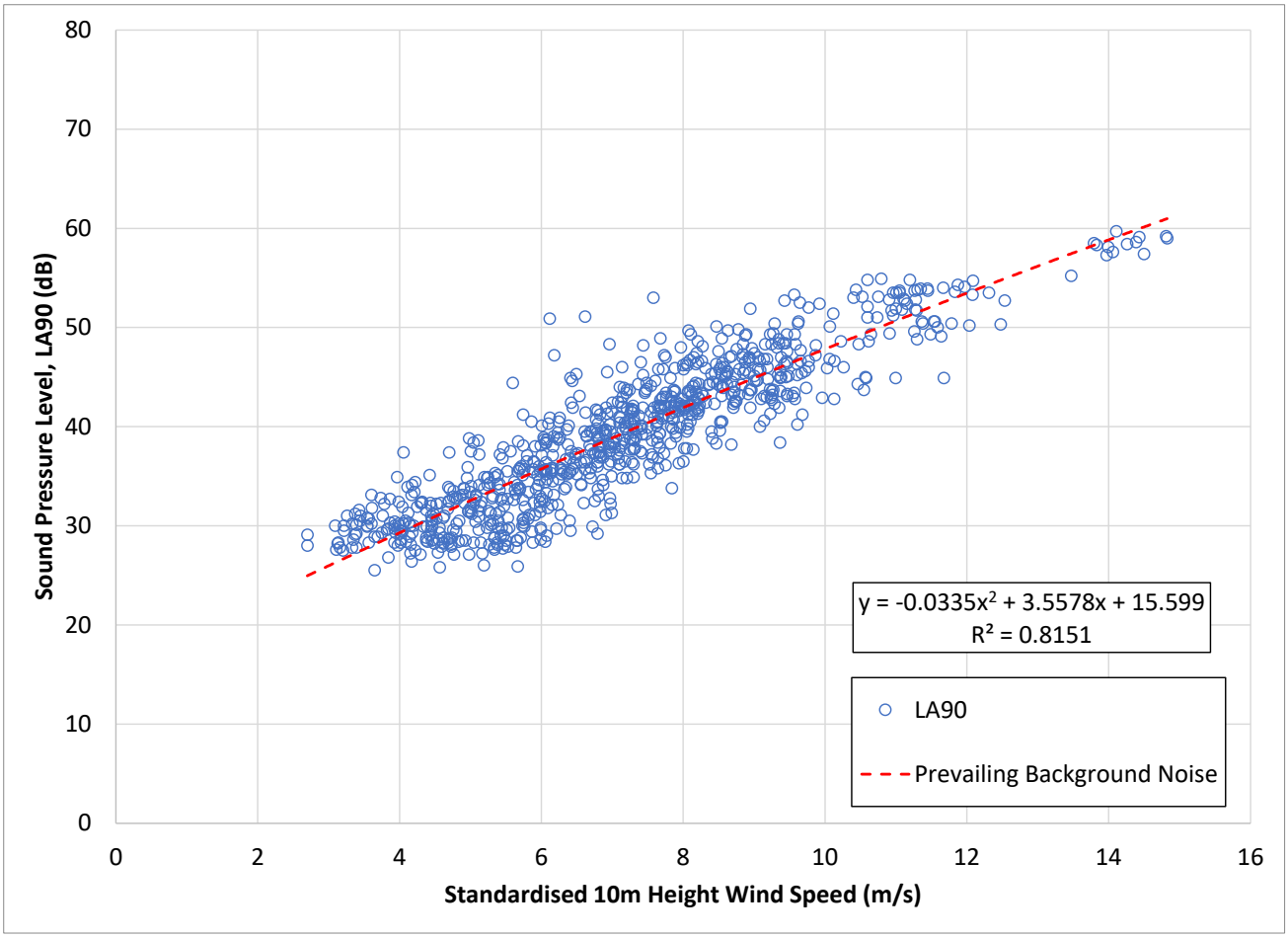

Figure A9.4: Prevailing Amenity/Daytime Background (L_{A90}) Noise Levels at H48

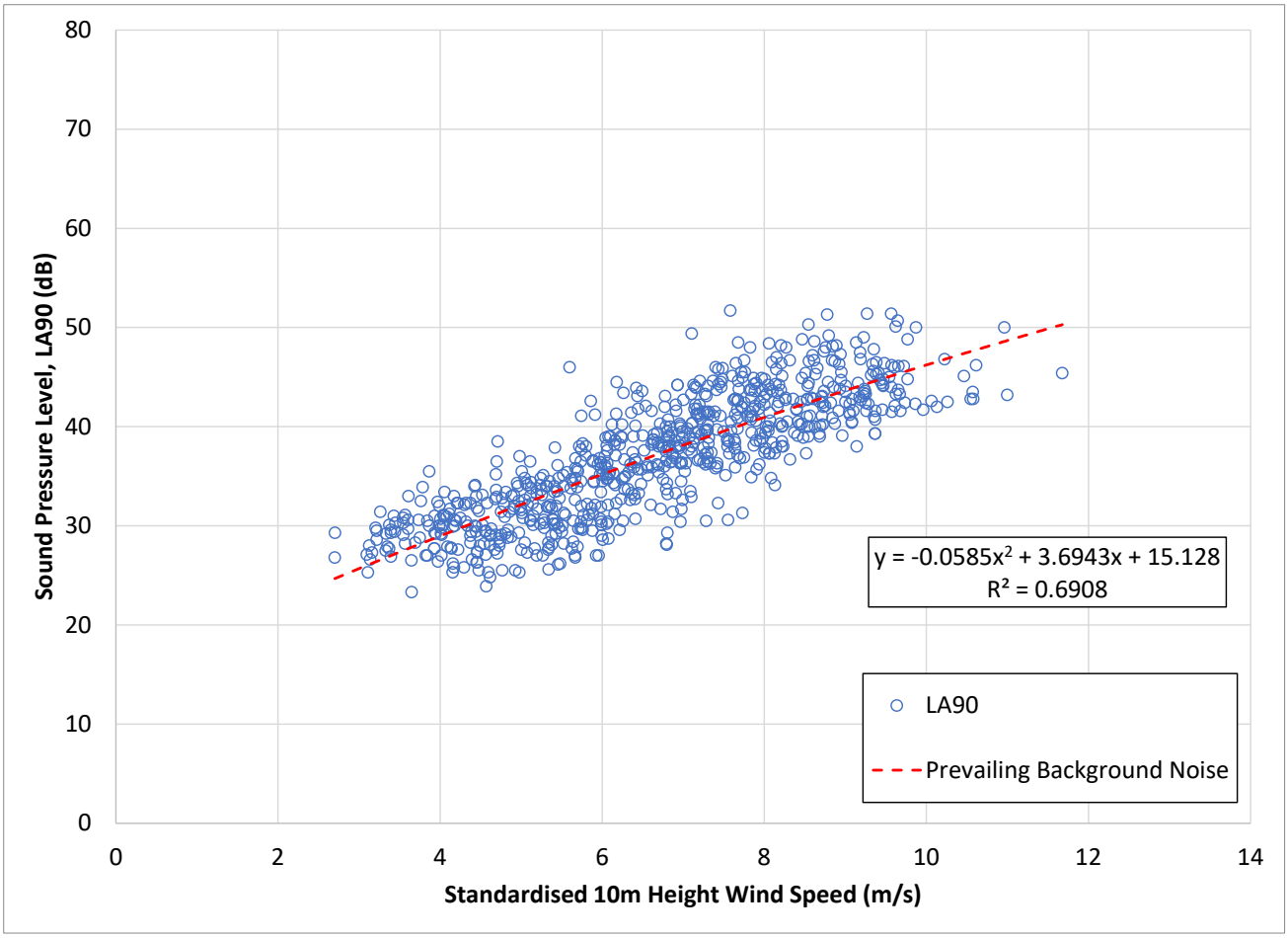

Figure A9.5: Prevailing Amenity/Daytime Background (L_{A90}) Noise Levels at H71

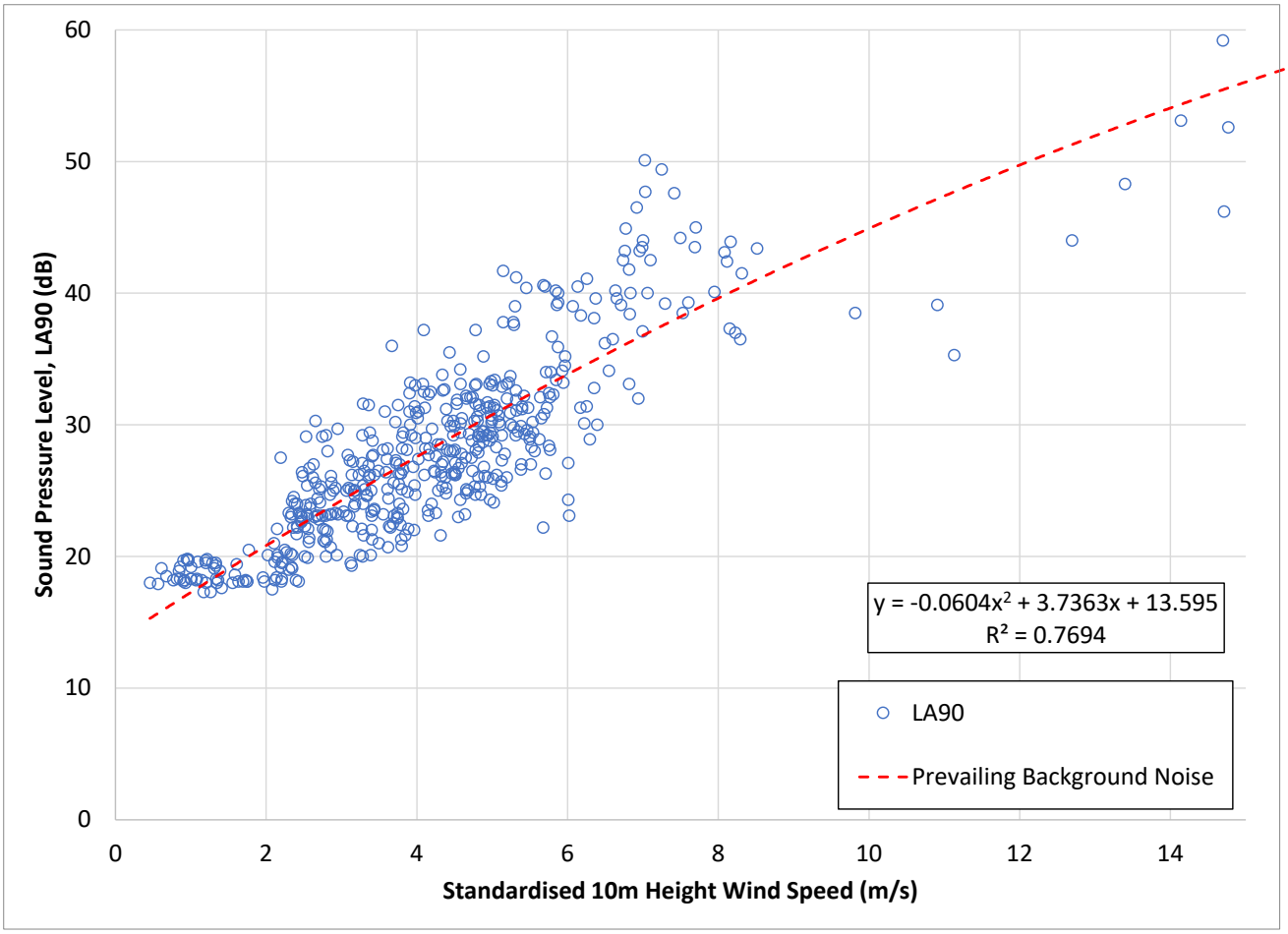

Figure A9.6: Prevailing Night-time Background (L_{A90}) Noise Levels at H1

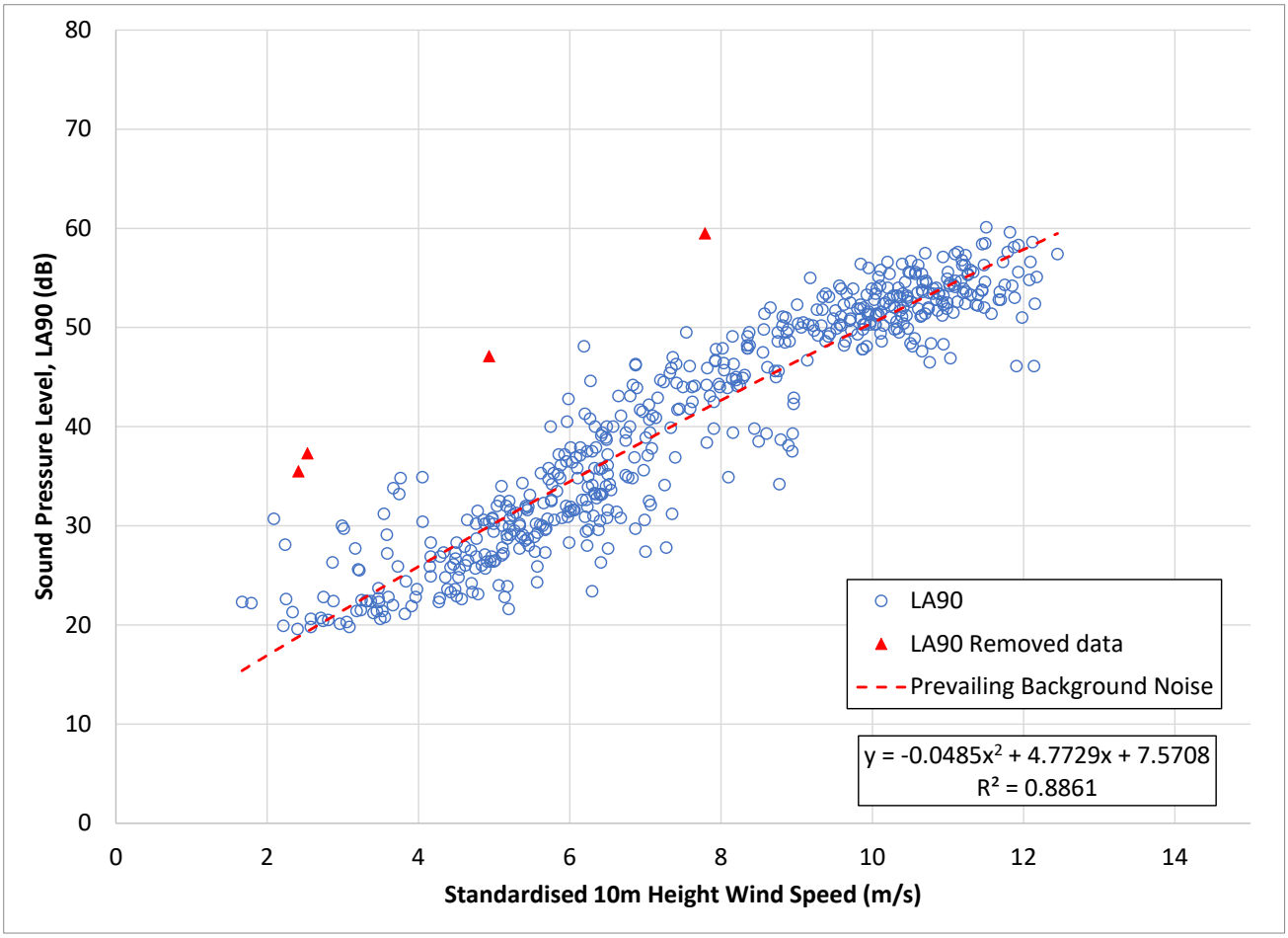

Figure A9.8: Prevailing Night-time Background (L_{A90}) Noise Levels at H40

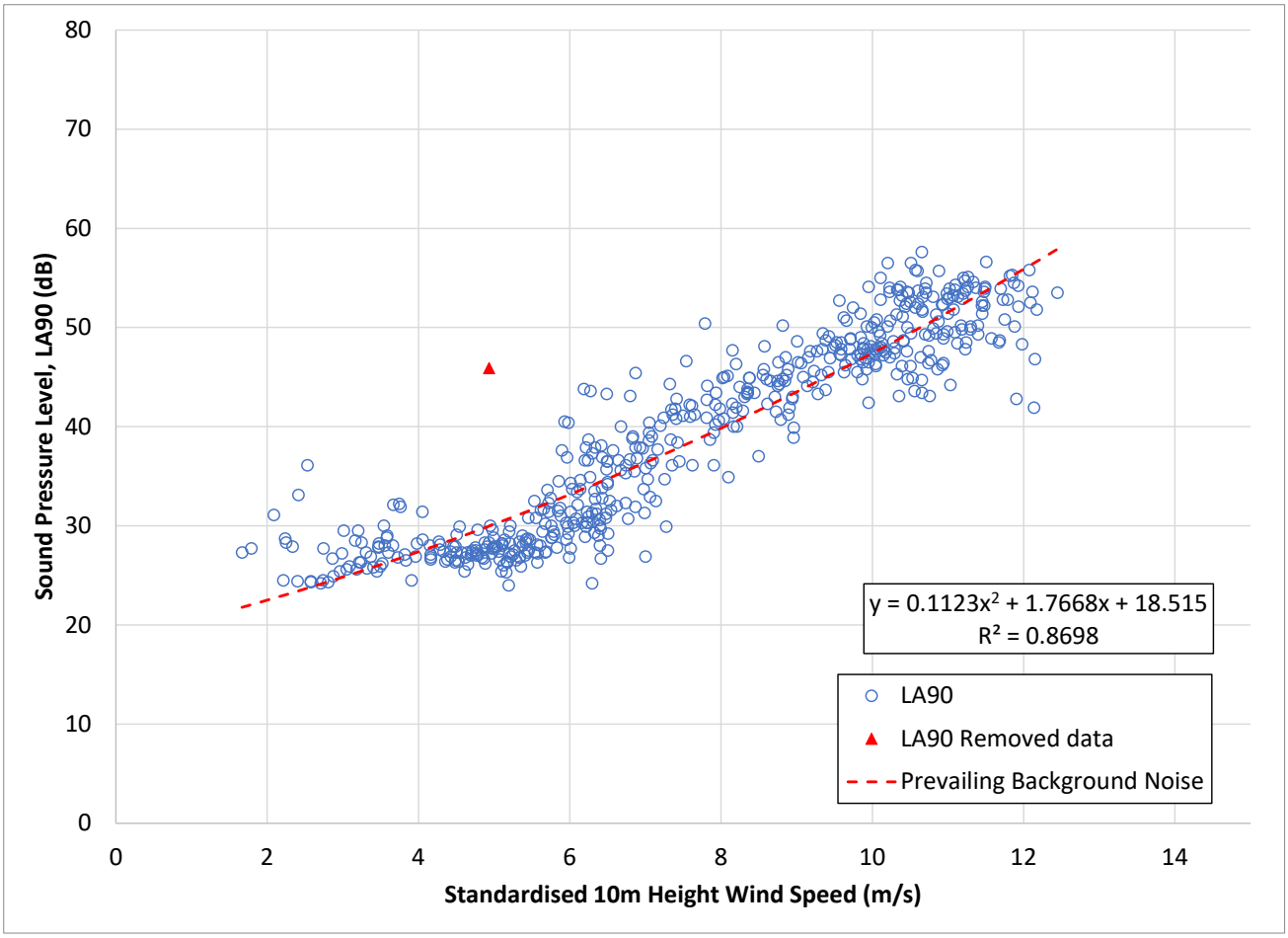

Figure A9.9: Prevailing Night-time Background (L_{A90}) Noise Levels at H48

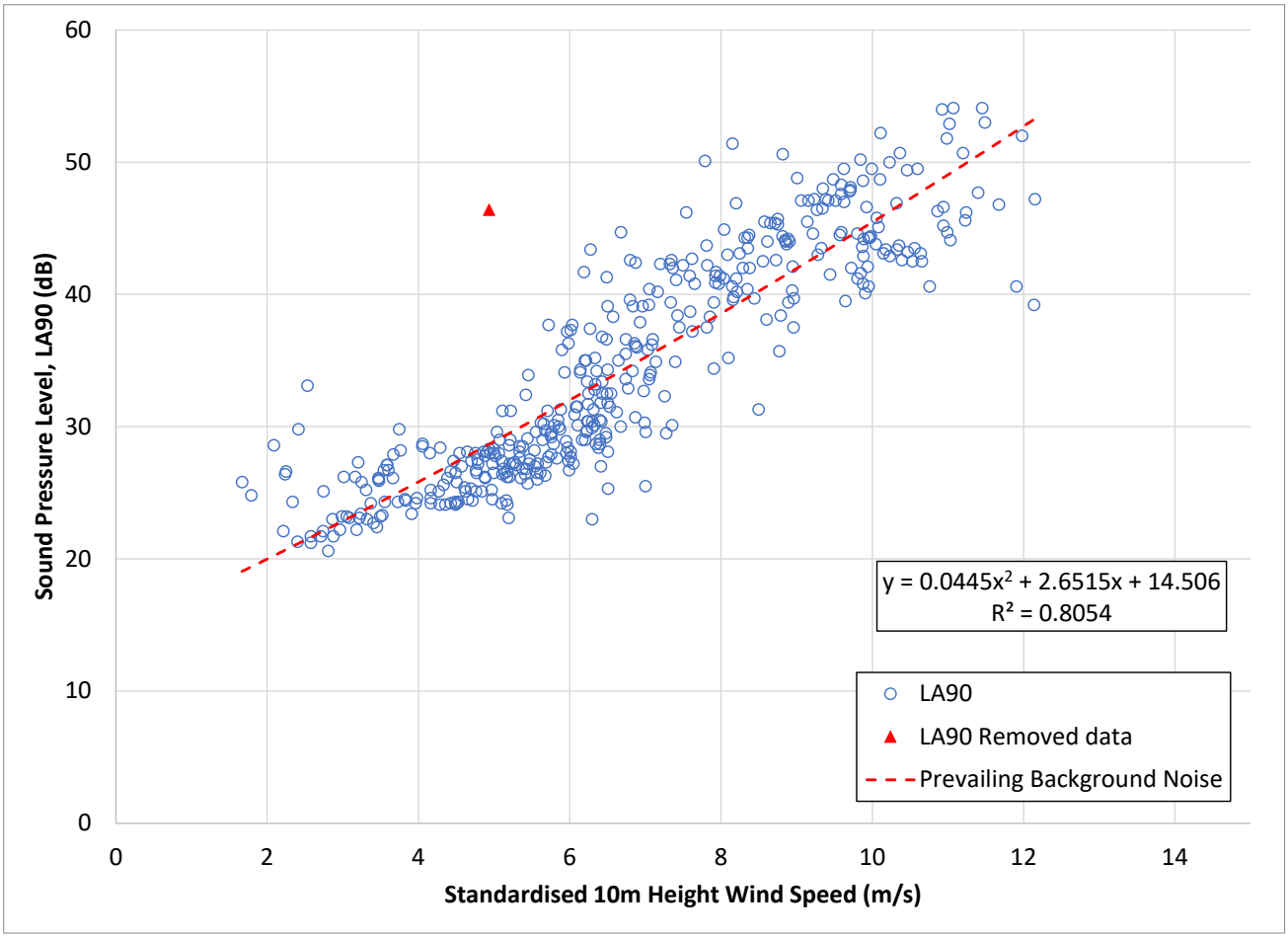

Figure A9.10: Prevailing Night-time Background (L_{A90}) Noise Levels at H71

Table 9.1.6: Prevailing Background Noise – Daytime Periods

Location	Prevailing Background Noise $L_{A90,10min}$ (dB) at Standardised 10 m Height Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
H1	27.3	29.8	32.8	36.1	39.9	44.1[1]	44.1[1]	44.1[1]	44.1[1]	44.1[1]
H40	21.6	26.9	31.9	36.5	40.7	44.5	48.0	51.1	53.8	56.1
H48	26.0	29.3	32.6	35.7	38.9	41.9	44.9	47.8	50.7	53.5
H71	25.7	29.0	32.1	35.2	38.1	40.9	43.6	46.2	48.7[1]	48.7[1]
1. Highest derived point										

Table 9.1.7: Prevailing Background Noise – Night-time Periods

Location	Prevailing Background Noise $L_{A90,10min}$ (dB) at Standardised 10 m Height Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
H1	24.3	27.6	30.8	33.8	36.8	39.6[1]	39.6[1]	39.6[1]	39.6[1]	39.6[1]
H40	21.5	25.9	30.2	34.5	38.6	42.7	46.6	50.4	54.2	57.9
H48	24.8	27.4	30.2	33.2	36.4	39.8	43.5	47.4	51.5	55.9
H71	25.0	26.8	29.0	31.6	34.5	37.9	41.6	45.6	50.1	54.9
1. Highest derived point										