

Renewable Power Ventures

Background Noise Monitoring Report

Capital Wind Farm

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Background Noise Monitoring Report Capital Wind Farm

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EXECUTIVE SUMMARY

A background noise monitoring survey for the proposed Capital Wind Farm site near Tarago, NSW has been conducted by Vipac Engineers & Scientists Ltd, in accordance with the SA EPA "Environmental Noise Guidelines: Wind Farms, 2003".

The background noise levels at ten residential sites in the vicinity of the proposed wind farm have been measured continuously over a period of at least two weeks, with 8 sites returning useful data. The noise monitoring was conducted between 9 February and 25 February 2005. The sound level meters monitored noise data simultaneously over the period, in conjunction with the collection of wind data from the wind farm site anemometer.

The noise data and wind data sampling periods were performed in synchronised 10-minute intervals. A total of in the order of 2,000 synchronised data pairs were obtained at most of the sites, although some sites had marginally fewer as a result of unsuitable data being omitted. There was rainfall recorded on the 19th, 20th and 21st of February. The noise levels recorded during periods of rain were omitted from the analysis in accordance with EPA recommendations.

A regression analysis of the noise-wind data scatter plots has been performed, which is used to determine the noise criteria for each site. A recommended noise criterion level at each of the monitored sites has been based on the level not exceeding 35 dB(A) or the regression fitted background noise level curve plus 5 dB(A).

The noise criterion level at 8ms^{-1} (at 10mAGL), determined from the plots in Appendix E, for the measured sites are :

- Site 1 (neighbour) : 41 dB(A)
- Site 2 (windfarmer) : 37 dB(A)
- Site 3 (windfarmer) : 37 dB(A)
- Site 5 (neighbour) : 40 dB(A)
- Site 6 (neighbour) : 36 dB(A)
- Site 8 (windfarmer) : 40 dB(A)
- Site 9 (windfarmer) : 38 dB(A)
- Site 10 (windfarmer) : 37 dB(A)

The criterion at each wind speed will also be provided in the main noise assessment report and compared with the predicted wind farm noise levels.

Residences with wind turbines on their properties are not relevant receivers, according to the South Australian EPA guidelines [Ref : 2.1], and as such do not have a formally applicable criterion. This applies to Sites 2, 3, 8, 9 and 10.



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1. INTRODUCTION

Vipac Engineers & Scientists have conducted a background noise monitoring survey for the proposed Capital Wind Farm site near Tarago, NSW.

The background noise levels at eight receiver sites in the vicinity of the proposed wind farm have been measured continuously over a period of two to three weeks. Noise monitoring equipment was installed at two additional sites, however no useful data was obtained at these locations.

Using simultaneously recorded wind data, a regression analysis of the noise-wind data plots for each site has been performed, which is used to determine the noise criteria.

2. REFERENCES

- 2.1 “Environmental Noise Guidelines: Wind Farms”, SA Environment Protection Authority, SA Government, Feb. 2003 (ISBN 1 876562 43 9).
- 2.2 Australian Standard AS 1259-1990, Acoustics – Sound Level Meters.
- 2.3 Letter to David Griffin from Department of Environment and Conservation (NSW) “Re: Capital Wind Farm Project, near Tarago”, Ref: 290757A1 (QUF5904)

3. NOISE CRITERIA

The “Environmental Noise Guidelines: Wind Farms, 2003” [Ref : 2.1] of the SA Environment Protection Authority (EPA) are used to assess noise associated with wind farms in NSW (on advice from NSW EPA).

The EPA guidelines [Ref : 2.1] state that: “The predicted equivalent noise ($L_{Aeq\ 10min}$), adjusted for tonality in accordance with these guidelines, should not exceed 35 dB(A) or the background noise ($L_{A90\ 10min}$) by more than 5 dB(A), whichever is the greater, at all relevant receivers for each integer wind speed from cut-in to rated power of the WTG”.

The EPA guidelines [Ref : 2.1] also state that all noise measurements are to be taken outdoors at 1.2 to 1.5 meters above the ground and within 20 metres of a noise sensitive premises (and at least 5m from any major reflecting surface). The background noise monitoring survey should be carried out over a period of at least 2 weeks to ensure the collection of at least 2000 valid data points. All wind speed measurements are to be taken at, or adjusted to, 10mAGL.

The environmental noise criteria for wind farms are determined from the background noise measurements at each relevant site plotted against the measured wind speed data. Application of regression analysis to the noise-wind data plots provides a best-fit curve that can then be used to determine the noise criterion at different wind speeds.

A glossary of acoustic terminology is provided in Appendix A.



4. SITE DESCRIPTION

The proposed Capital Wind Farm near Tarago is located north east of Canberra, and is shown in Figure 1 in Appendix B. The proposed wind farm configuration will consist of up to 65 Wind Turbine Generators (WTGs) distributed on the Great Dividing Range near Tarago.

The general area of the wind farm site comprises a mix of pasture and open farming properties. The aspect of the landscape is open, with significant hills and occasional trees and other obstructions. The area is classified as rural or predominantly rural with some agricultural industry. The land use in the area mainly comprises intermediate-sized farming properties.

5. NOISE MONITORING SURVEY

5.1. Measurement Equipment

Type-1 sound level meters (SLMs) were used at the residential sites 2, 3, 6, 8 and 9. Type-2 SLMs were used at sites 1, 5 and 10.

SLM units monitored noise data at each site simultaneously with the collection of wind data from the wind farm site anemometer over the period from 9 February 2005 to 25 February 2005, with data collected over a period of about two to three weeks at each site. The noise data and wind data sampling periods were performed in synchronised 10-minute intervals.

Two of the ten noise loggers malfunctioned. Site 7 returned no noise data and site 4 returned data that appeared to be incorrect and also recorded in 15-minute intervals rather than 10-minute intervals. The data from site 4 has been included in the results to demonstrate that data was taken, however we do not consider it to be suitable for determining noise criterion levels.

The sound level meters used satisfy the requirements of AS 1259-1990 [Ref : 2.2] and were calibrated with a piston-phone before and after the monitoring survey. Microphones were protected with windshields in accordance with the manufacturer's instructions.

Wind speed/direction data (in 10-minute intervals) at 10m AGL was collected simultaneously from the wind farm site anemometer for the whole of the noise monitoring period, and this is the data against which the background noise levels were compared.

Bureau of Meteorology data from the Goulburn station was used to remotely monitor periods of rainfall in the general area, and determine the amount of rainfall that had occurred on any day over the monitoring period. Sites 1, 5, 7 and 8 had localised weather stations which were used to determine the precise times and amount of rainfall recorded at those sites.

5.2. Monitoring Sites

Renewable Power Ventures selected ten sites for the collection of background noise information. Due to the spread of the four groups of turbines over a wide area, a broad range of sites were selected to provide a distribution across the project area and obtain data from sites with differing physical characteristics. Where possible, sites which are neighbours to the wind farm were sought; however, access was not available to one of these and in that instance a nearby 'Wind Farmer' site has been used.



The selection strategy was proposed so as to enable use of the data from the selected sites for assessing impact at up to [58] residences, of which [46] are neighbouring residences, within about 2 kilometres of the nearest turbine, if it was required. A summary of the sites, their characteristics and the basis for selection of each is provided below:

Site Name	Site Characteristics	Basis for Selection	Status
1 Luckdale	On western side of Grose Hill Ridge, reasonably sheltered and access available. Site in stock yard adjacent to house. Large pines near house.	The closest of 3 residences to north-west of the Grose Hill Group. A neighbour.	Neighbour
2 Euroka	Fairly sheltered from westerly winds, with large mature pines. Access was sought to a neighbours residence nearby, but access was not possible at the time.	Representative of residences on north end of Taylors Creek Road to north east of Grose Hill Group.	Wind Farmer
3 Sunnybrook	Due to sheltered location, may have a lower background than for nearby houses and if used for those sites would provide a conservative result. Site located within garden area adjacent to house.	In close proximity to a small cluster of residences. Access available. Considered representative of a number of nearby houses.	Wind Farmer
4 Collins near Kalbilli	Elevated site on ridge. Access available. Large mature trees near to house.	Closest neighbour's house to Kalbilli Group. Access available.	Neighbour
5 The Patch	On ridge set back from Tarago Road. No mature trees close to residence, but considerable amount of new planting.	At the time, the closest neighbour house to south east of Hammonds Hill Group. Access available.	Neighbour
6 TCE Lot 7W Gray	Within small cluster of residences at eastern end of Taylors Creek Road and reasonably close to project site. Trees around residence.	Representative of some of the houses in cluster at eastern end of Taylors Creek Road.	Neighbour
7 TCE Lot 8	Within small cluster of residences at eastern end of Taylors Creek Road and one of the closer to project site. Relatively clear around residence.	Representative of residences close to Taylors Creek Road. Reasonably close to wind farm site.	Neighbour
8 L'Orizon	In exposed location near Ellenden Group turbines. Large Pines nearby.	One of the closest residences to wind turbines. Access available.	Wind Farmer
9 Currandooley	No neighbour residences in this area. House is surrounded by mature pines.	Closest residence to the west of Hammonds Hill Group.	Wind Farmer
10 Wyoming	Distant from public roads. Sheltered from westerly winds. Trees around residence	Close to former location of turbines proposed for Governors Hill and to the south of Grose Hill.	Wind Farmer

Table 1: Characteristic on the Residential Sites in the Vicinity of the Proposed Wind Farm.



As can be seen in Appendix B, the distribution of the monitoring sites provides a spread across the project area. Four weather stations were also installed at locations spread across the site to provide data on local rain and wind conditions to ascertain suitability of conditions for the background monitoring and to provide a basis for rejection of unsuitable data.

The residential sites where background noise monitoring occurred are listed in Table 2 below, with details on the location and name of the property, the SLM details (type and serial number) and whether the site is to be identified as a 'windfarmer' i.e. with a wind turbine to be installed on that property. The residential sites are also shown relative to the proposed wind turbine locations in Appendix B.

	Name	Approximate Location		Windfarmer	SLM Type	SLM / Weather Station Serial No.
		Easting	Northing			
1	Luckdale	727346	6113731	N	2	194528 / 9904-274
2	Euroka	729717	6113930	Y	1	16-004-025
3	Sunnybrook1	729865	6111669	Y	1	16-004-026
4	Collins	738778	6105931	N	1	870B1465
5	The Patch	731911	6104303	N	2	194535 / 0310-614
6	TCE – Gray Lot 7	733296	6109158	N	1	15-199-416 TR(79788)
7	Clearview Lot 8	733589	6107212	N	1	194633 / 0012-0397
8	L'Orizon	725575	6106444	Y	1	TR (285853) / 9909-0256
9	Currandooley	727499	6104978	Y	1	16-199-415
10	Wyoming	726811	6109963	Y	2	194663

Table 2: Details on the Residential Sites in the Vicinity of the Proposed Wind Farm.

Photographs of the noise monitoring equipment at each of the residential sites are provided in Appendix C. All sites are quite exposed and do not have significant sheltered topographical features nearby.

5.3. Results & Regression Analysis

The noise monitoring data was analysed and correlated with the measured wind data (from the site anemometer). The measured wind data was taken at a height of 10mAGL.

A regression analysis of the resulting plots was used to determine the site noise criteria, in accordance with EPA guidelines [Ref : 2.1].

The continuous noise and wind data are shown over the monitoring period in Appendix D. Wind speeds typically ranged between about 0m/s and 16m/s (WTG cut-in will be around 3.5m/s and rated power at about 11.5m/s).

Background noise data (noise/wind data pairs) during periods of rainfall and high ground-level wind speed were omitted from the data plots and criterion calculations, as indicated in Appendices D and E. A total of about 2,000 synchronised data pairs were obtained at most of the sites, although some sites had marginally fewer as a result of this potentially unsuitable data being omitted.

Rainfall and microphone-level wind data for each of the monitored residences was taken from the site which most closely approximated the location and siting at which data was recorded :

- Site 1 rainfall/wind data applies to Sites 1, 2 and 3
- Site 5 rainfall/wind data applies to Sites 4, 5 and 9
- Site 7 rainfall/wind data applies to Sites 6 and 7
- Site 8 rainfall/wind data applies to Sites 8 and 10



Rainfall

The rainfall recorded at sites 1, 5, 7 and 8 is shown. Background noise data (noise/wind data pairs) was omitted from the regression calculations during periods of rainfall in accordance with EPA guidelines [Ref: 2.1].

Rainfall Recorded Across Background Noise Monitoring Period (mm)				
Date	Site 1	Site 5	Site 7	Site 8
19 th Feb	-	1	-	-
20 th Feb	32	32	34	28
21 st Feb	3	2	4	6

Table 3: Recorded rainfall (mm) over the monitoring period.

Microphone level wind speed

The microphone-level wind speeds were also recorded at sites 1, 5, 7 and 8. The number of 10-minute intervals during which the measured wind speed exceeded 5ms^{-1} is shown in Table 4 below. For all background noise measurements, a standard windshield (manufacturer supplied) was installed on the microphones to minimise the influence of wind-induced noise on the resulting measurements.

We have not observed any instances of wind speeds less than 5ms^{-1} adversely affecting measured noise levels with these windshields/microphones.

Background noise data (noise/wind data pairs) was omitted from the regression calculations during periods of high wind speeds ($>5\text{ms}^{-1}$) on the microphone in accordance with EPA guidelines [Ref: 2.1].

High Microphone Level Wind Speeds Recorded Across Background Noise Monitoring Period				
Date	Site 1	Site 5	Site 7	Site 8
10 th Feb	-	9	-	-
12 th Feb	-	7	-	3
13 th Feb	-	10	-	15
15 th Feb	-	40	3	35
16 th Feb	-	17	-	16
17 th Feb	-	10	-	-
18 th Feb	-	11	-	1
19 th Feb	-	15	6	17
20 th Feb	-	10	-	11
21 st Feb	1	-	-	-

Table 4: Recorded high microphone-level wind speeds over the monitoring period.

The scatter plots of noise level against wind speed measured at the site monitoring tower (at 10mAGL) are given in Appendix E. Regression curves were fitted to the plots in accordance with EPA guidelines [Ref : 2.1]. The formula for the resulting polynomial line of best fit is shown on the plots along with the associated correlation coefficient. For most locations, a second order equation gave the curve of best fit, although for residence 6, a third order equation gave a more appropriate curve.



The background (L_{A90}) noise level at each integer wind speed from the cut-in wind speed is calculated from the plots in Appendix E and is shown in Table 5 below.

	Wind Speed (m/s)													
	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Site 1	30	31	33	34	36	37	38	39	41	42	43	44	45	45
Site 2	28	29	30	31	32	33	35	36	38	40	42	44	46	48
Site 3	27	28	30	31	32	34	35	37	38	39	41	42	44	45
Site 5	31	32	33	34	35	36	37	38	39	39	40	41	42	42
Site 6	29	29	29	30	31	32	34	35	37	38	40	41	42	42
Site 8	25	27	30	33	35	38	40	42	44	46	49	50	52	54
Site 9	28	29	30	32	33	34	35	36	37	38	39	39	40	41
Site 10	27	28	30	31	32	34	35	36	38	39	40	42	43	44

Table 5: Background noise levels at various wind speeds (at 10mAGL).

A recommended noise criterion level at each of the monitored sites has been based on the level not exceeding 35 dB(A) or the regression fitted background noise level curve plus 5 dB(A), whichever is greater. The noise criterion level at each integer wind speed from the cut-in wind speed is also calculated from the plots in Appendix E and is shown in Table 6 :

	Wind Speed (m/s)													
	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Site 1	35	36	38	39	41	42	43	44	46	47	48	49	50	50
Site 2*	35	35	35	36	37	38	40	41	43	45	47	49	51	53
Site 3*	35	35	35	36	37	39	40	42	43	44	46	47	49	50
Site 5	36	37	38	39	40	41	42	43	44	44	45	46	47	47
Site 6	35	35	35	35	36	37	39	40	42	43	45	46	47	47
Site 8*	35	35	35	38	40	43	45	47	49	51	54	55	57	59
Site 9*	35	35	35	37	38	39	40	41	42	43	44	44	45	46
Site 10*	35	35	35	36	37	39	40	41	43	44	45	47	48	49

Table 6: Noise level criteria at various wind speeds (at 10mAGL).

* The residences with wind turbines on their properties (identified as windfarmers in Table 1) are not relevant receivers, according to the EPA guidelines [Ref : 2.1], and as such do not have a formally applicable criterion.

The noise criterion at each wind speed will be provided in the main noise assessment report and compared with the predicted wind farm noise levels.

For completeness, we also calculated the noise criteria which would be applicable if the rain- and high ground level wind speed affected data were included in the data set. We found that the full-data-set criteria for Sites 1, 2, 3, 6, 8 and 9 vary by less than 1 dB from the corrected data. The full-data-set criteria for Sites 5 and 10 also vary by less than 1 dB from the corrected data at wind speeds below 10ms^{-1} , however the corrected criteria for higher wind speeds are up to 4 dB (Site 5) and 9 dB (Site 10) lower than those calculated without unsuitable data omitted.

As it is generally the noise levels from wind farms at wind speeds less than 9 or 10ms^{-1} which are more critical, and noise criteria at wind speeds above 10ms^{-1} are generally achieved, we conclude that the removal of possibly unsuitable data from the applicable data set is unlikely to have any practical impact on the environmental noise impact study.

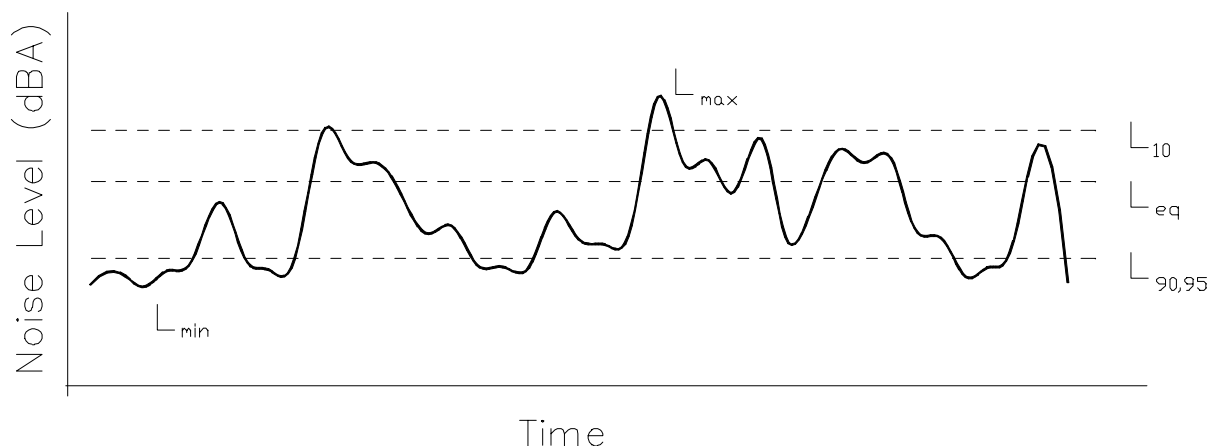


Appendix A: Glossary of Acoustic Terminology



Glossary of Acoustic Terminology

dB(A)	A unit of measurement, decibels(A), of sound pressure level which has its frequency characteristics modified by a filter ("A-weighted") so as to more closely approximate the frequency response of the human ear.
L₁₀	The noise level which is equalled or exceeded for 10% of the measurement period. L ₁₀ is an indicator of the mean maximum noise level, and is used in Australia as the descriptor for intrusive noise [usually in dBA]. Nominal measurement period is usually 15 minutes.
L₉₀	The noise level which is equalled or exceeded for 90% of the measurement period. L ₉₀ or L ₉₅ is an indicator of the mean minimum noise level, and is used in Australia as the descriptor for background or ambient noise [usually in dBA].
L_{eq}	The equivalent continuous noise level for the measurement period, weighted for duration and intensity. L _{eq} is an indicator of the average noise level [in dBA].
L_{max}	The maximum noise level for the measurement period [usually in dBA].
L_{peak}	The maximum numerical noise level, usually unweighted, attained during the measurement period [usually in dB(lin)].
SEL	The single event Sound Exposure Level is the equivalent A-weighted sound level which, if it lasted for one second, would produce the same sound energy as the actual event [in dBA].



Note: The subjective response or reaction to changes in noise levels can be described as follows:

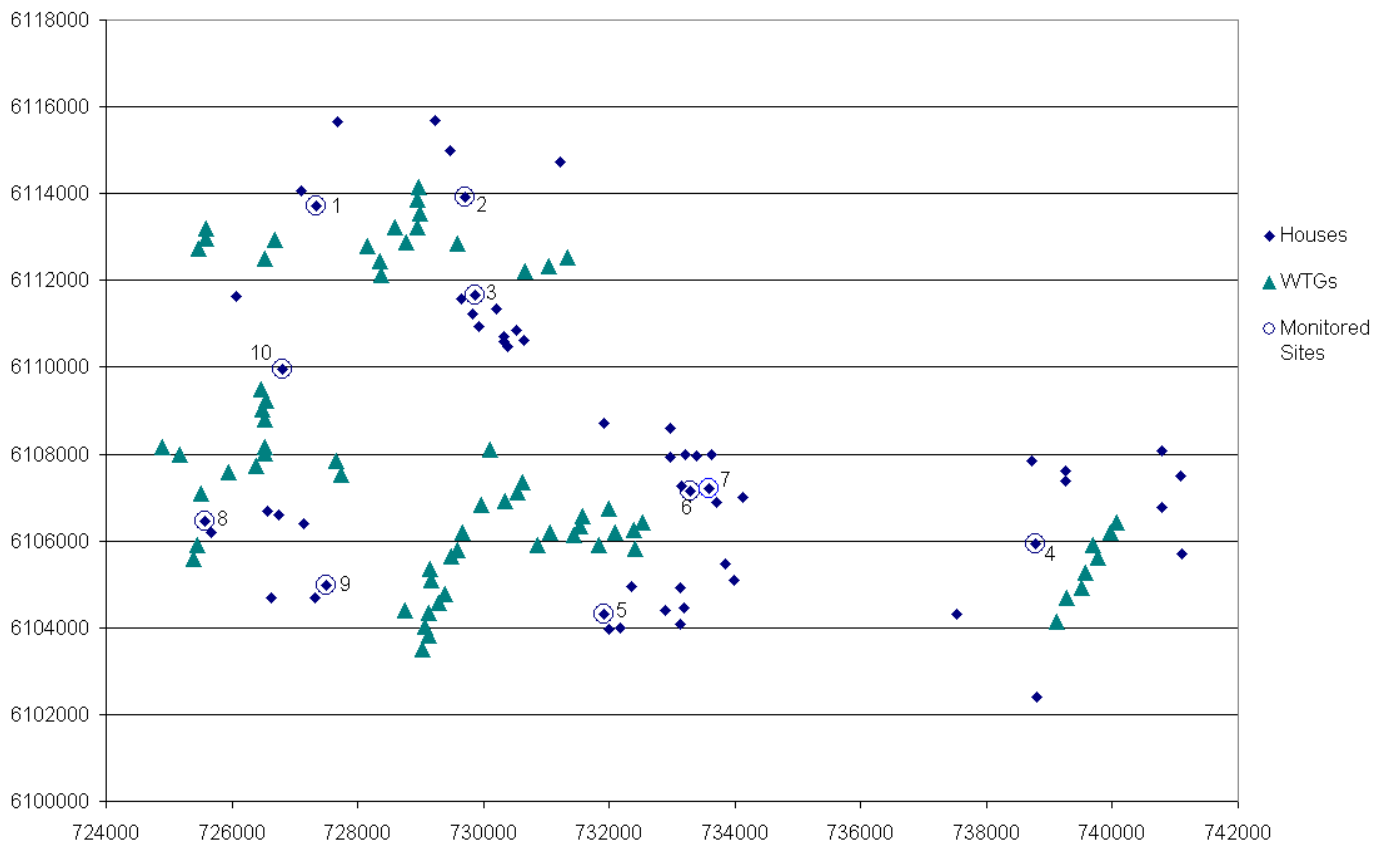
A 3 dB(A) change in sound pressure level is just perceptible to the average human ear, a 5 dBA increase is quite noticeable, a 10 dB(A) increase is typically perceived as a doubling in loudness.



Appendix B: Site Map & House Locations



Locations Of Monitored Sites Relative to Wind Farm





Appendix C: Site & Equipment Photographs



NOTE: In photos where the noise logger is not shown, the photo has been taken standing next to the noise logger.



Site 1: Noise Monitor Set-up and Location relative to Residence and Property.



Site 2: Noise Monitor Set-up and Location relative to Residence and Property.



Site 3: Noise Monitor Set-up and Location relative to Residence and Property.



Site 4: Noise Monitor Set-up and Location relative to Residence and Property.



Site 5: Noise Monitor Set-up and Location relative to Residence and Property.



Site 6: Noise Monitor Set-up and Location relative to Residence and Property.



Site 7: Noise Monitor Set-up and Location relative to Residence and Property.



Site 8: Noise Monitor Set-up and Location relative to Residence and Property.



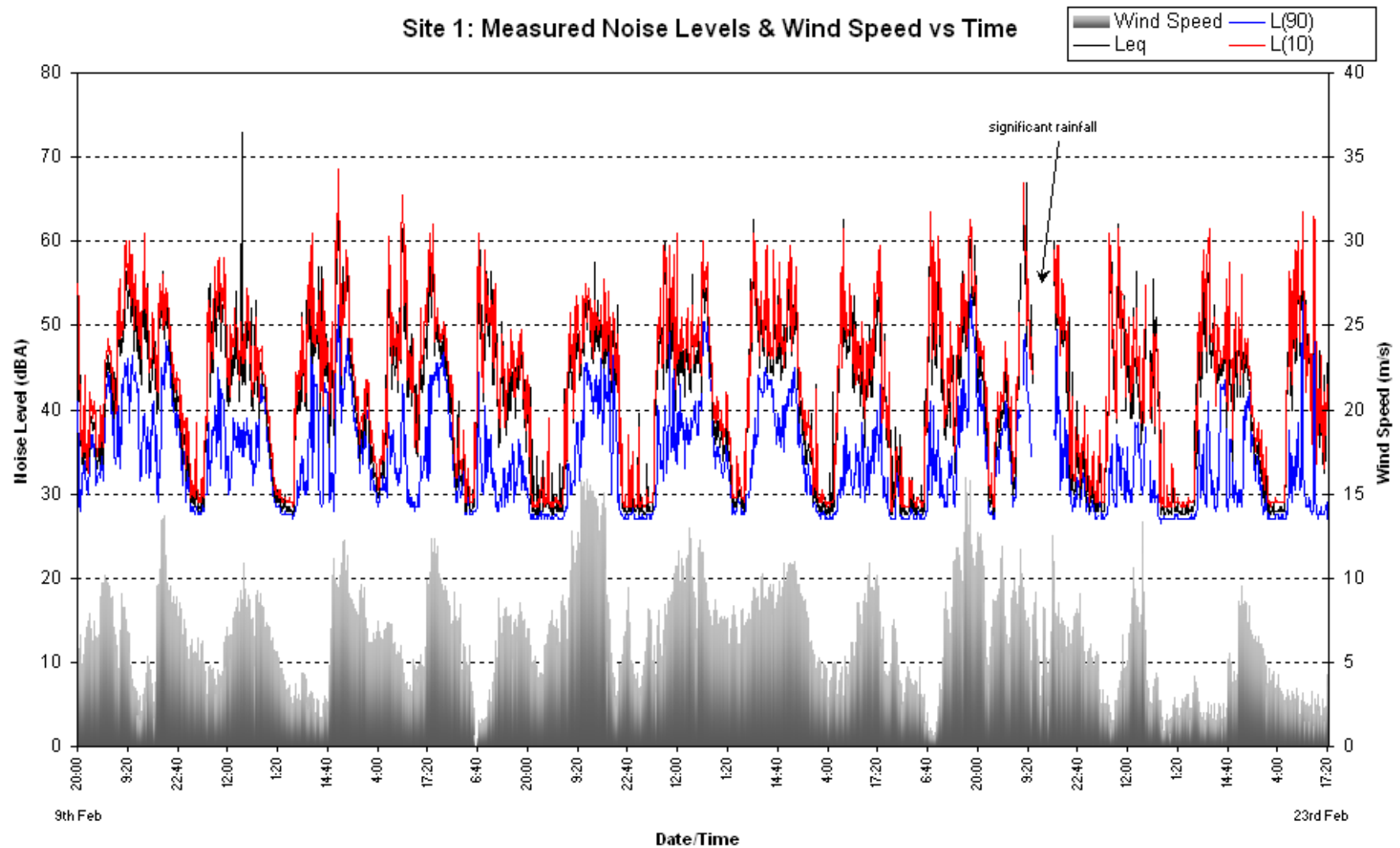
Site 9: Noise Monitor Set-up and Location relative to Residence and Property.

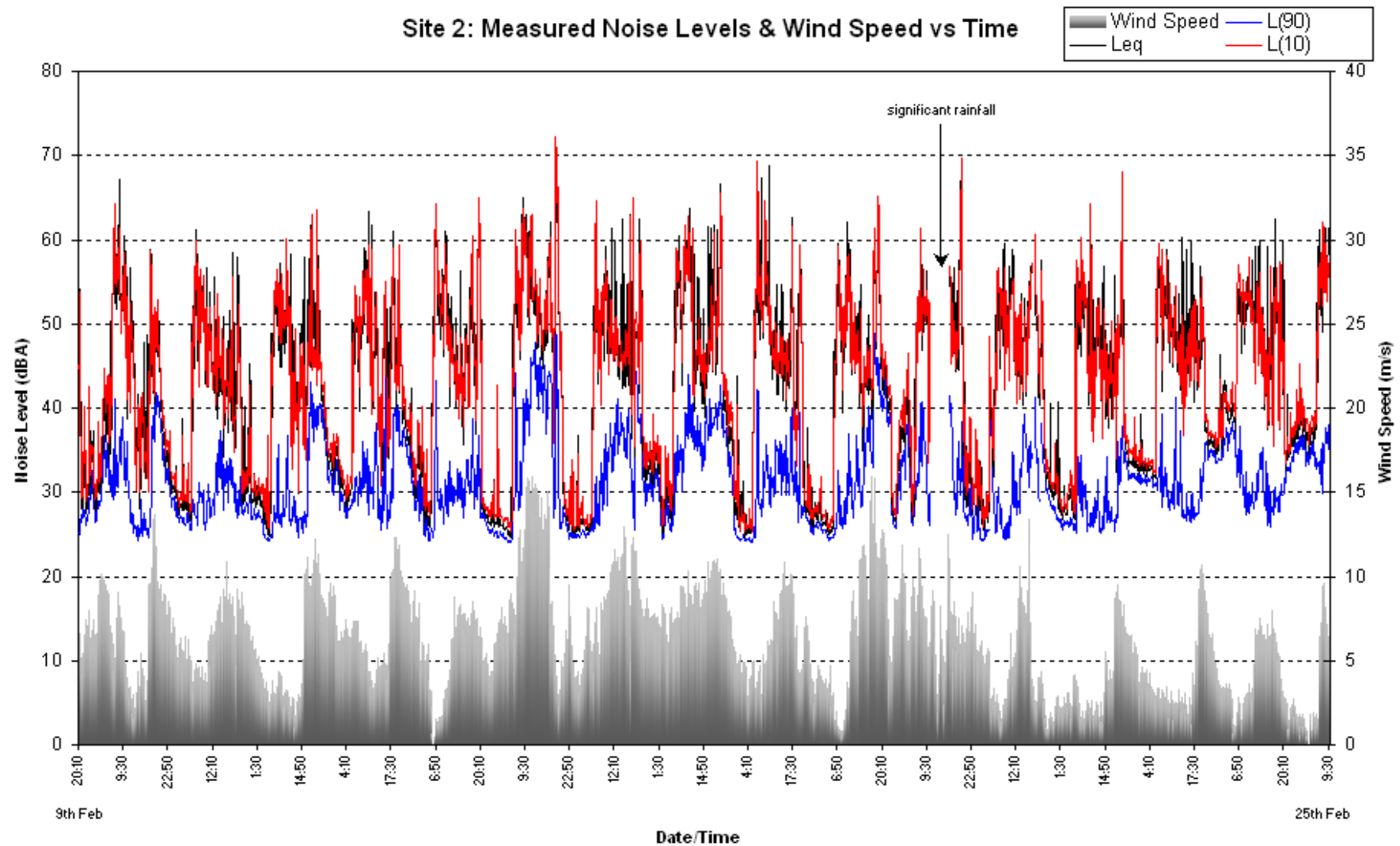


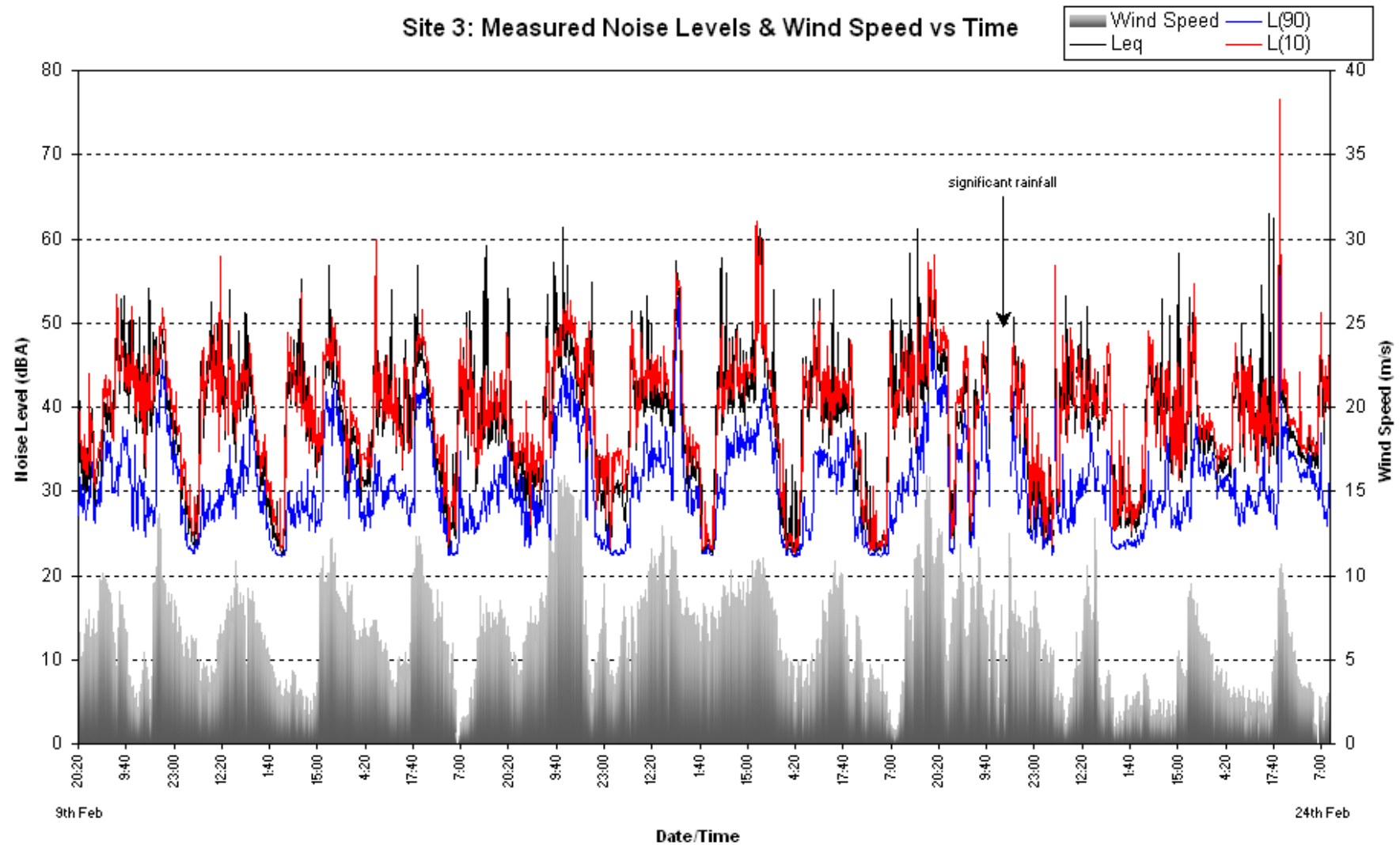
Site 10: Noise Monitor Set-up and Location relative to Residence and Property.

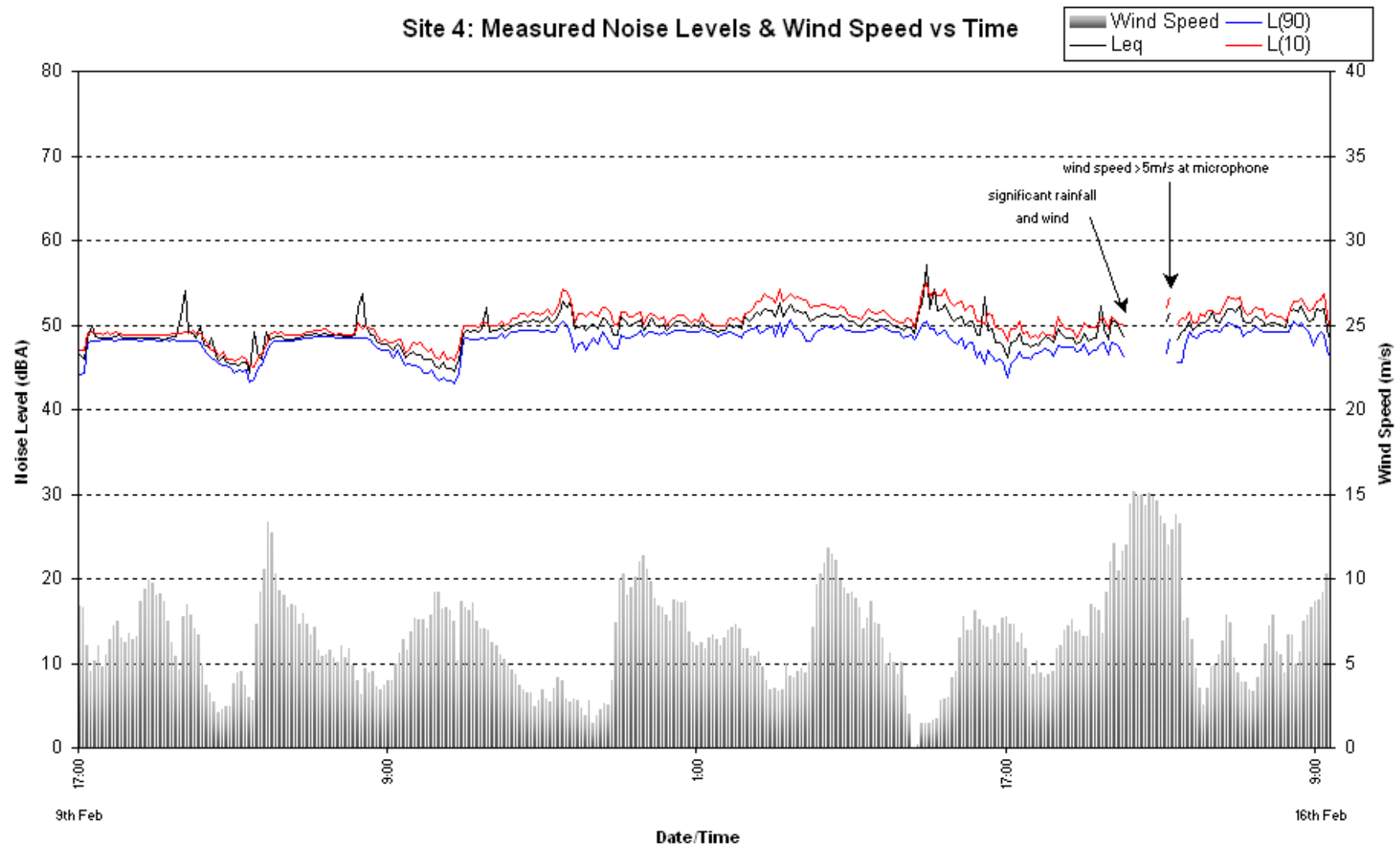


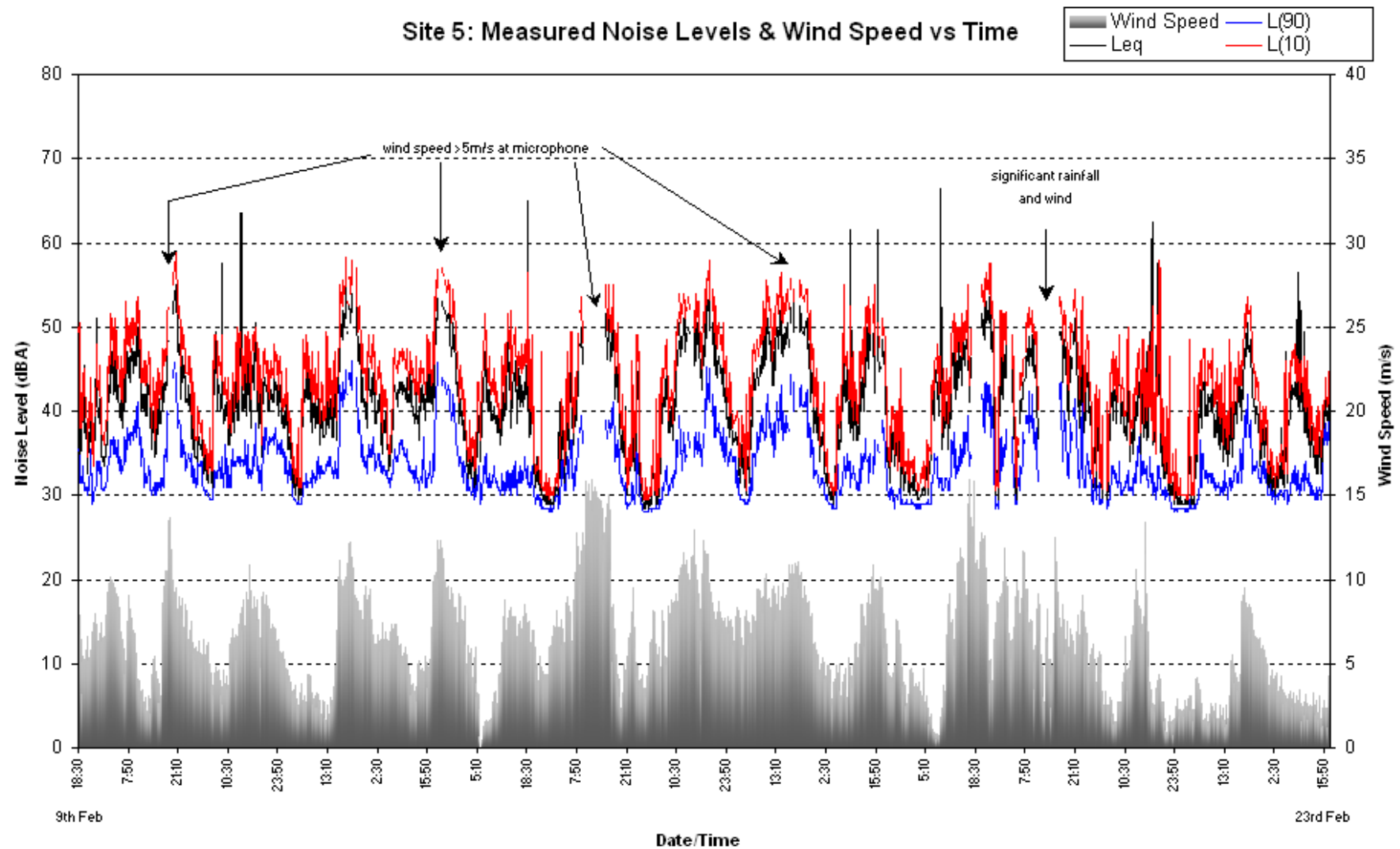
Appendix D: Continuous Plots of Noise Level & Wind Speed at Monitoring Tower Over Monitoring Period

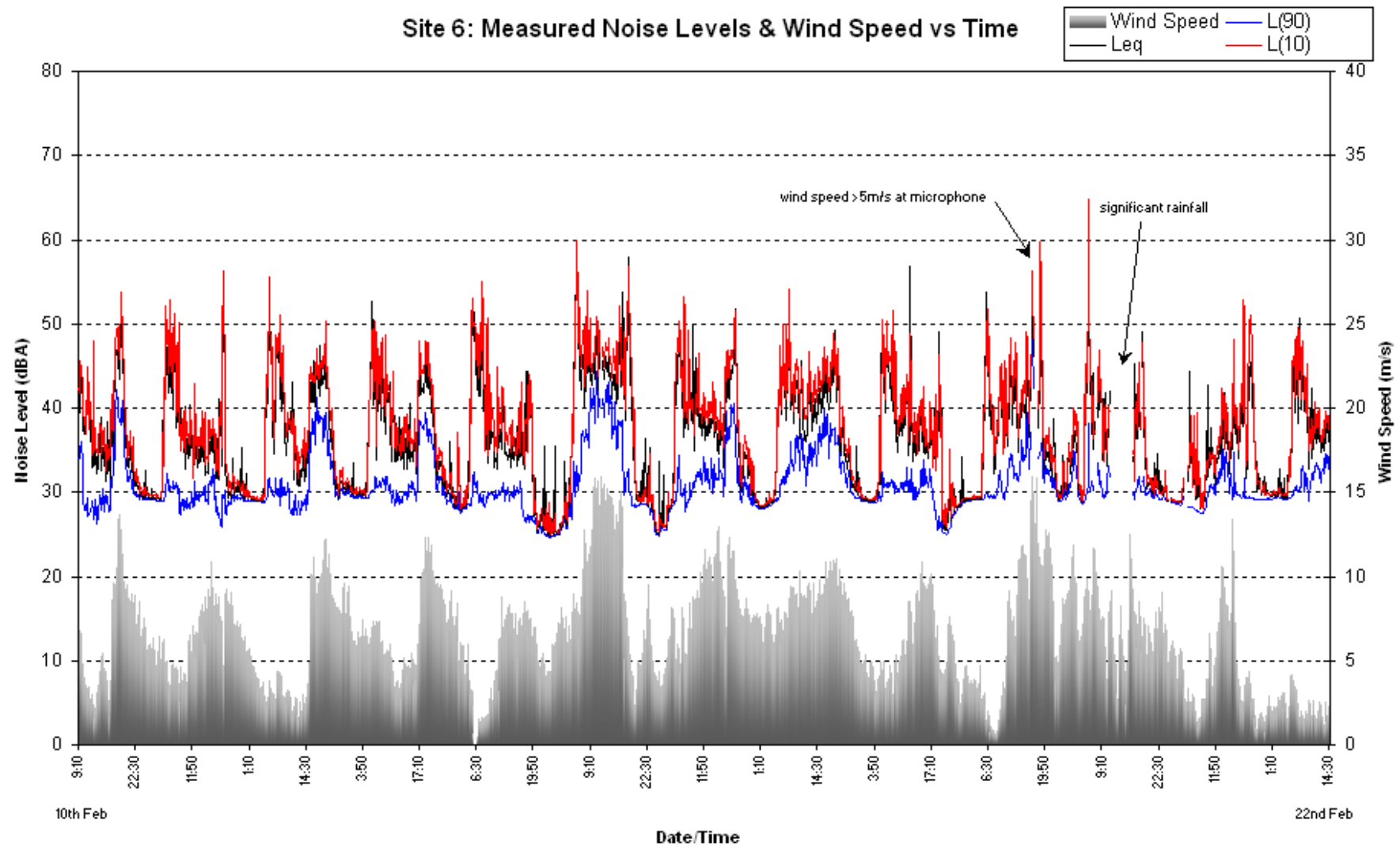


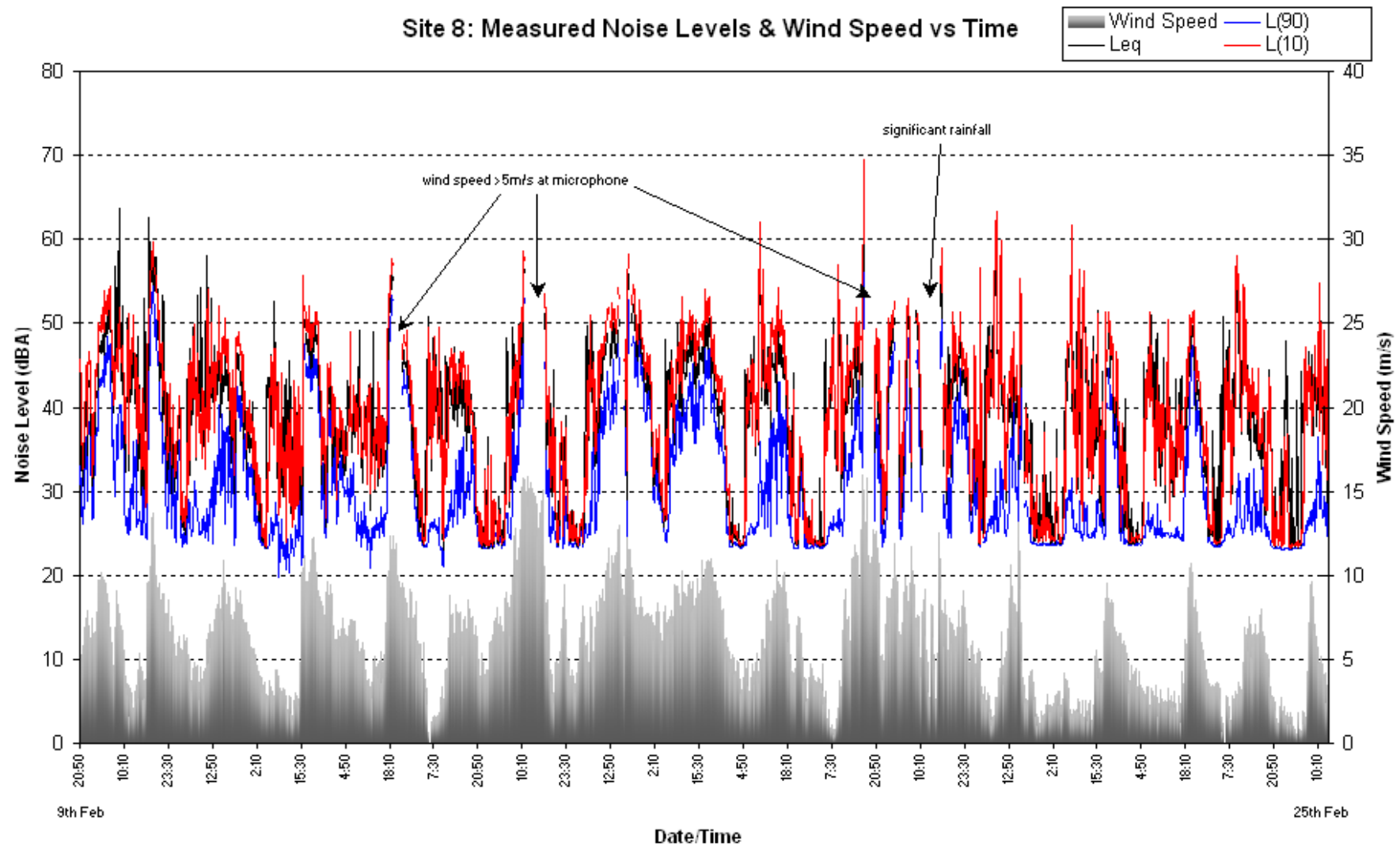


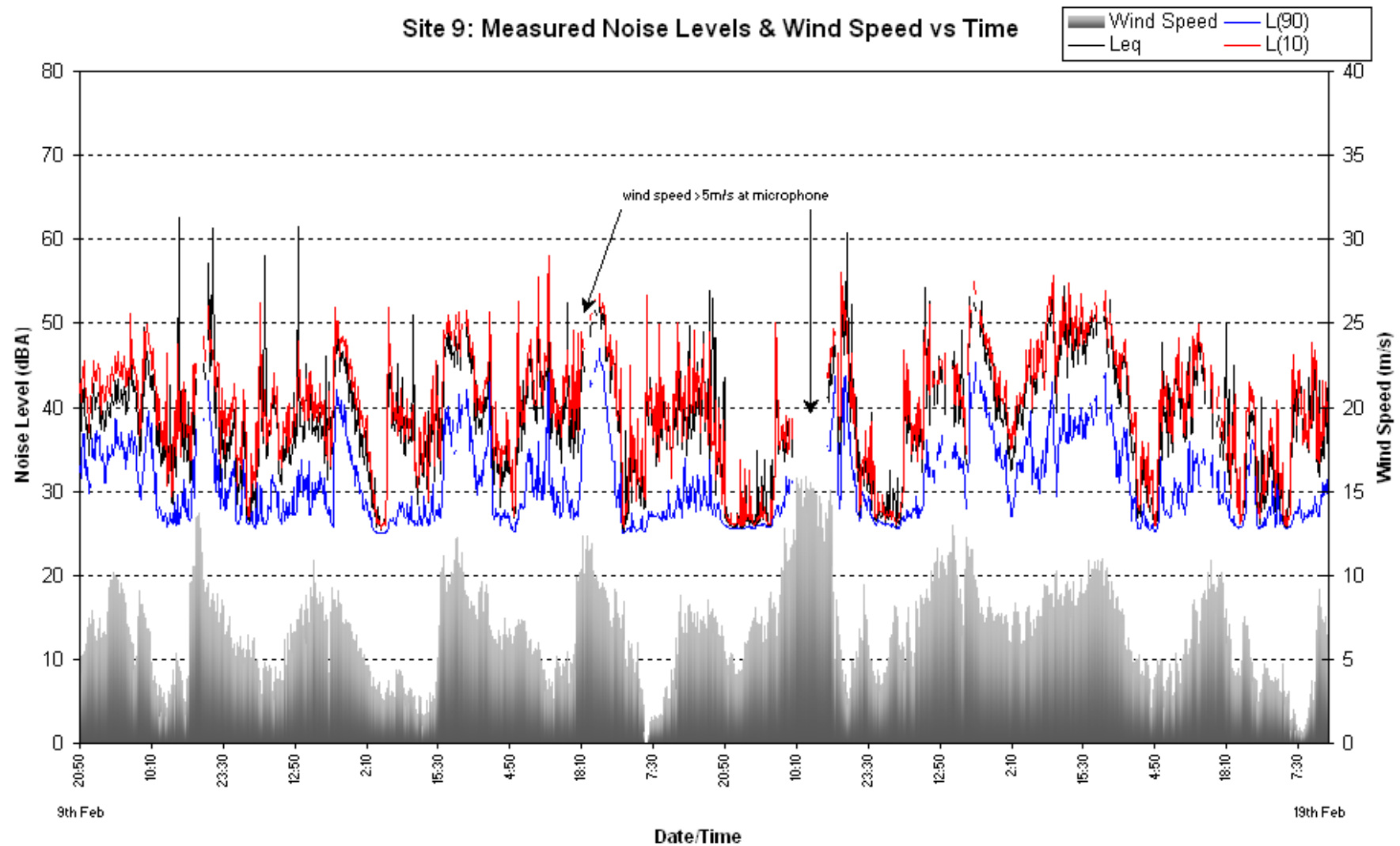


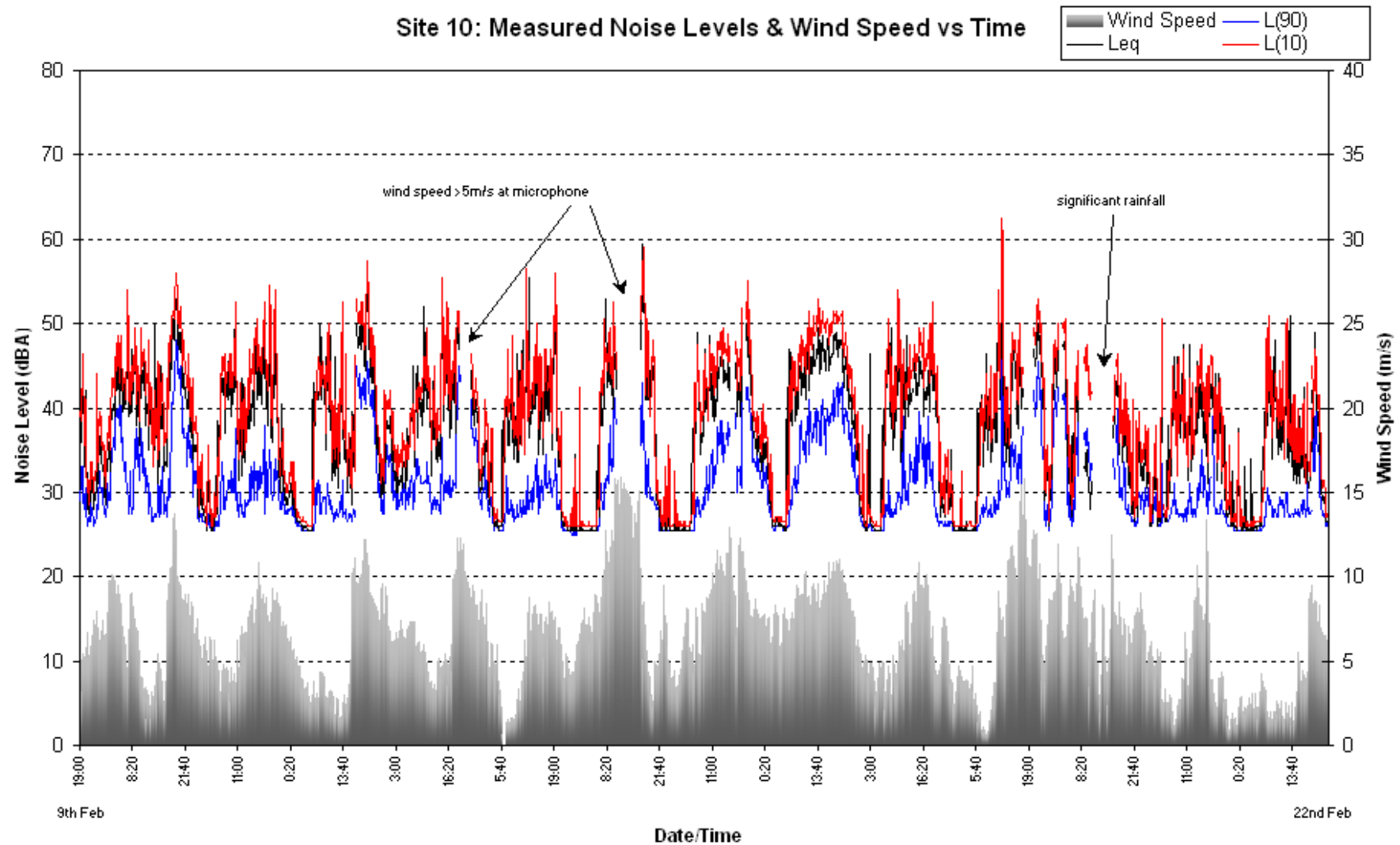










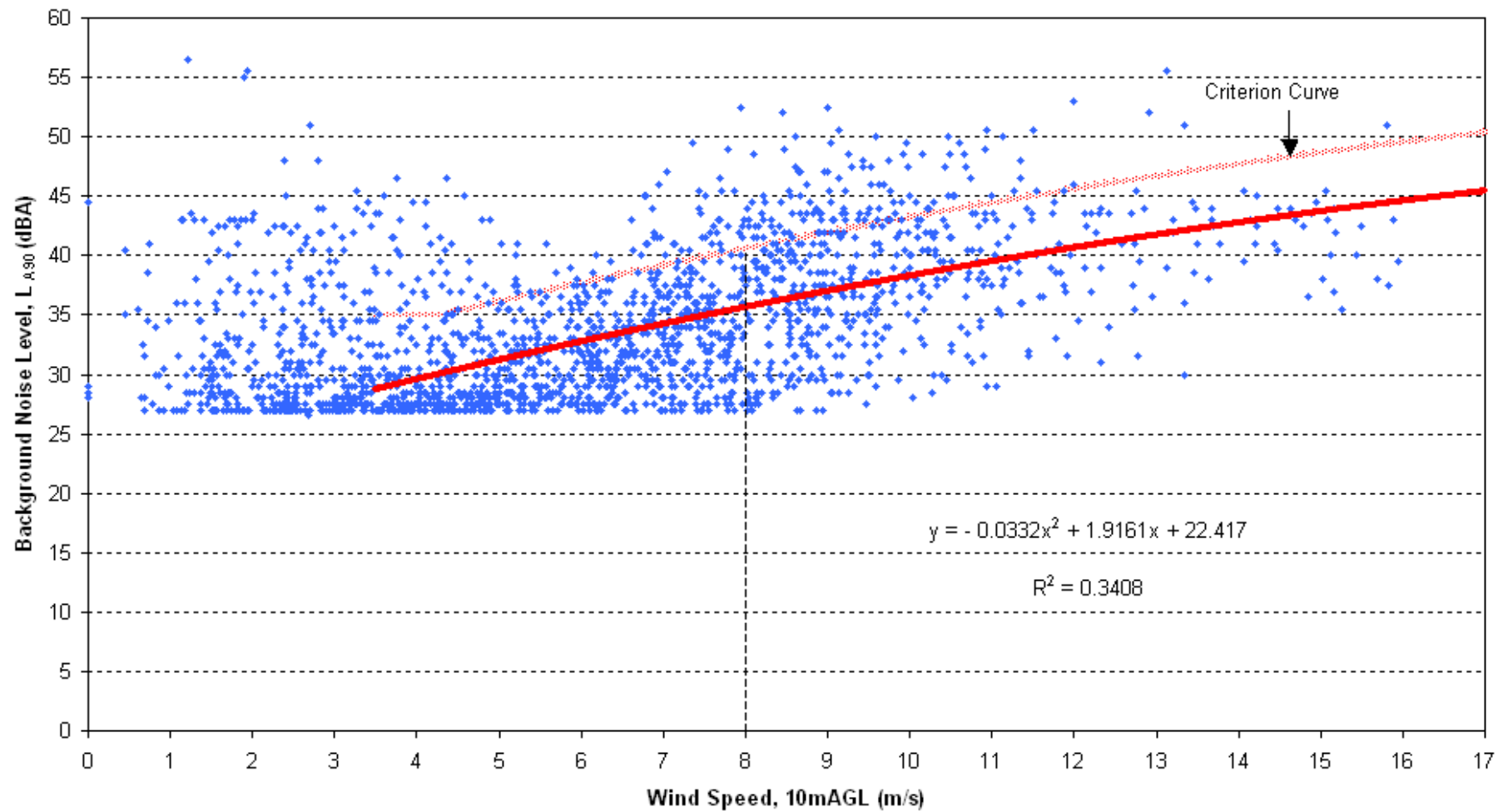




Appendix E: Noise Level-Wind Speed Data Plots & Best Fit Regression

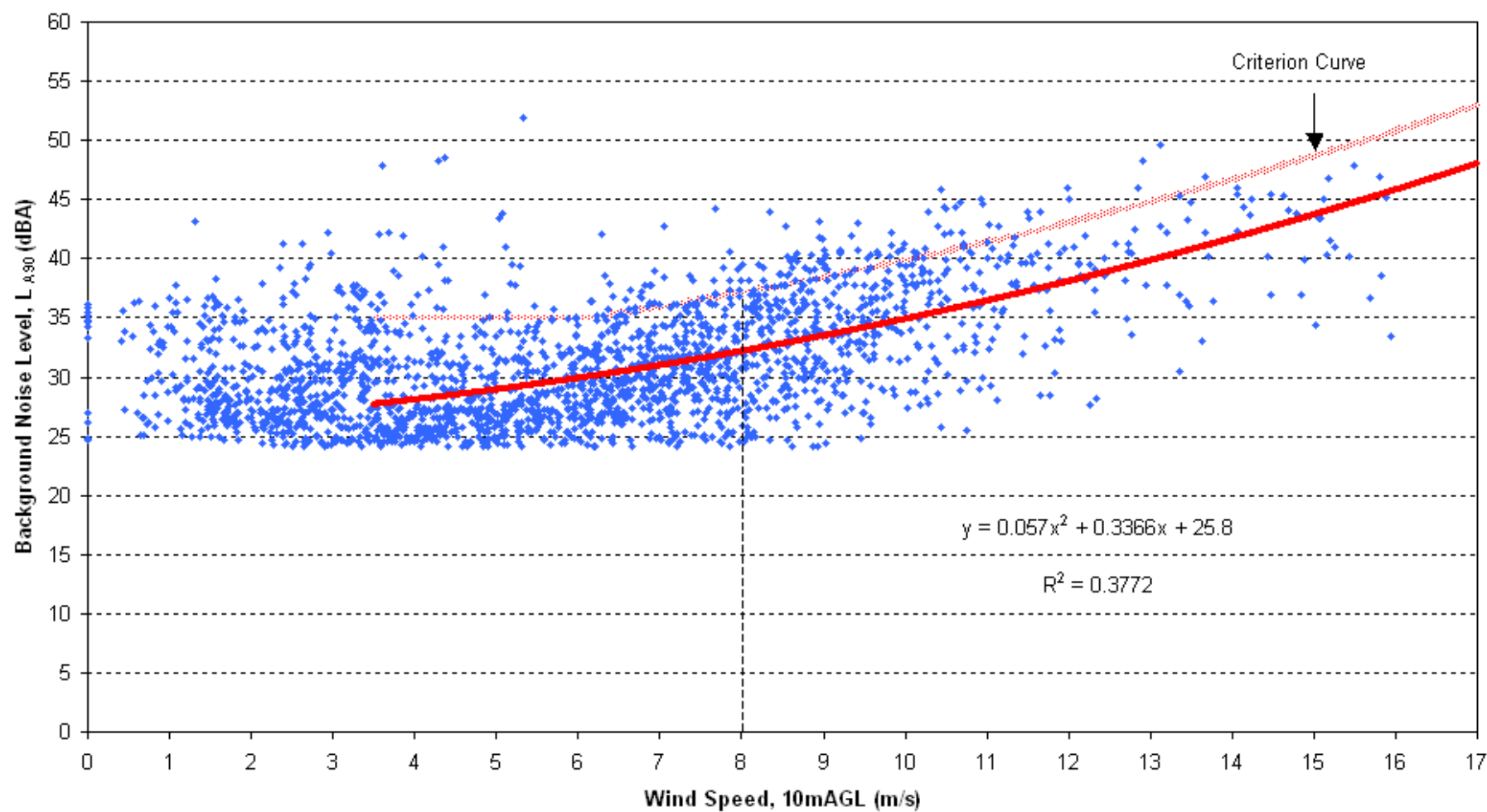


Site 1 : Background Noise at Receiver vs Wind Speed at Windfarm



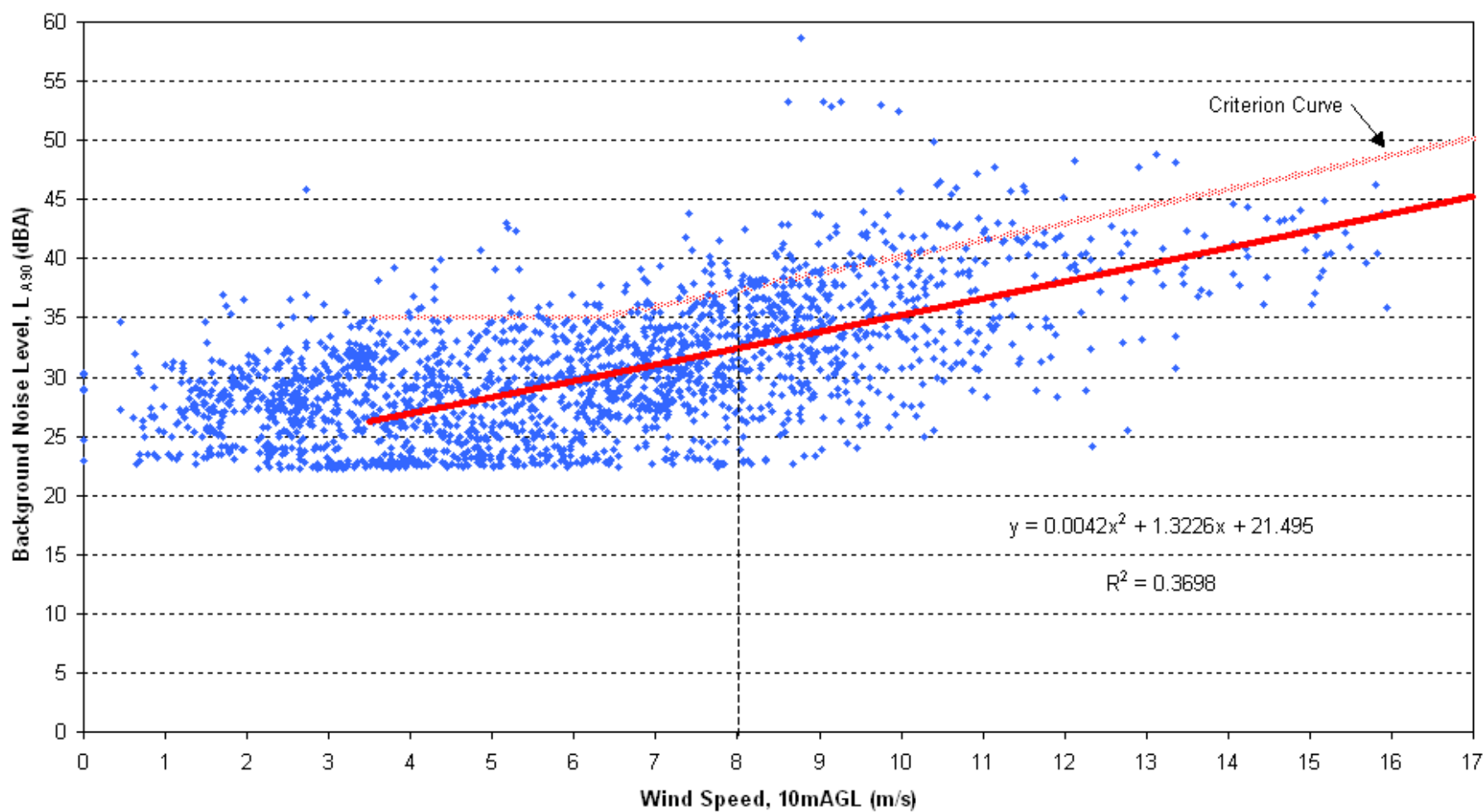


Site 2 : Background Noise at Receiver vs Wind Speed at Windfarm



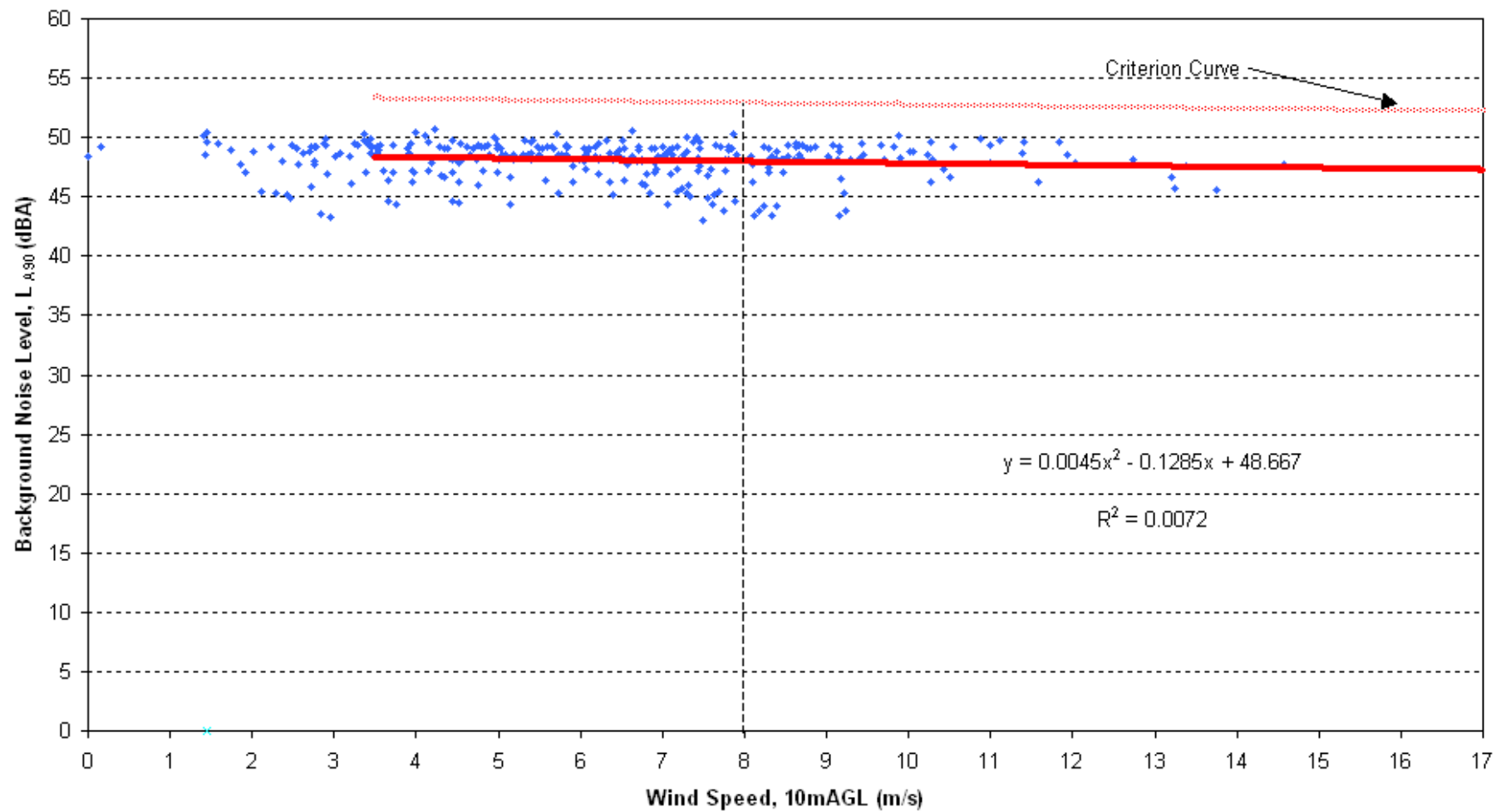


Site 3 : Background Noise at Receiver vs Wind Speed at Windfarm



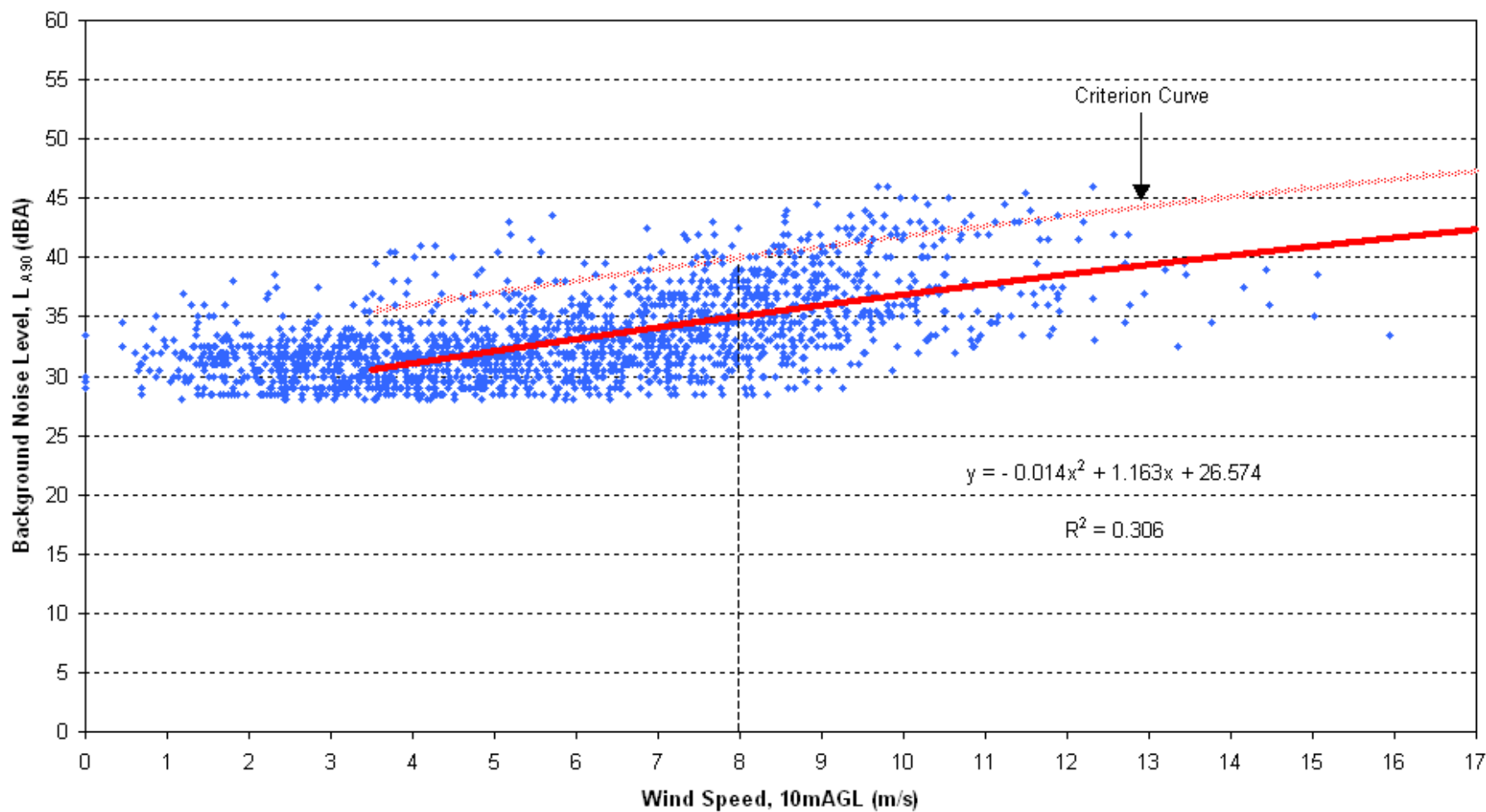


Site 4 : Background Noise at Receiver vs Wind Speed at Windfarm



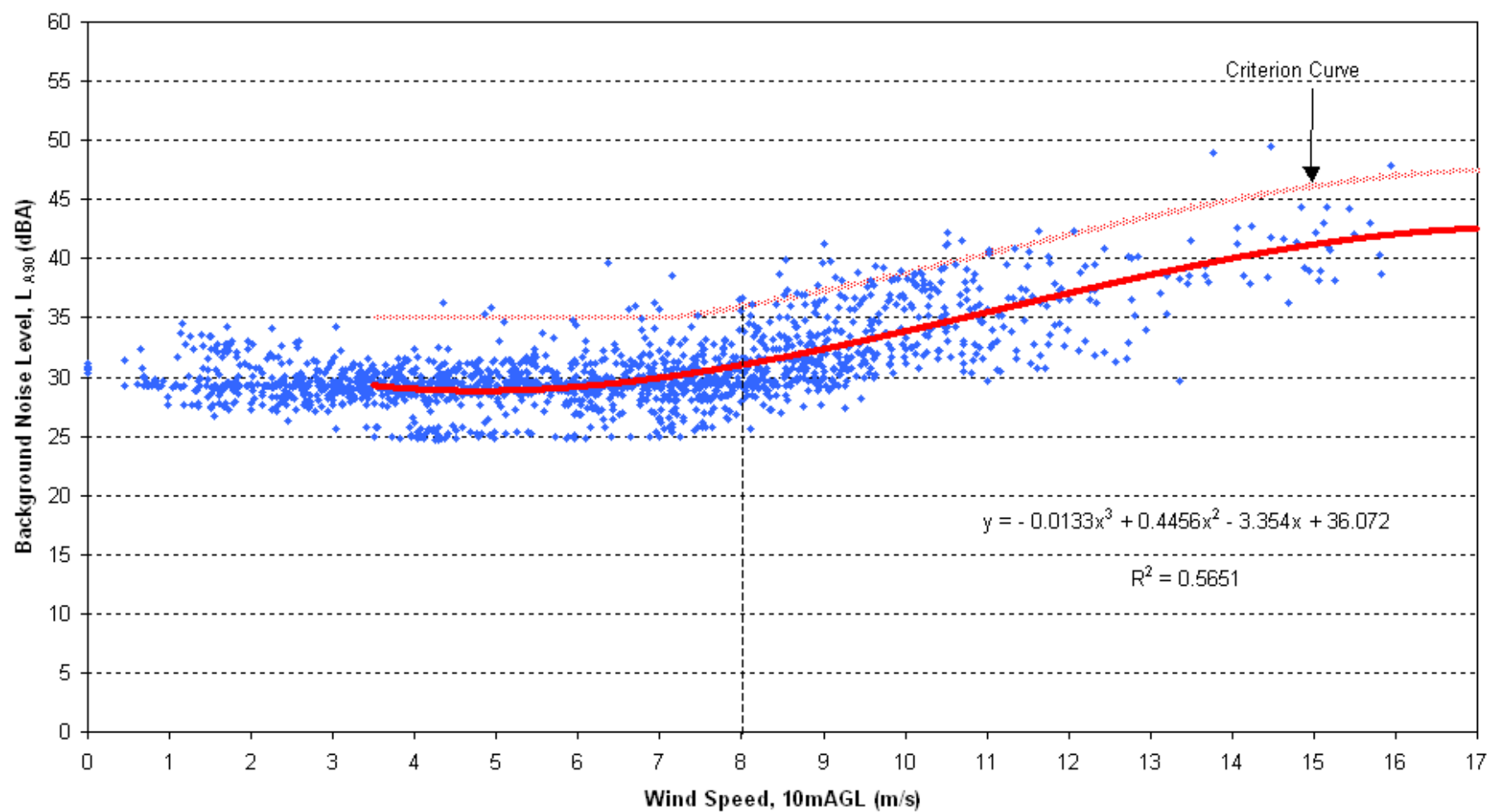


Site 5 : Background Noise at Receiver vs Wind Speed at Windfarm



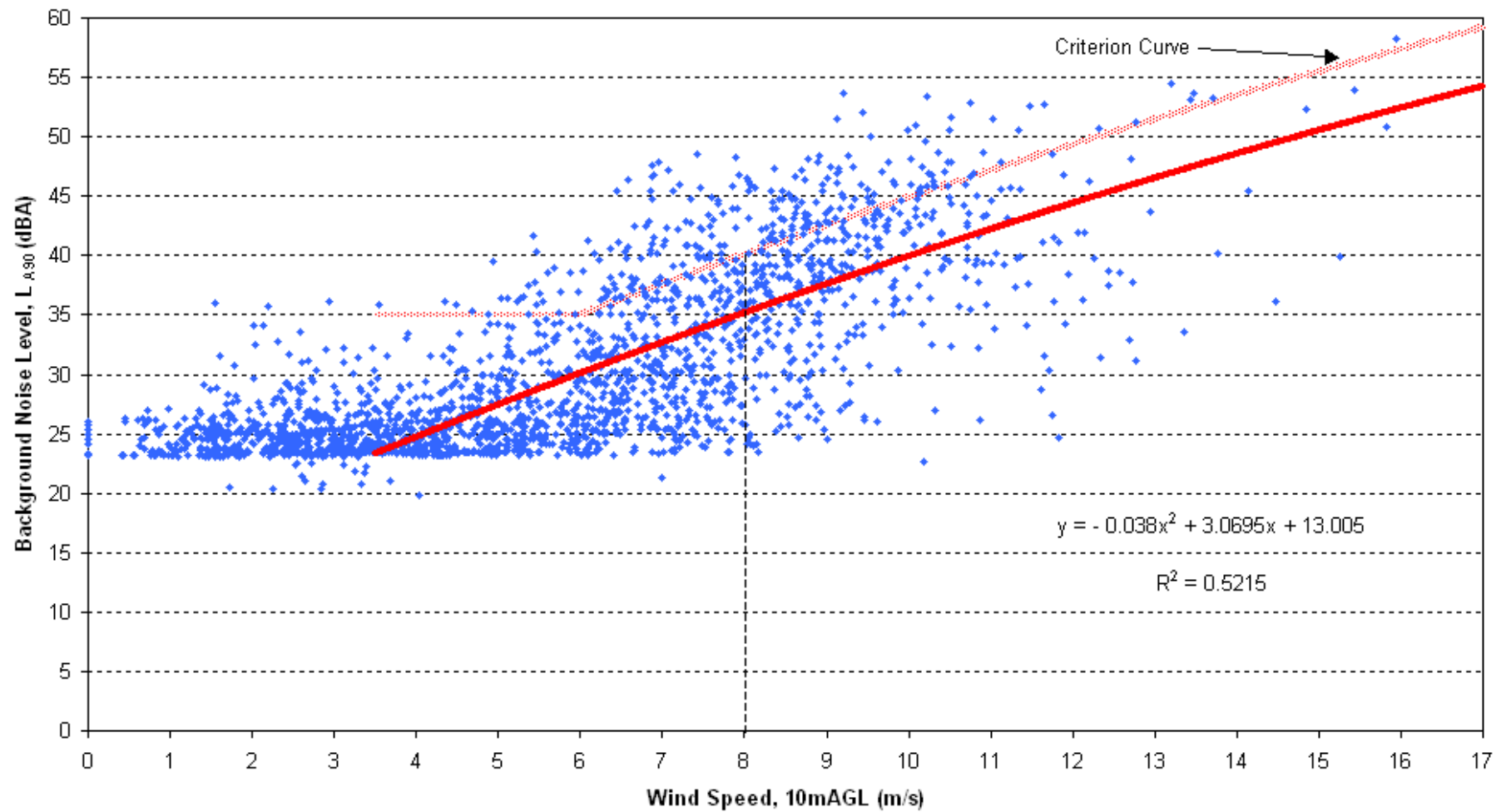


Site 6 : Background Noise at Receiver vs Wind Speed at Windfarm



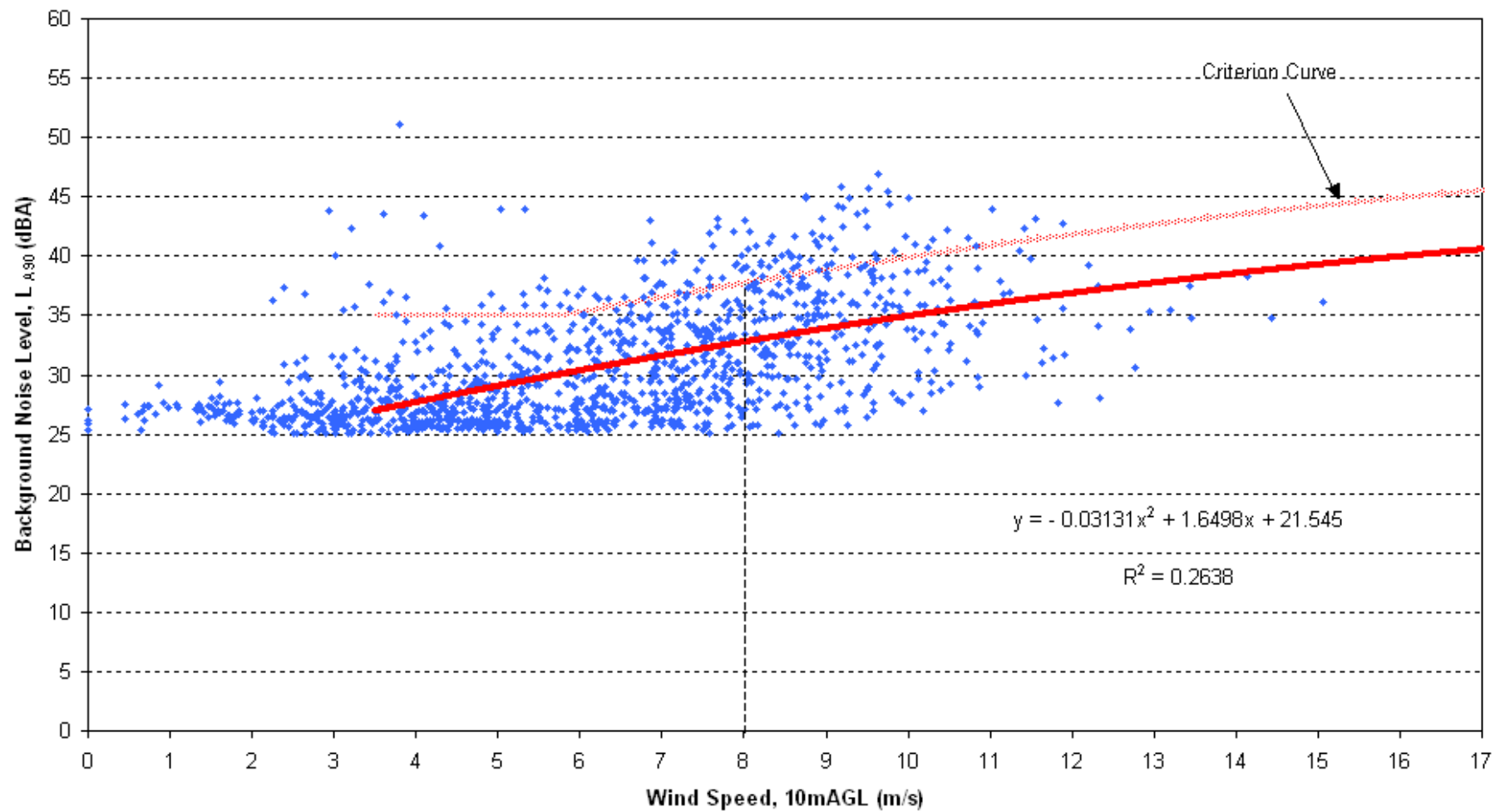


Site 8 : Background Noise at Receiver vs Wind Speed at Windfarm





Site 9 : Background Noise at Receiver vs Wind Speed at Windfarm





Site 10 : Background Noise at Receiver vs Wind Speed at Windfarm

