

CHAPTER 9: NOISE

INTRODUCTION

- 9.1 Chapter 10 of the original Environmental Statement (ES) for the Heckington Fen Wind Park (the Development Site) presented an assessment of the potential construction and operational noise impacts of the Development on the residents of nearby dwellings. The present Chapter presents an updated noise assessment based on potential changes to the number and types of candidate turbine that are now being proposed for the site, along with a change to the proposed alignment of the access track to the site and a change in the location of the proposed substation.
- 9.2 This Chapter has been prepared by Hoare Lea Acoustics (HLA). HLA are a specialist department within Hoare Lea and Partners, Europe's longest established firm of consulting engineers. For almost 25 years, HLA has been consistently involved in over 250 wind farm developments both in the UK and continental Europe. HLA are currently involved in the Institute of Acoustics (IOA) working group responsible for the production of the Good Practice Guide to the Application of ETSU-R-97 and are also part of the IOA working group that is currently in the process of developing further guidance on the assessment of Amplitude Modulation. HLA also lead the RenewableUK research project into amplitude modulation, the findings of which were published in late 2013.
- 9.3 The proposed Development is located to the north of the A17, approximately 13.5 km to the east of Sleaford, Lincolnshire, which is a predominantly rural area. The original ES detailed a proposed Development consisting of up to 22 turbines with a maximum tip height of 125 m.
- 9.4 This Addendum assesses the effects of the proposed minor amendments to the Heckington Fen Wind Park on noise. It uses the same data and follows the same methods and guidance as detailed in Chapter 10: Noise in the original Environmental Statement (ES). The assessment considers the following changes to the permitted scheme:
- *Amending the onsite access track along two sections within the Development Site and an allowance for micro-siting as set out in **Figure 3.1**;*
 - *Relocating and increasing the footprint of the onsite substation, including relocating the temporary construction compound to an area of existing hardstanding, providing temporary auxiliary crane pad areas and an underground cabling corridor from the turbines to the onsite substation as set out in **Figure 3.1**; and,*
 - *Amending the turbine rotor diameter from 90m, as indicated on the consented Site Edged Red plan (4038_A0085_03), to a maximum rotor diameter of up to 103m and a 10 metre radius micro-siting allowance around each turbine location where onsite constraints allow as set out in **Figure 3.1**.*
- 9.5 **Chapter 3: Details of the Variation** provides further details of these amendments.
- 9.6 The proposed amendment to the maximum rotor diameter is due to rapidly improving wind turbine technology which would allow Ecotricity to maximise renewable energy generation on the site. The maximum tip height will remain the same at 125 m; however, the lower blade sweep could be reduced to 23.5 m.

METHODOLOGY

Planning Policy and Advice Relating to Noise

- 9.7 Planning policy relating to noise was summarised in paragraphs 10.6 to 10.9 of the ES. Since the publication of the ES, planning policy has been updated, with the National Planning Policy Framework (NPPF)¹ replacing PPG24. The NPPF sets out general planning policy aims with regard to noise, specifically:
- avoiding significant impacts and minimising other impacts arising from new development;
 - protecting identified areas of tranquility; and
 - recognising that this should be balanced against the need for business to operate without unreasonable restrictions being imposed.
- 9.8 The above is consistent with general Government policy on noise as set out in the Noise Policy Statement for England (NPSE)².

Planning Policy and Advice Relating to Operational Noise

- 9.9 The NPPF makes it clear that (page 22):
- 'In assessing the likely impacts of potential wind energy development when identifying suitable areas, and in determining planning applications for such development, planning authorities should follow the approach set out in the National Policy Statement for Renewable Energy Infrastructure...'*
- 9.10 The National Policy Statement for Renewable Energy Infrastructure (EN-3)³ includes specific guidance on noise assessment for onshore wind farm developments. EN-3 advises that the ETSU-R-97 methodology, and any subsequent good practice reflecting updated guidance issued in relation to ETSU-R-97 and accepted by the Government, should be used to assess whether the noise from the operation of the wind turbines is within acceptable levels. Specifically, EN-3 advises:
- 'where the correct methodology has been followed and a wind farm is shown to comply with ETSU-R-97 it should be reasonable [...] to conclude that it may give little or no weight to adverse noise impacts from the operation of the wind turbines'*
- 9.11 ETSU-R-97 is also referenced in National Planning Practice Guidance (NPPG)⁴, which states that it 'should be used by local planning authorities'. As such, it remains the case that ETSU-R-97 should be used to assess operational noise impacts from wind turbines, as was the case when the ES was produced.

¹ DCLG, National Planning Policy Framework, March 2012

² DEFRA, Noise Policy Statement for England, March 2010

³ DECC, National Policy Statement for Renewable Energy Infrastructure (EN-3), July 2011

⁴ DCLG, National Planning Practice Guidance, March 2012

9.12 Guidance on good practice in relation to the application of ETSU-R-97 (IOA GPG)⁵ has also been published by the Institute of Acoustics since the production of the ES. This has subsequently been endorsed by the UK Government. The operational noise assessment contained in Chapter 10 of the original ES has therefore been reviewed against the guidance contained in the GPG, and it has been concluded that the assessment is in line with the recommendations of the GPG. In particular:

- the survey locations used were sufficiently representative of the noise sensitive dwellings in the vicinity of the development;
- the survey equipment used was in line with the requirements of the GPG;
- the baseline noise measurements were referenced to wind speeds measured on a tall anemometry mast and were analysed in line with GPG guidance;
- noise predictions were made based on sound power levels provided by the relevant turbine manufacturers, with the addition of appropriate allowances for measurement uncertainty; and,
- predictions have been carried out using appropriate prediction parameters.

9.13 The previous predictions were, however, carried out on the basis of different candidate turbines with smaller rotor diameters, therefore the predictions have been revised and are discussed in paragraphs 9.18 to 9.23 of this Chapter.

9.14 Finally, Appendix 10.A of the original ES included a brief discussion in relation to the subject of “blade swish” or “amplitude modulation” (AM). Since the production of the original ES, the results of an extensive research programme on this subject have been published⁶. This research discusses techniques for identifying and quantifying AM noise and relating such an objective measure to the subjective response to AM noise. There remains, however, no universally agreed method for rating or controlling AM.

Planning Policy and Advice Relating to Construction Noise

9.15 As discussed above in relation to turbine operational noise, PPG24 has been replaced by the NPPF. Whilst there is no specific reference to the assessment of construction noise impacts within the NPPF, British Standard BS 5228:2009 remains the extant UK guidance on the assessment of construction noise and therefore the appropriate methodology for assessing construction noise impacts outlined in Table 10.1 of the original ES remains appropriate. As such, the significance criteria applicable to construction noise and defined in the original ES remain valid, and are reproduced in the following table. As per the assessment presented in the original ES, a construction noise impact with a moderate or major magnitude is considered significant and impacts of minor or negligible magnitude are considered not significant in EIA terms.

Table 9.1: Free-Field Noise Criteria against which Construction Noise Impacts Are Assessed

Significance	Condition
Major	Construction noise is greater than 72 dB $L_{Aeq,T}$ for any part of the construction works or exceeds 67 dB $L_{Aeq,T}$ for more than 4 weeks in any 12 month period
Moderate	Construction noise is less than or equal to 67 dB $L_{Aeq,T}$ throughout the construction period.

⁵ Institute of Acoustics, *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise*, May 2013

⁶ RenewableUK, *Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effect*, December 2013

Minor	Construction noise is generally less than or equal to 60 dB $L_{Aeq,T}$, with periods of up to 67 dB $L_{Aeq,T}$ lasting not more than 4 weeks in any 12 month period
Negligible	Construction noise is generally less than or equal to 55 dB $L_{Aeq,T}$, with periods of up to 60 dB $L_{Aeq,T}$ lasting not more than 4 weeks in any 12 month period

BASELINE

9.16 Appropriate baseline noise levels remain those set out in the original ES. These include measurements taken at six locations considered representative of residential receptors in the vicinity of the proposed Development.

9.17 The appropriate ETSU-R-97 noise limits derived from these measurements were set out in Tables 10.4 and 10.5 of the original ES and are reproduced below.

Table 9.2: Daytime $L_{A90,T}$ Noise Limits Derived from the Baseline Noise Survey According to ETSU-R-97

Property	Wind Speed at 10 m Height, m/s									
	3	4	5	6	7	8	9	10	11	12
1 - 4 New Cottage, Side Bar Lane	40.0	40.4	40.9	41.6	42.3	43.0	43.8	43.8	43.8	43.8
2 Council House, East Heckington	46.9	47.6	48.3	49.0	49.7	50.2	50.2	50.2	50.2	50.2
Catlins Farm	40.0	40.0	40.0	40.9	42.5	44.2	46.0	47.7	47.7	47.7
College Farm	40.0	40.0	40.0	40.9	42.5	44.2	46.0	47.7	47.7	47.7
Derwent Cottage, Side Bar Lane	40.0	40.4	40.9	41.6	42.3	43.0	43.8	43.8	43.8	43.8
Elm Grange Farm, East Heckington	46.9	47.6	48.3	49.0	49.7	50.2	50.2	50.2	50.2	50.2
First Cottage, Side Bar Lane	40.0	40.4	40.9	41.6	42.3	43.0	43.8	43.8	43.8	43.8
Five Willow Wath Farm, Side Bar Lane	40.0	40.0	40.0	40.0	41.2	43.0	44.8	46.8	46.8	46.8
Glebe Farm, Side Bar Lane	40.0	40.0	40.0	40.0	41.2	43.0	44.8	46.8	46.8	46.8
Home Farm, East Heckington	46.9	47.6	48.3	49.0	49.7	50.2	50.2	50.2	50.2	50.2
Mill Green Farm	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.7	40.7	40.7
Rakes Farm, East Heckington	46.9	47.6	48.3	49.0	49.7	50.2	50.2	50.2	50.2	50.2
Rectory Farm House, East Heckington	46.9	47.6	48.3	49.0	49.7	50.2	50.2	50.2	50.2	50.2
Six Hundreds Drove, East Heckington	46.9	47.6	48.3	49.0	49.7	50.2	50.2	50.2	50.2	50.2
Spinney Farm	40.0	40.0	40.0	40.0	40.0	40.4	44.5	49.1	49.1	49.1
Swineshead House	46.9	47.6	48.3	49.0	49.7	50.2	50.2	50.2	50.2	50.2
The Chapel House, Side Bar Lane	40.0	40.4	40.9	41.6	42.3	43.0	43.8	43.8	43.8	43.8
The Old Church	40.0	40.0	40.0	40.0	40.0	40.4	44.5	49.1	49.1	49.1
Unnamed Property (B1395)	40.0	40.4	40.9	41.6	42.3	43.0	43.8	43.8	43.8	43.8

Table 9.3: Night-time $L_{A90,T}$ Noise Limits Derived from the Baseline Noise Survey According to ETSU-R-97

Property	Wind Speed at 10 m Height, m/s									
	3	4	5	6	7	8	9	10	11	12
1 - 4 New Cottage, Side Bar Lane	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
2 Council House, East Heckington	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Catlins Farm	43.0	43.0	43.0	43.0	43.0	43.0	45.1	49.1	51.3	51.3
College Farm	43.0	43.0	43.0	43.0	43.0	43.0	45.1	49.1	51.3	51.3
Derwent Cottage, Side Bar Lane	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Elm Grange Farm, East Heckington	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
First Cottage, Side Bar Lane	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Five Willow Wath Farm, Side Bar Lane	43.0	43.0	43.0	43.0	43.0	43.0	44.3	48.9	51.5	51.5
Glebe Farm, Side Bar Lane	43.0	43.0	43.0	43.0	43.0	43.0	44.3	48.9	51.5	51.5
Home Farm, East Heckington	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Mill Green Farm	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.3	44.3
Rakes Farm, East Heckington	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Rectory Farm House, East Heckington	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Six Hundreds Drove, East Heckington	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Spinney Farm	43.0	43.0	43.0	43.0	43.0	43.0	43.0	48.1	48.1	48.1
Swineshead House	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
The Chapel House, Side Bar Lane	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
The Old Church	43.0	43.0	43.0	43.0	43.0	43.0	43.0	48.1	48.1	48.1
Unnamed Property (B1395)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0

ASSESSMENT OF EFFECTS

Operational Noise

9.18 As noted in the Introduction, current proposals are to utilise turbines that have a larger rotor diameter than those that were originally considered in the original ES. In addition, for some of the turbine options, the larger generating capacity that is available for turbines with a larger rotor means that a reduced number of turbines are needed in order to achieve the equivalent power generation.

9.19 Consequently, the following candidate turbine options are considered in this assessment.

Table 9.4: Summary of Candidate Turbine Options

Scenario No	Candidate Turbine Type	Generating Capacity per Turbine	Number on Site	Turbines Removed from Consented Layout	Hub Height
1	Siemens SWT101	2.3 MW	22	None	74.5 m
2	GE 103	2.85 MW	19	T11, T16, T21	73.5 m
3	Enercon E101	3.05 MW	18	T11, T16, T17, T21	74.5 m

9.20 Source sound power levels for each of the above turbine options have been provided by the respective manufacturers. In accordance with the recommendations of the IOA GPG, appropriate allowances have been added to the supplied sound power levels to account for measurement uncertainty. Since no information is available on the uncertainty associated with the Siemens SWT101 or the GE103 machines, a +2 dB allowance has been added to the sound power levels for these turbines. For the Enercon E101 machine, a +1 dB allowance has been added, as recommended by Enercon. The resulting sound power levels, after the addition of the uncertainty allowances, are summarised in the following table.

Table 9.5: Turbine Sound Power Levels

Standardised Wind Speed at Ten Metre Height (m/s)	Sound Power Level (dB L_{Aeq})		
	Siemens SWT101 2.3 MW + 2 dB	GE GE 103 2.85 MW + 2 dB	Enercon E101 3.05 MW +1 dB
4	98.6	94.8	-
5	101.6	98.7	100.0
6	106.8	103.8	103.9
7	108.0	107.0	106.4
8	108.0	107.0	107.0
9	108.0	107.0	107.0
10	108.0	107.0	107.0
11	108.0	107.0	107.0
12	108.0	107.0	107.0

9.21 Spectral data for each of the above candidate turbines has also been provided by the turbine manufacturers. This information is summarised in the following table.

Table 9.6: Turbine Spectral Data

Octave Band Centre Frequency (Hz)	A-Weighted Sound Power Level (dB(A))		
	Siemens SWT101 2.3 MW	GE GE103 2.85 MW	Enercon E101 3.05 MW
63	82.5	90.2	86.7
125	93.4	94.7	94.7
250	97.1	96.0	94.4
500	101.1	97.4	97.0
1000	101.1	99.0	98.8
2000	97.4	99.1	93.9
4000	90.2	92.8	81.6
8000	86.2	73.3	73.5

9.22 Based on the above source data, predictions have been carried out in accordance with the recommendations outlined in the IOA GPG. Comparisons of these predictions with the limits set out in **Tables 9.1 and 9.2** above are given in the following tables.

Table 9.7: Comparison of Predicted Noise Immission Levels assuming the Siemens SWT101 2.3 MW Candidate Turbine with the ETSU-R-97 Daytime Noise Limits from Table 9.2. Negative values indicate that the predicted noise immission levels are below the limit.

Property	Wind Speed at 10 m Height, m/s								
	4	5	6	7	8	9	10	11	12
1 - 4 New Cottage, Side Bar Lane	-11.3	-7.1	-2.6	-2.1	-2.8	-3.6	-3.6	-3.6	-3.6
2 Council House, East Heckington	-17.8	-13.8	-9.3	-8.8	-9.3	-9.3	-9.3	-9.3	-9.3
Catlins Farm	-10.7	-6.0	-1.7	-2.1	-3.8	-5.6	-7.3	-7.3	-7.3
College Farm	-10.9	-6.2	-1.9	-2.3	-4.0	-5.8	-7.5	-7.5	-7.5
Derwent Cottage, Side Bar Lane	-11.7	-7.5	-3.0	-2.5	-3.2	-4.0	-4.0	-4.0	-4.0
Elm Grange Farm, East Heckington	-18.6	-14.6	-10.1	-9.6	-10.1	-10.1	-10.1	-10.1	-10.1
First Cottage, Side Bar Lane	-12.0	-7.8	-3.3	-2.8	-3.5	-4.3	-4.3	-4.3	-4.3
Five Willow Wath Farm, Side Bar Lane	-12.1	-7.4	-2.2	-2.2	-4.0	-5.8	-7.8	-7.8	-7.8
Glebe Farm, Side Bar Lane	-11.1	-6.4	-1.2	-1.2	-3.0	-4.8	-6.8	-6.8	-6.8
Home Farm, East Heckington	-17.4	-13.4	-8.9	-8.4	-8.9	-8.9	-8.9	-8.9	-8.9
Mill Green Farm	-9.3	-4.6	0.6	1.8	1.8	1.8	1.1	1.1	1.1
Rakes Farm, East Heckington	-19.1	-15.1	-10.6	-10.1	-10.6	-10.6	-10.6	-10.6	-10.6
Rectory Farm House, East Heckington	-17.5	-13.5	-9.0	-8.5	-9.0	-9.0	-9.0	-9.0	-9.0
Six Hundreds Drove, East Heckington	-19.5	-15.5	-11.0	-10.5	-11.0	-11.0	-11.0	-11.0	-11.0
Spinney Farm	-13.7	-9.0	-3.8	-2.6	-3.0	-7.1	-11.7	-11.7	-11.7
Swineshead House	-20.8	-16.8	-12.3	-11.8	-12.3	-12.3	-12.3	-12.3	-12.3

Property	Wind Speed at 10 m Height, m/s								
	4	5	6	7	8	9	10	11	12
The Chapel House, Side Bar Lane	-12.1	-7.9	-3.4	-2.9	-3.6	-4.4	-4.4	-4.4	-4.4
The Old Church	-12.0	-7.3	-2.1	-0.9	-1.3	-5.4	-10.0	-10.0	-10.0

Table 9.8: Comparison of Predicted Noise Immission Levels assuming the Siemens SWT101 2.3 MW Candidate Turbine with the ETSU-R-97 Night-Time Noise Limits from Table 9.3. Negative values indicate that the predicted noise immission levels are below the limit.

Property	Wind Speed at 10 m Height, m/s								
	4	5	6	7	8	9	10	11	12
1 - 4 New Cottage, Side Bar Lane	-13.9	-9.2	-4.0	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8
2 Council House, East Heckington	-13.2	-8.5	-3.3	-2.1	-2.1	-2.1	-2.1	-2.1	-2.1
Catlins Farm	-13.7	-9.0	-3.8	-2.6	-2.6	-4.7	-8.7	-10.9	-10.9
College Farm	-13.9	-9.2	-4.0	-2.8	-2.8	-4.9	-8.9	-11.1	-11.1
Derwent Cottage, Side Bar Lane	-14.3	-9.6	-4.4	-3.2	-3.2	-3.2	-3.2	-3.2	-3.2
Elm Grange Farm, East Heckington	-14.0	-9.3	-4.1	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9
First Cottage, Side Bar Lane	-14.6	-9.9	-4.7	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5
Five Willow Wath Farm, Side Bar Lane	-15.1	-10.4	-5.2	-4.0	-4.0	-5.3	-9.9	-12.5	-12.5
Glebe Farm, Side Bar Lane	-14.1	-9.4	-4.2	-3.0	-3.0	-4.3	-8.9	-11.5	-11.5
Home Farm, East Heckington	-12.8	-8.1	-2.9	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7
Mill Green Farm	-12.3	-7.6	-2.4	-1.2	-1.2	-1.2	-1.2	-2.5	-2.5
Rakes Farm, East Heckington	-14.5	-9.8	-4.6	-3.4	-3.4	-3.4	-3.4	-3.4	-3.4
Rectory Farm House, East Heckington	-12.9	-8.2	-3.0	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
Six Hundreds Drove, East Heckington	-14.9	-10.2	-5.0	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8
Spinney Farm	-16.7	-12.0	-6.8	-5.6	-5.6	-5.6	-10.7	-10.7	-10.7
Swineshead House	-16.2	-11.5	-6.3	-5.1	-5.1	-5.1	-5.1	-5.1	-5.1
The Chapel House, Side Bar Lane	-14.7	-10.0	-4.8	-3.6	-3.6	-3.6	-3.6	-3.6	-3.6
The Old Church	-15.0	-10.3	-5.1	-3.9	-3.9	-3.9	-9.0	-9.0	-9.0

Table 9.9: Comparison of Predicted Noise Immission Levels assuming the GE GE103 2.85 MW Candidate Turbine with the ETSU-R-97 Daytime Noise Limits from Table 9.2. Negative values indicate that the predicted noise immission levels are below the limit.

Property	Wind Speed at 10 m Height, m/s								
	4	5	6	7	8	9	10	11	12
1 - 4 New Cottage, Side Bar Lane	-14.0	-10.6	-6.2	-3.7	-4.4	-5.2	-5.2	-5.2	-5.2
2 Council House, East Heckington	-20.4	-17.2	-12.8	-10.3	-10.8	-10.8	-10.8	-10.8	-10.8
Catlins Farm	-13.6	-9.7	-5.5	-3.9	-5.6	-7.4	-9.1	-9.1	-9.1
College Farm	-13.8	-9.9	-5.7	-4.1	-5.8	-7.6	-9.3	-9.3	-9.3
Derwent Cottage, Side Bar Lane	-14.3	-10.9	-6.5	-4.0	-4.7	-5.5	-5.5	-5.5	-5.5
Elm Grange Farm, East Heckington	-21.2	-18.0	-13.6	-11.1	-11.6	-11.6	-11.6	-11.6	-11.6
First Cottage, Side Bar Lane	-14.6	-11.2	-6.8	-4.3	-5.0	-5.8	-5.8	-5.8	-5.8
Five Willow Wath Farm, Side Bar Lane	-14.8	-10.9	-5.8	-3.8	-5.6	-7.4	-9.4	-9.4	-9.4
Glebe Farm, Side Bar Lane	-13.8	-9.9	-4.8	-2.8	-4.6	-6.4	-8.4	-8.4	-8.4
Home Farm, East Heckington	-20.0	-16.8	-12.4	-9.9	-10.4	-10.4	-10.4	-10.4	-10.4
Mill Green Farm	-12.7	-8.8	-3.7	-0.5	-0.5	-0.5	-1.2	-1.2	-1.2
Rakes Farm, East Heckington	-21.7	-18.5	-14.1	-11.6	-12.1	-12.1	-12.1	-12.1	-12.1
Rectory Farm House, East Heckington	-20.2	-17.0	-12.6	-10.1	-10.6	-10.6	-10.6	-10.6	-10.6
Six Hundreds Drove, East Heckington	-22.1	-18.9	-14.5	-12.0	-12.5	-12.5	-12.5	-12.5	-12.5
Spinney Farm	-17.2	-13.3	-8.2	-5.0	-5.4	-9.5	-14.1	-14.1	-14.1
Swineshead House	-23.4	-20.2	-15.8	-13.3	-13.8	-13.8	-13.8	-13.8	-13.8
The Chapel House, Side Bar Lane	-14.7	-11.3	-6.9	-4.4	-5.1	-5.9	-5.9	-5.9	-5.9
The Old Church	-16.1	-12.2	-7.1	-3.9	-4.3	-8.4	-13.0	-13.0	-13.0

Table 9.10: Comparison of Predicted Noise Immission Levels assuming the GE GE103 2.85 MW Candidate Turbine with the ETSU-R-97 Night-Time Noise Limits from Table 9.3. Negative values indicate that the predicted noise immission levels are below the limit.

Property	Wind Speed at 10 m Height, m/s								
	4	5	6	7	8	9	10	11	12
1 - 4 New Cottage, Side Bar Lane	-16.6	-12.7	-7.6	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4
2 Council House, East Heckington	-15.8	-11.9	-6.8	-3.6	-3.6	-3.6	-3.6	-3.6	-3.6
Catlins Farm	-16.6	-12.7	-7.6	-4.4	-4.4	-6.5	-10.5	-12.7	-12.7
College Farm	-16.8	-12.9	-7.8	-4.6	-4.6	-6.7	-10.7	-12.9	-12.9
Derwent Cottage, Side Bar Lane	-16.9	-13.0	-7.9	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7
Elm Grange Farm, East Heckington	-16.6	-12.7	-7.6	-4.4	-4.4	-4.4	-4.4	-4.4	-4.4

Property	Wind Speed at 10 m Height, m/s								
	4	5	6	7	8	9	10	11	12
First Cottage, Side Bar Lane	-17.2	-13.3	-8.2	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
Five Willow Wath Farm, Side Bar Lane	-17.8	-13.9	-8.8	-5.6	-5.6	-6.9	-11.5	-14.1	-14.1
Glebe Farm, Side Bar Lane	-16.8	-12.9	-7.8	-4.6	-4.6	-5.9	-10.5	-13.1	-13.1
Home Farm, East Heckington	-15.4	-11.5	-6.4	-3.2	-3.2	-3.2	-3.2	-3.2	-3.2
Mill Green Farm	-15.7	-11.8	-6.7	-3.5	-3.5	-3.5	-3.5	-4.8	-4.8
Rakes Farm, East Heckington	-17.1	-13.2	-8.1	-4.9	-4.9	-4.9	-4.9	-4.9	-4.9
Rectory Farm House, East Heckington	-15.6	-11.7	-6.6	-3.4	-3.4	-3.4	-3.4	-3.4	-3.4
Six Hundreds Drove, East Heckington	-17.5	-13.6	-8.5	-5.3	-5.3	-5.3	-5.3	-5.3	-5.3
Spinney Farm	-20.2	-16.3	-11.2	-8.0	-8.0	-8.0	-13.1	-13.1	-13.1
Swineshead House	-18.8	-14.9	-9.8	-6.6	-6.6	-6.6	-6.6	-6.6	-6.6
The Chapel House, Side Bar Lane	-17.3	-13.4	-8.3	-5.1	-5.1	-5.1	-5.1	-5.1	-5.1
The Old Church	-19.1	-15.2	-10.1	-6.9	-6.9	-6.9	-12.0	-12.0	-12.0

Table 9.11: Comparison of Predicted Noise Immission Levels assuming the Enercon E101 3.05 MW Candidate Turbine with the ETSU-R-97 Daytime Noise Limits from Table 9.2. Negative values indicate that the predicted noise immission levels are below the limit.

Property	Wind Speed at 10 m Height, m/s								
	4	5	6	7	8	9	10	11	12
1 - 4 New Cottage, Side Bar Lane	-	-8.6	-5.4	-3.6	-3.7	-4.5	-4.5	-4.5	-4.5
2 Council House, East Heckington	-	-15.2	-12.0	-10.2	-10.1	-10.1	-10.1	-10.1	-10.1
Catlins Farm	-	-7.8	-4.8	-3.9	-5.0	-6.8	-8.5	-8.5	-8.5
College Farm	-	-8.0	-5.0	-4.1	-5.2	-7.0	-8.7	-8.7	-8.7
Derwent Cottage, Side Bar Lane	-	-8.9	-5.7	-3.9	-4.0	-4.8	-4.8	-4.8	-4.8
Elm Grange Farm, East Heckington	-	-16.0	-12.8	-11.0	-10.9	-10.9	-10.9	-10.9	-10.9
First Cottage, Side Bar Lane	-	-9.2	-6.0	-4.2	-4.3	-5.1	-5.1	-5.1	-5.1
Five Willow Wath Farm, Side Bar Lane	-	-9.0	-5.1	-3.8	-5.0	-6.8	-8.8	-8.8	-8.8
Glebe Farm, Side Bar Lane	-	-7.9	-4.0	-2.7	-3.9	-5.7	-7.7	-7.7	-7.7
Home Farm, East Heckington	-	-14.9	-11.7	-9.9	-9.8	-9.8	-9.8	-9.8	-9.8
Mill Green Farm	-	-7.0	-3.1	-0.6	0.0	0.0	-0.7	-0.7	-0.7
Rakes Farm, East Heckington	-	-16.6	-13.4	-11.6	-11.5	-11.5	-11.5	-11.5	-11.5
Rectory Farm House, East Heckington	-	-15.0	-11.8	-10.0	-9.9	-9.9	-9.9	-9.9	-9.9
Six Hundreds Drove, East Heckington	-	-17.0	-13.8	-12.0	-11.9	-11.9	-11.9	-11.9	-11.9

Property	Wind Speed at 10 m Height, m/s								
	4	5	6	7	8	9	10	11	12
Spinney Farm	-	-11.8	-7.9	-5.4	-5.2	-9.3	-13.9	-13.9	-13.9
Swineshead House	-	-18.4	-15.2	-13.4	-13.3	-13.3	-13.3	-13.3	-13.3
The Chapel House, Side Bar Lane	-	-9.3	-6.1	-4.3	-4.4	-5.2	-5.2	-5.2	-5.2
The Old Church	-	-10.8	-6.9	-4.4	-4.2	-8.3	-12.9	-12.9	-12.9

Table 9.12: Comparison of Predicted Noise Immission Levels assuming the Enercon E101 3.05 MW Candidate Turbine with the ETSU-R-97 Night-Time Noise Limits from Table 9.3. Negative values indicate that the predicted noise immission levels are below the limit.

Property	Wind Speed at 10 m Height, m/s								
	4	5	6	7	8	9	10	11	12
1 - 4 New Cottage, Side Bar Lane	-	-10.7	-6.8	-4.3	-3.7	-3.7	-3.7	-3.7	-3.7
2 Council House, East Heckington	-	-9.9	-6.0	-3.5	-2.9	-2.9	-2.9	-2.9	-2.9
Catlins Farm	-	-10.8	-6.9	-4.4	-3.8	-5.9	-9.9	-12.1	-12.1
College Farm	-	-11.0	-7.1	-4.6	-4.0	-6.1	-10.1	-12.3	-12.3
Derwent Cottage, Side Bar Lane	-	-11.0	-7.1	-4.6	-4.0	-4.0	-4.0	-4.0	-4.0
Elm Grange Farm, East Heckington	-	-10.7	-6.8	-4.3	-3.7	-3.7	-3.7	-3.7	-3.7
First Cottage, Side Bar Lane	-	-11.3	-7.4	-4.9	-4.3	-4.3	-4.3	-4.3	-4.3
Five Willow Wath Farm, Side Bar Lane	-	-12.0	-8.1	-5.6	-5.0	-6.3	-10.9	-13.5	-13.5
Glebe Farm, Side Bar Lane	-	-10.9	-7.0	-4.5	-3.9	-5.2	-9.8	-12.4	-12.4
Home Farm, East Heckington	-	-9.6	-5.7	-3.2	-2.6	-2.6	-2.6	-2.6	-2.6
Mill Green Farm	-	-10.0	-6.1	-3.6	-3.0	-3.0	-3.0	-4.3	-4.3
Rakes Farm, East Heckington	-	-11.3	-7.4	-4.9	-4.3	-4.3	-4.3	-4.3	-4.3
Rectory Farm House, East Heckington	-	-9.7	-5.8	-3.3	-2.7	-2.7	-2.7	-2.7	-2.7
Six Hundreds Drove, East Heckington	-	-11.7	-7.8	-5.3	-4.7	-4.7	-4.7	-4.7	-4.7
Spinney Farm	-	-14.8	-10.9	-8.4	-7.8	-7.8	-12.9	-12.9	-12.9
Swineshead House	-	-13.1	-9.2	-6.7	-6.1	-6.1	-6.1	-6.1	-6.1
The Chapel House, Side Bar Lane	-	-11.4	-7.5	-5.0	-4.4	-4.4	-4.4	-4.4	-4.4
The Old Church	-	-13.8	-9.9	-7.4	-6.8	-6.8	-11.9	-11.9	-11.9

9.23 As can be seen from **Tables 9.9 to 9.12** above, the predicted noise immission levels for the GE GE103 and the Enercon E101 candidate turbines are below the consented noise limits at all wind speeds and for all receptors. **Tables 9.7 and 9.8** show, however, that without operational constraints, noise immission levels from the proposed development are predicted to exceed the consented daytime noise limits at one location if the Siemens SWT-101 candidate turbine option is used. Operational constraints that could be applied to the Siemens SWT-101 turbine that would be expected to result in predicted noise immission levels being less than the consented noise limits are described in the Mitigation section below.

Construction Noise

9.24 As noted in the Introduction to this Chapter, the alignment of the access track into the site has changed from the consented scheme, as has the proposed location of the substation. Both of these changes have the potential to lead to changes in the construction noise impact assessment form that presented in the ES. Whilst the access track alignment has changed within the proposed site, the location of the site entrance has remained in the same place. As such, the minimum distance between the access track and the nearest residential property (Rectory Cottages) remains 70 m and the worst-case assessment presented in the ES remains valid.

9.25 With regard to the change to the location of the proposed substation, the minimum distance between the substation and the nearest residential property reduces to 495 m, with the nearest property to the substation now Ashley House in East Heckington. As such, the predicted worst-case noise level during construction at the nearest residential property during construction of the substation is now as follows:

Table 9.13: Predicted Construction Noise Levels - Substation

Task Name	Plant/Equipment	Upper Collective Sound Emission Over Working Day $L_{WA,T}$	Nearest Receiver	Minimum Distance to Nearest Receiver	Predicted Upper Day Time Noise Levels $L_{Aeq,T}$
Construct Sub-Station	Excavator / Concrete truck / Delivery truck	110	Ashley House	495 m	45

9.26 As can be seen from comparing the results presented in **Table 9.13** above to the significance criteria in **Table 9.1**, construction noise impacts during construction of the substation will remain **negligible**.

MITIGATION

Construction Noise

9.27 The mitigation measures applicable to construction noise remain the same as those identified in the ES. No additional mitigation is required as a consequence of the proposed changes to the site layout.

Operational Noise

9.28 As identified in **Table 9.7**, the consented daytime noise limits are predicted to be exceeded at Mill Green Farm if the Siemens SWT-101 candidate turbine is installed on the site and operated in its

unconstrained mode of operation. As such, operational constraints will need to be applied to the Siemens candidate turbine in order to achieve the consented daytime noise limits. As such, predicted noise immission levels have been calculated with the following turbine constraints:

- Turbines 1, 4, 7, 11 and 12 operating in the “-4 dB” mode;
- Turbine 2 operating in the “-5dB” mode; and
- Turbine 3 operating in the “-6 dB mode.

9.29 Predicted noise immission levels with the proposed constraints applied have been calculated and the following table gives the comparison of the predicted noise immission levels with constraints applied with the consented daytime noise limits.

Table 9.14: Comparison of Predicted Noise Immission Levels assuming the Siemens SWT-101 2.3 MW Candidate Turbine with Constraint Applied as above with the ETSU-R-97 Daytime Noise Limits from Table 9.2. Negative values indicate that the predicted noise immission levels are below the limit.

Property	Wind Speed at 10 m Height, m/s								
	4	5	6	7	8	9	10	11	12
1 - 4 New Cottage, Side Bar Lane	-11.4	-7.9	-4.2	-3.8	-4.5	-5.3	-5.3	-5.3	-5.3
2 Council House, East Heckington	-17.8	-13.9	-9.7	-9.2	-9.7	-9.7	-9.7	-9.7	-9.7
Catlins Farm	-10.7	-6.2	-2.0	-2.4	-4.1	-5.9	-7.6	-7.6	-7.6
College Farm	-10.9	-6.3	-2.2	-2.6	-4.3	-6.1	-7.8	-7.8	-7.8
Derwent Cottage, Side Bar Lane	-11.7	-8.2	-4.4	-4.0	-4.7	-5.5	-5.5	-5.5	-5.5
Elm Grange Farm, East Heckington	-18.6	-15.0	-11.0	-10.6	-11.1	-11.1	-11.1	-11.1	-11.1
First Cottage, Side Bar Lane	-12.0	-8.4	-4.6	-4.2	-4.9	-5.7	-5.7	-5.7	-5.7
Five Willow Wath Farm, Side Bar Lane	-12.1	-8.3	-4.4	-4.5	-6.3	-8.1	-10.1	-10.1	-10.1
Glebe Farm, Side Bar Lane	-11.2	-7.3	-3.3	-3.5	-5.3	-7.1	-9.1	-9.1	-9.1
Home Farm, East Heckington	-17.4	-13.8	-9.7	-9.2	-9.7	-9.7	-9.7	-9.7	-9.7
Mill Green Farm	-9.3	-5.3	-1.3	-0.2	-0.2	-0.2	-0.9	-0.9	-0.9
Rakes Farm, East Heckington	-19.1	-15.2	-10.9	-10.4	-10.9	-10.9	-10.9	-10.9	-10.9
Rectory Farm House, East Heckington	-17.5	-13.8	-9.6	-9.1	-9.6	-9.6	-9.6	-9.6	-9.6
Six Hundreds Drove, East Heckington	-19.5	-15.7	-11.4	-10.9	-11.4	-11.4	-11.4	-11.4	-11.4
Spinney Farm	-13.7	-9.2	-4.3	-3.1	-3.5	-7.6	-12.2	-12.2	-12.2
Swineshead House	-20.8	-17.0	-12.7	-12.2	-12.7	-12.7	-12.7	-12.7	-12.7
The Chapel House, Side Bar Lane	-12.1	-8.7	-5.3	-4.9	-5.6	-6.4	-6.4	-6.4	-6.4
The Old Church	-12.0	-7.7	-2.9	-1.8	-2.2	-6.3	-10.9	-10.9	-10.9

9.30 As can be seen from the above, with the proposed mitigation applied, the predicted noise immission levels from the Siemens SWT-101 turbine would be expected to achieve the consented daytime noise limits. Since the night-time noise limits are predicted to be achieved with this candidate turbine without the application of constraints, the night-time limits would also be achieved if the proposed constraints plan is applied.

9.31 No specific mitigation measures would be required if the GE103 or Enercon E101 turbines are installed at the site, as both of these options are predicted to achieve the relevant ETSU-R-97 noise limits during both day and night, for all wind speeds and at all noise sensitive receptor locations.

STATEMENT OF RESIDUAL SIGNIFICANCE

Construction Noise

9.32 The construction noise assessment has determined that the levels of noise associated with construction activities are expected to be audible at various times throughout the construction programme, but remain within acceptable limits, such that their temporary impacts are considered at worst minor and are therefore **not significant** in EIA terms.

Operational Noise

9.33 Operational noise from the Development has been assessed in accordance with the methodology that is currently endorsed by the UK Government, namely that set out in the 1996 DTI report ETSU-R-97. In addition, the recommendations of the IOA Good Practice Guide have been applied when carrying out the operational noise assessment. The predicted operational noise limits, with appropriate mitigation applied, are within the ETSU-R-97 criteria at all noise sensitive receptors and for all wind conditions and, as such, residual operational noise impacts are acceptable according to current UK planning policy and are therefore **not significant** in EIA terms.

Table 9.15: Summary Table of Effects

Potential Effect	Evaluation of Effect
Construction Noise	Noise levels have been predicted using the methodology set out in BS 5228. Based on impact assessment criteria derived and supported by a range of noise policy and guidance, the overall impact of construction noise is considered to represent a negligible effect at the majority of receptors. The construction of new access tracks is predicted to result in a minor effect at Rectory Cottages. These predicted impacts would be considered not significant in EIA terms.
Operational Noise	Noise criteria have been established in accordance with ETSU-R-97. It has also been shown that these criteria are achievable with a commercially available turbine suitable for the site. The basis of the ETSU-R-97 method is to define acceptable noise limits thought to offer reasonable protection to residents in areas around wind farm developments. Operational noise immission levels are acceptable in terms of the guidance commended by planning policy for the assessment of wind farm noise, and therefore considered not significant in EIA terms.

REFERENCES

1. National Planning Policy Framework, Department for Communities and Local Government, March 2012.
2. Noise Policy Statement for England, Department for Environment, Food and Rural Affairs, March 2010.
3. The National Policy Statement on Renewable Energy Infrastructure (EN-3), Planning for new energy infrastructure, Department of Energy and Climate Change, July 2011.
4. A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, M. Cand, R. Davis, C. Jordan, M. Hayes, R. Perkins, Institute of Acoustics, May 2013.
5. National Planning Practice Guidance, Renewable and low carbon energy, March 2014, <http://planningguidance.planningportal.gov.uk/blog/guidance/renewable-and-low-carbon-energy/>
6. Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effect, Renewable UK, December 2013.

APPENDIX 9.A: LOCATION MAPS



Figure A1: Map showing the layout of the Siemens SWT-101 turbines (green dots), the noise monitoring locations (blue dots within red circles) and the additional noise assessment locations (orange dots within red circles).

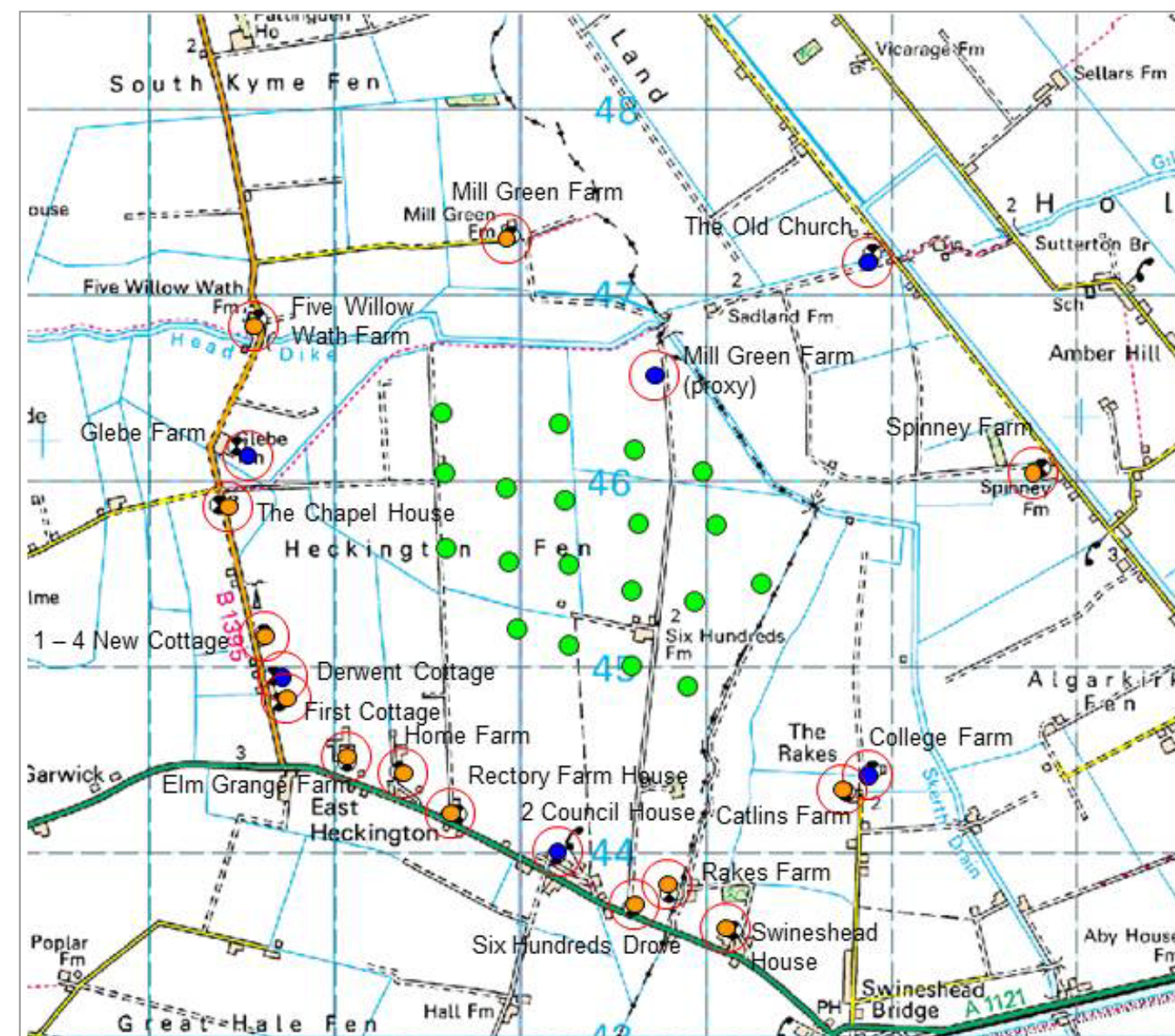


Figure A2: Map showing the layout of the GE103 turbines (green dots), the noise monitoring locations (blue dots within red circles) and the additional noise assessment locations (orange dots within red circles).

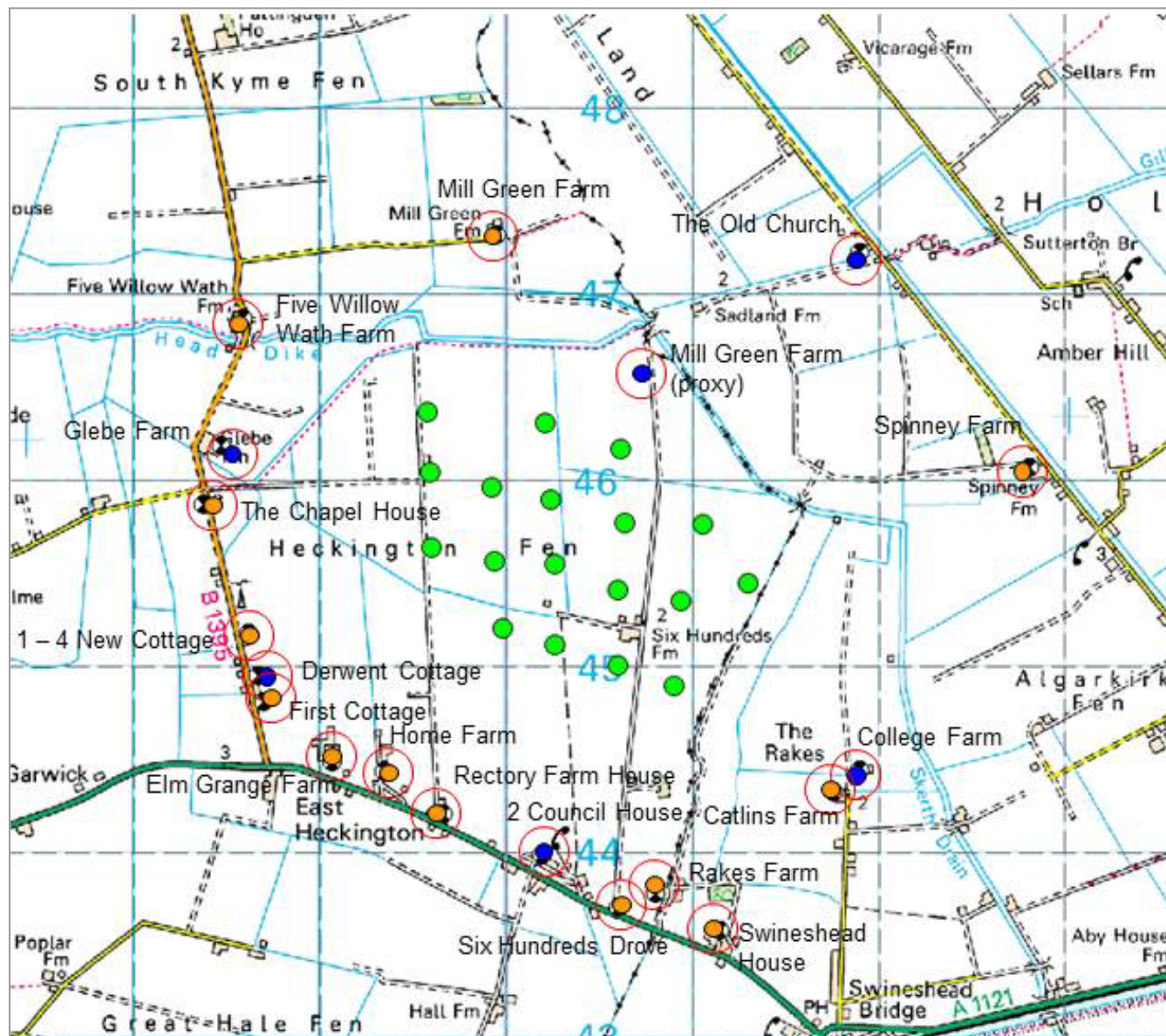


Figure A3: Map showing the layout of the Enercon E101 turbines (green dots), the noise monitoring locations (blue dots within red circles) and the additional noise assessment locations (orange dots within red circles).

APPENDIX 9.B: PREDICTED NOISE IMMISSION LEVELS AND NOISE LIMITS

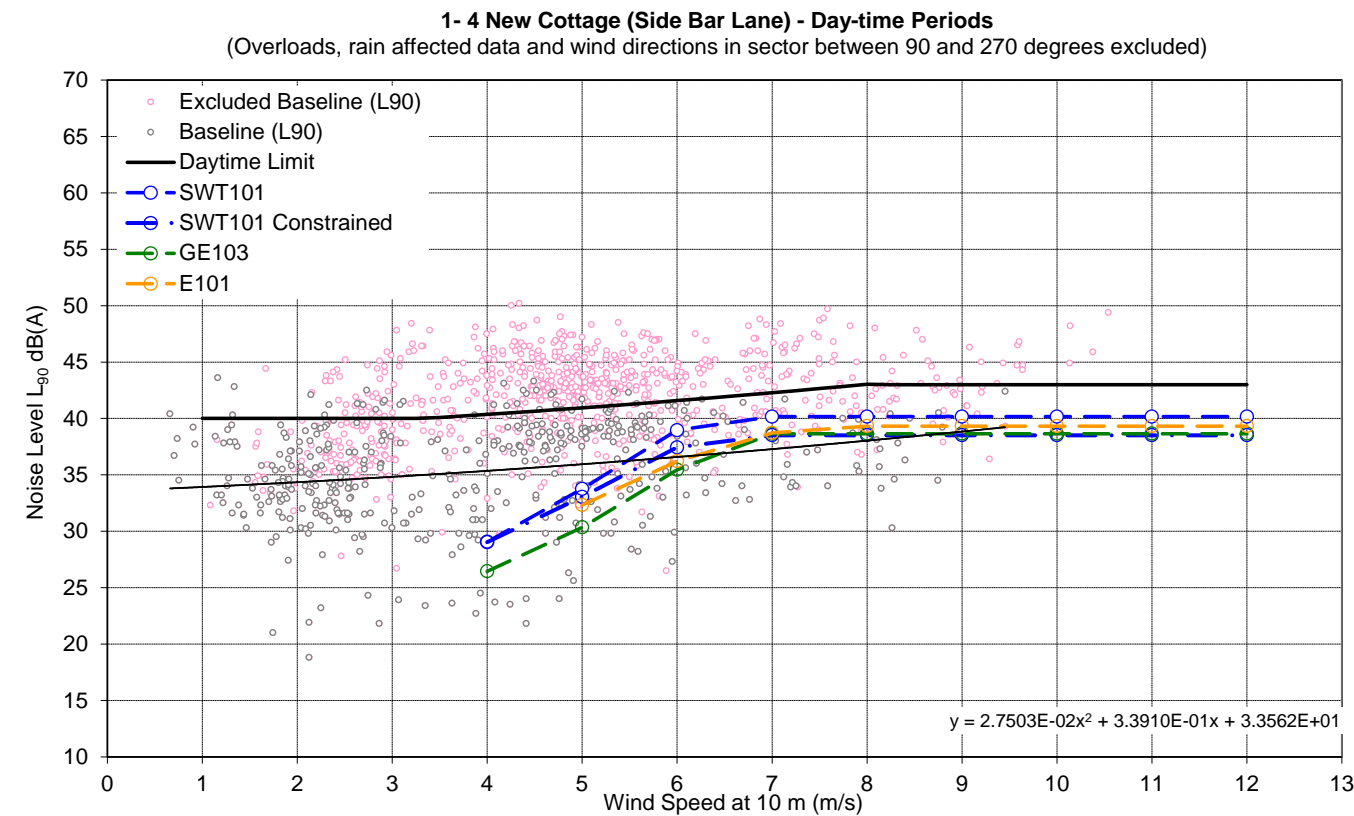


Chart of daytime background noise levels (from Side Bar Lane), daytime noise limit and predicted noise immission levels at 1-4 New Cottage against wind speeds.

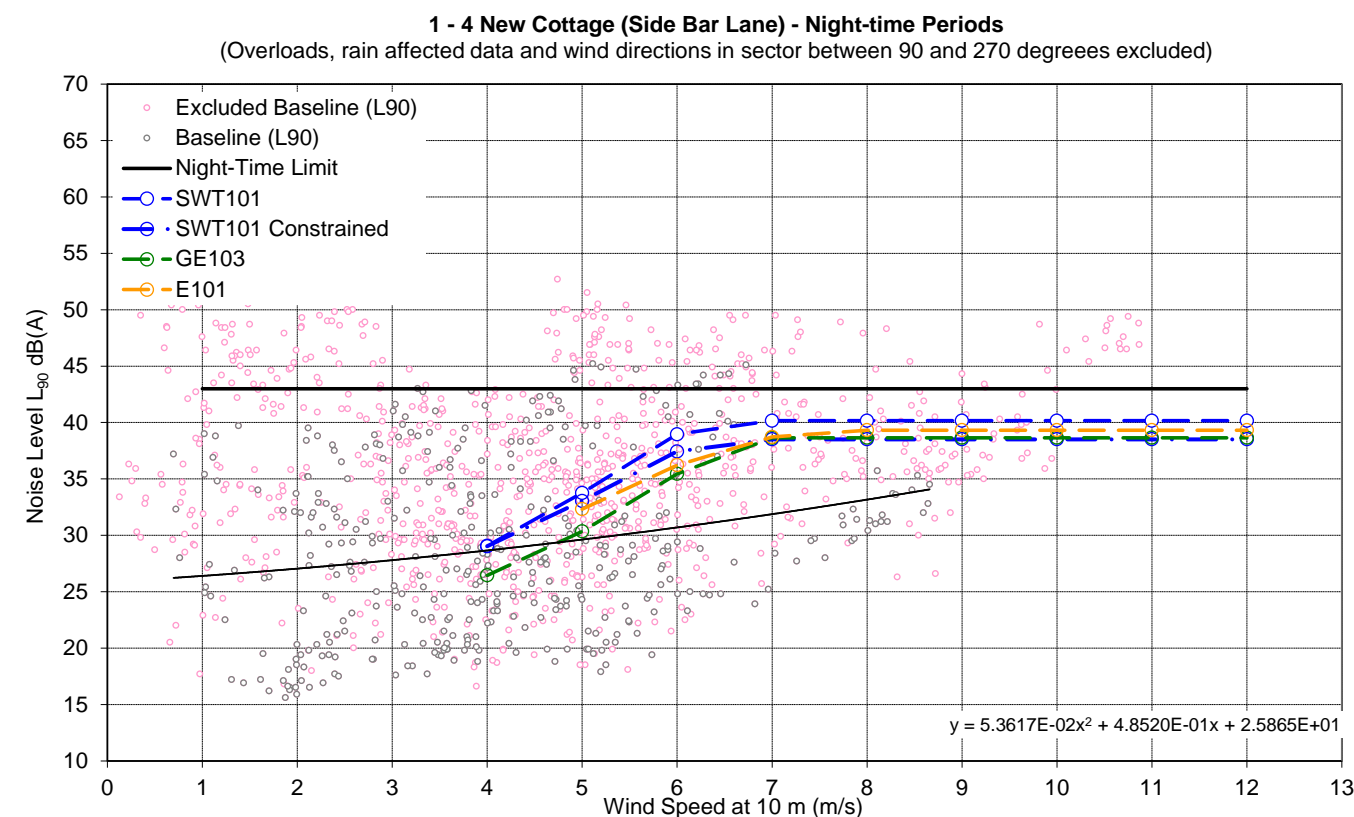


Chart of night-time background noise levels (from Side Bar Lane), night-time noise limit and predicted noise immission levels at 1-4 New Cottage against wind speeds.

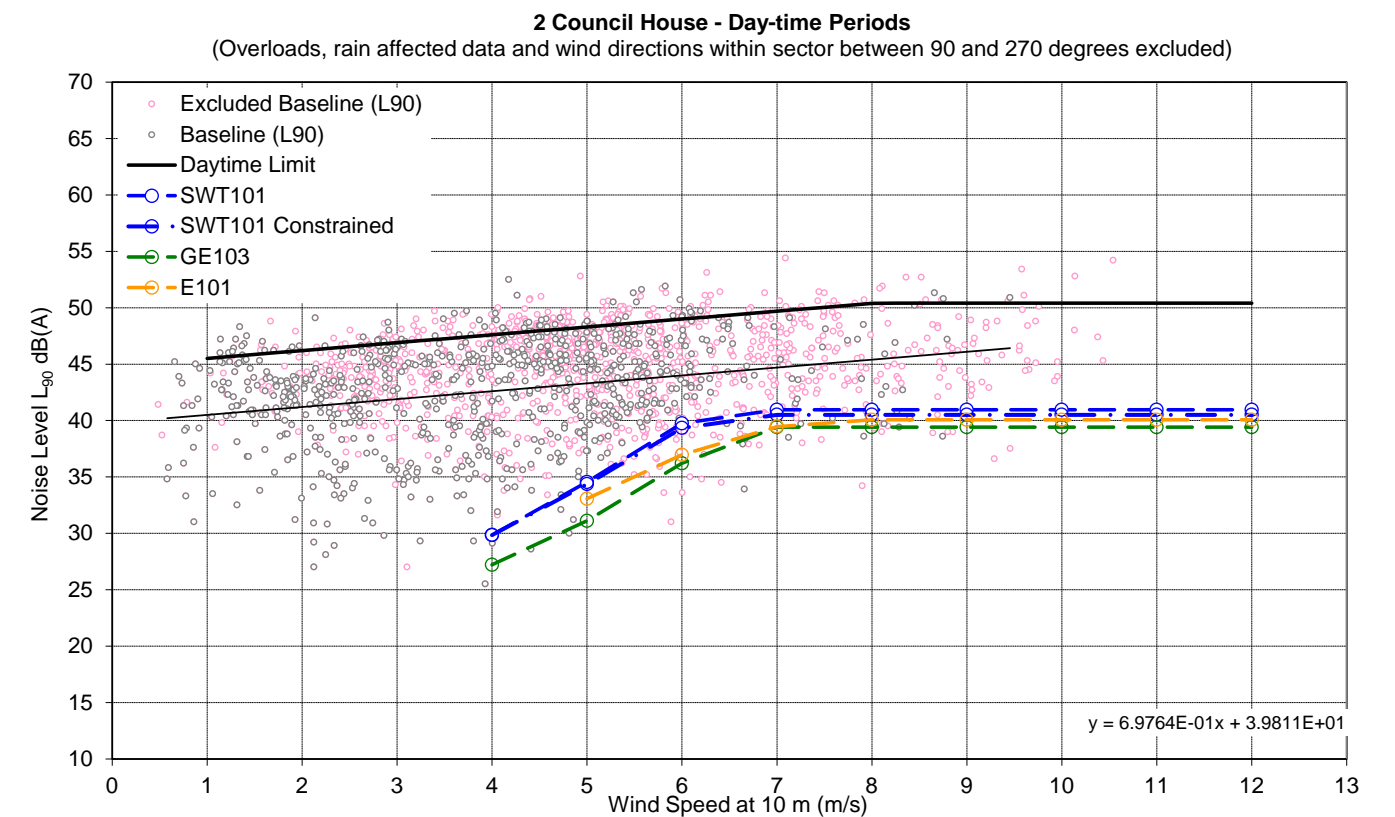


Chart of daytime background noise levels, daytime noise limit and predicted noise immission levels at 2 Council House against wind speeds.

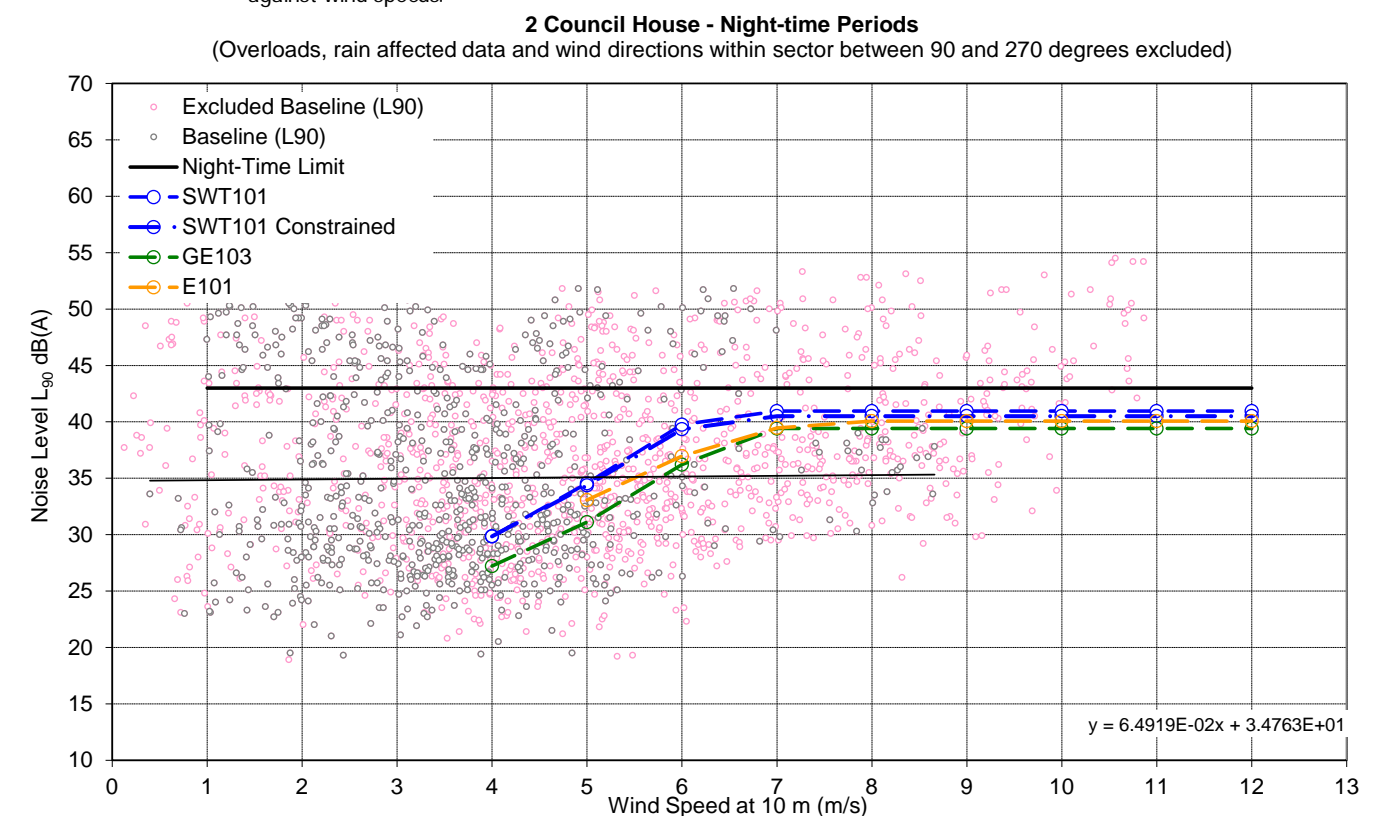
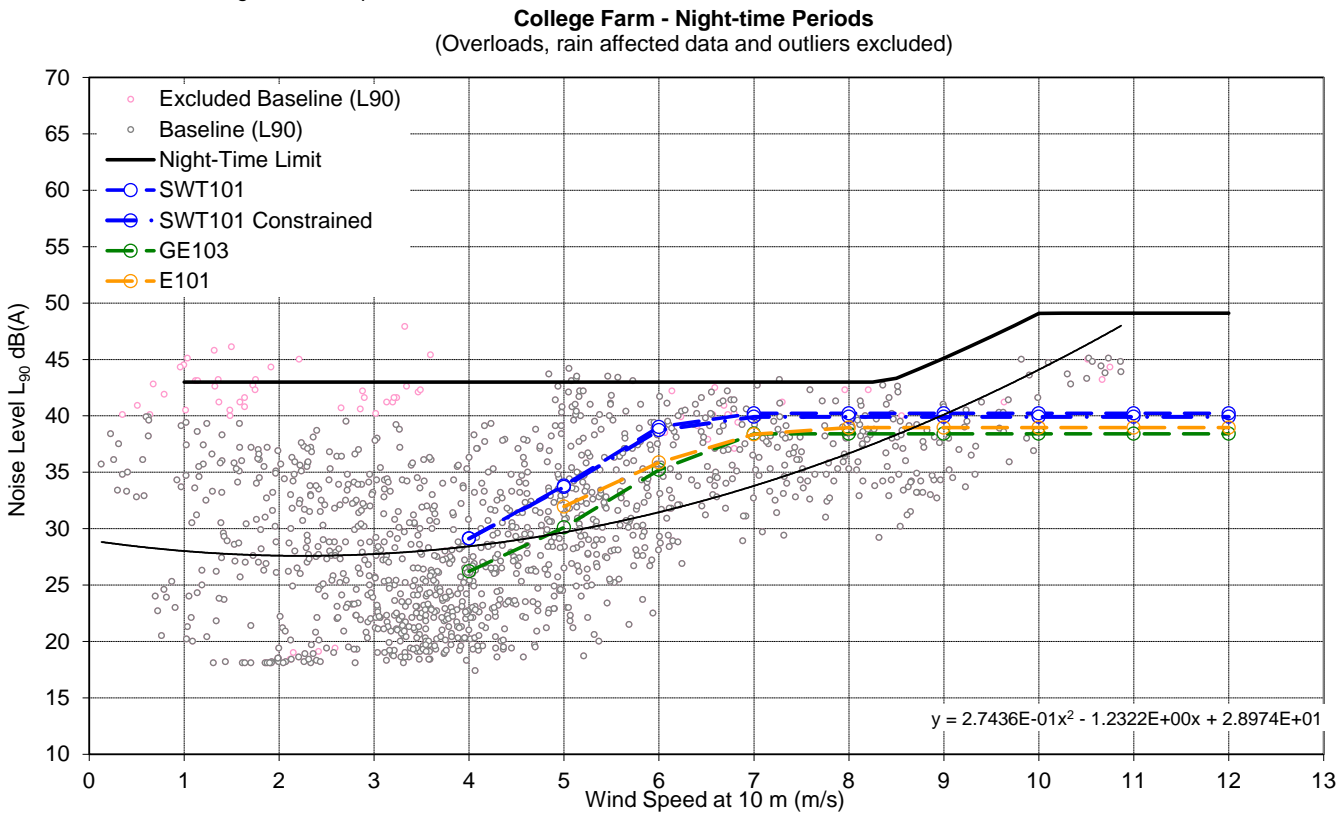
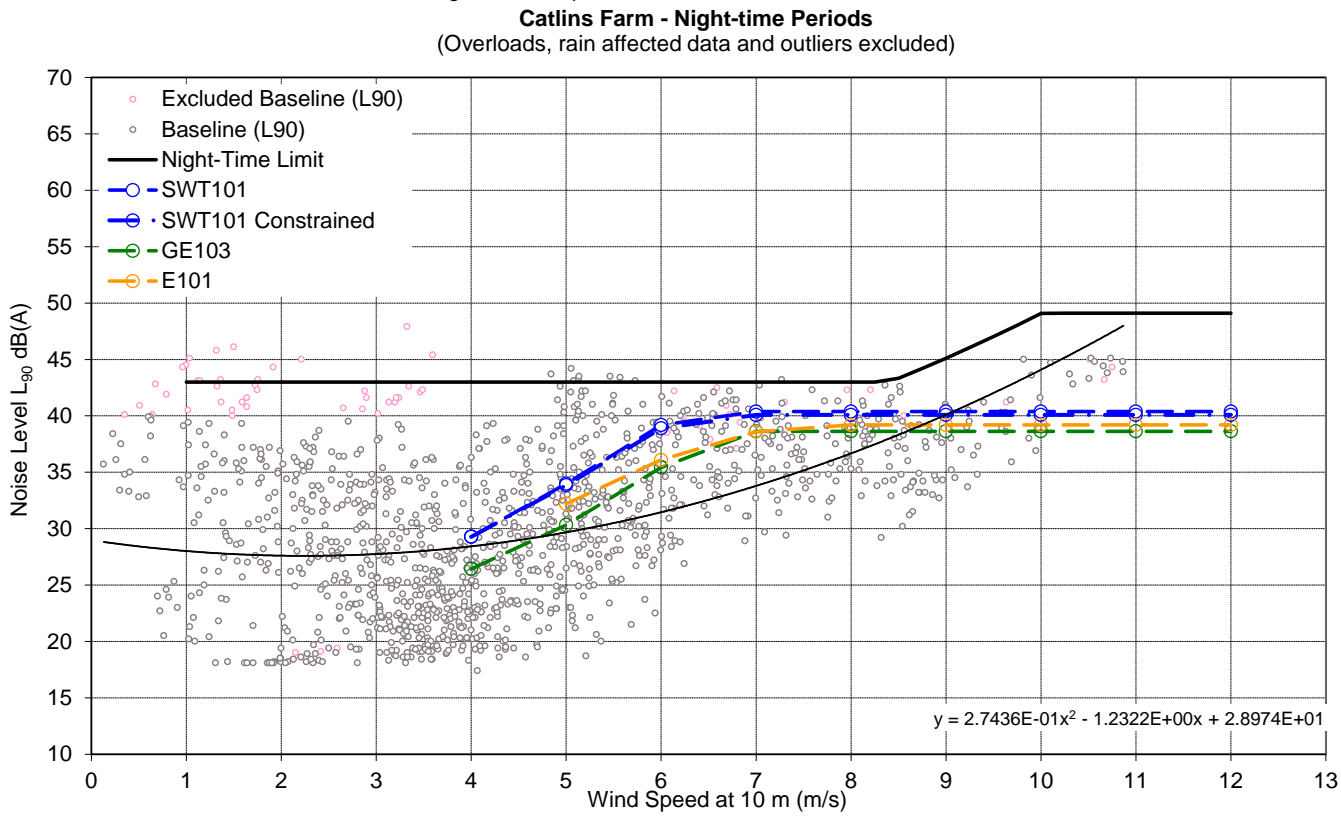
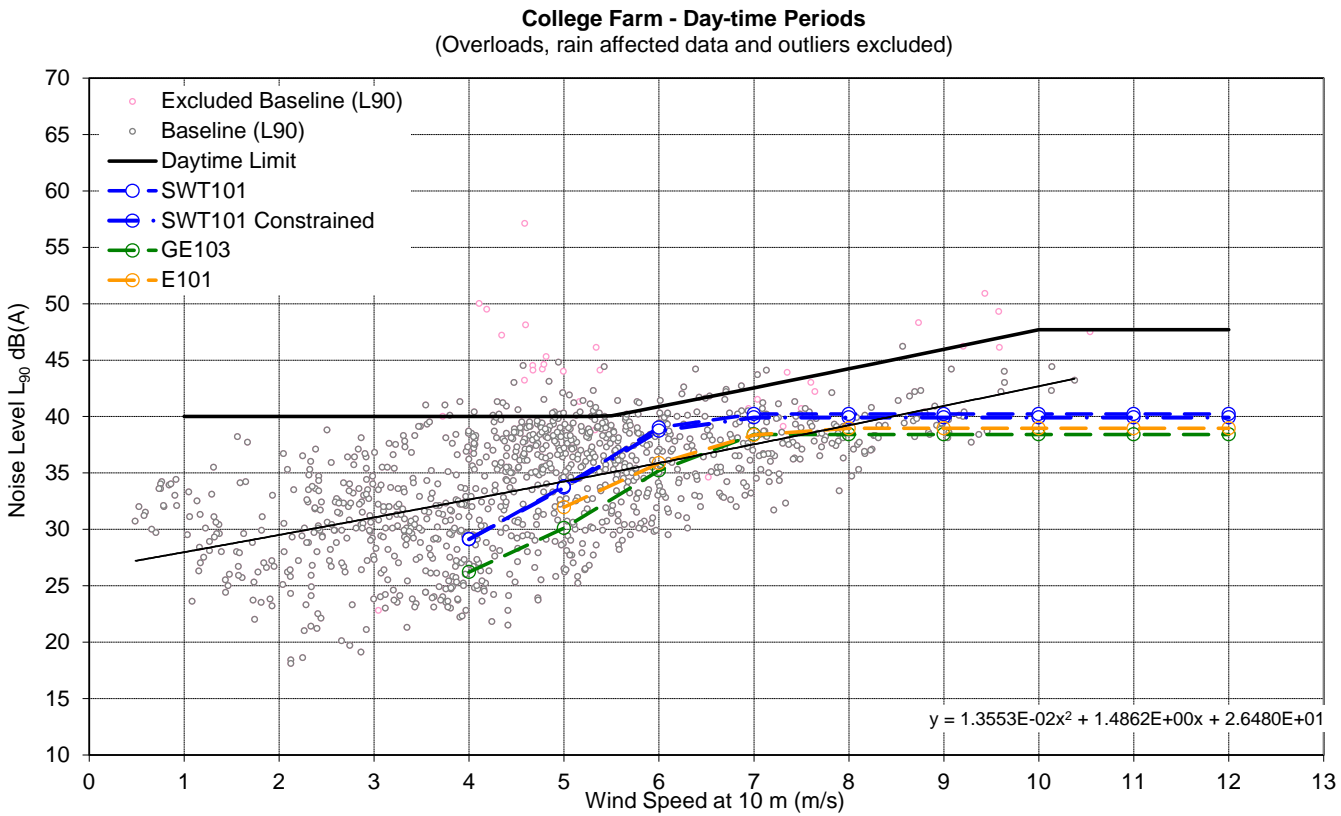
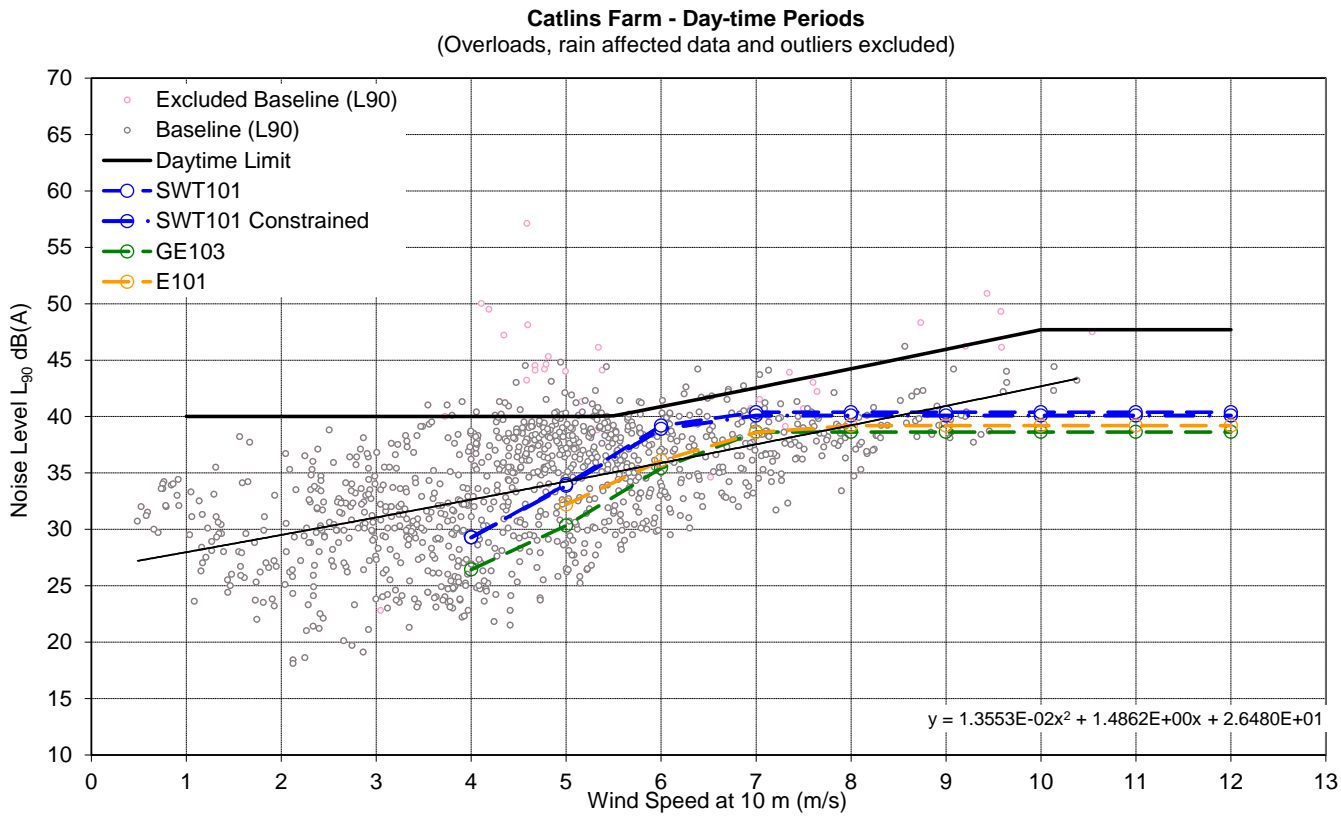
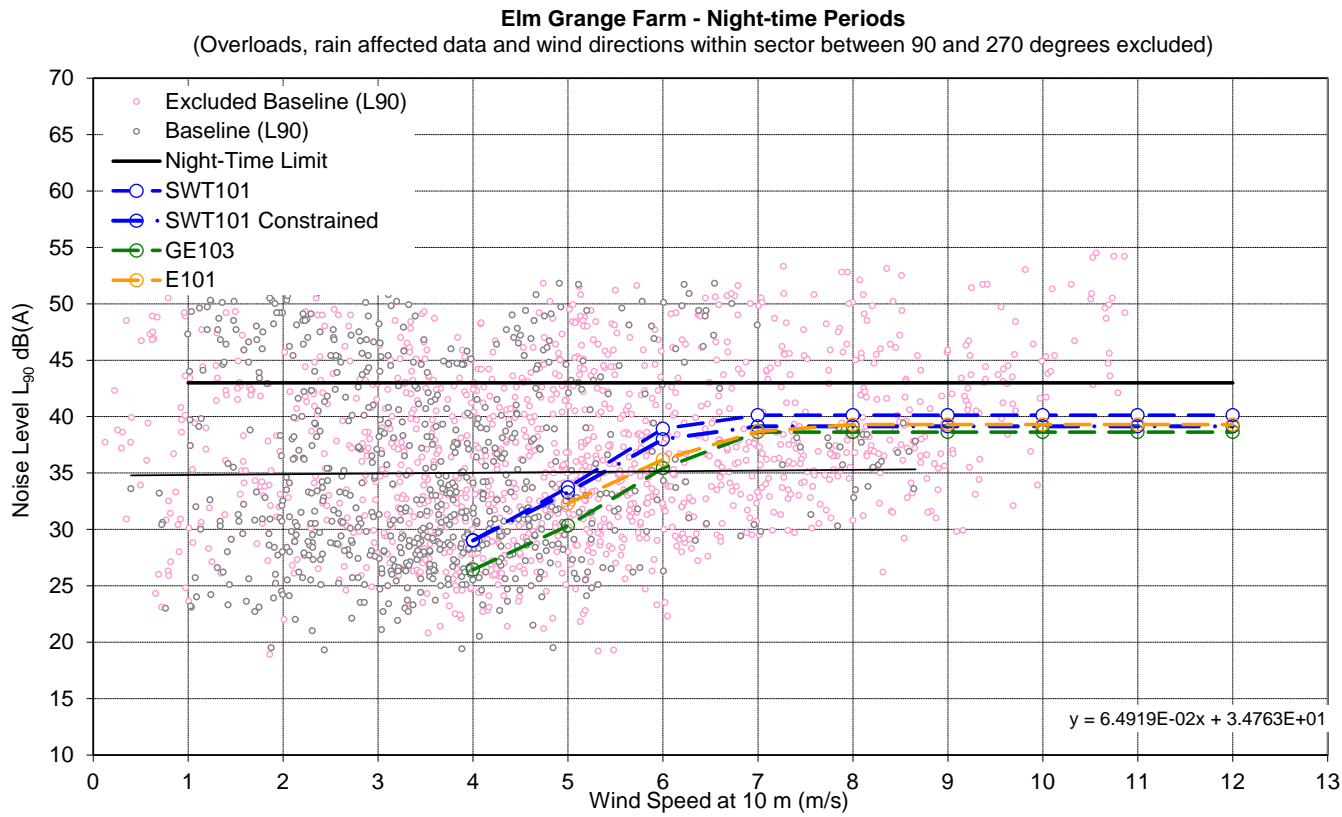
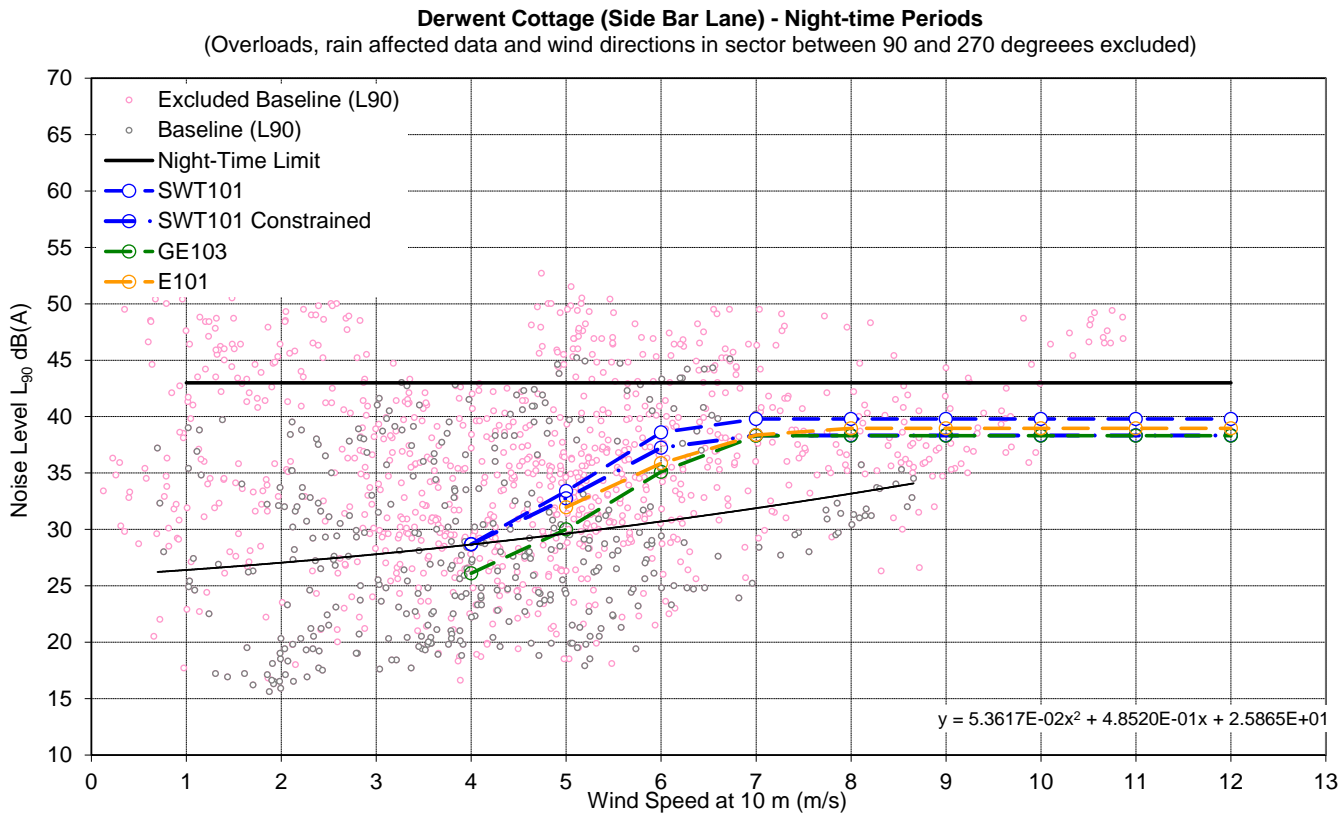
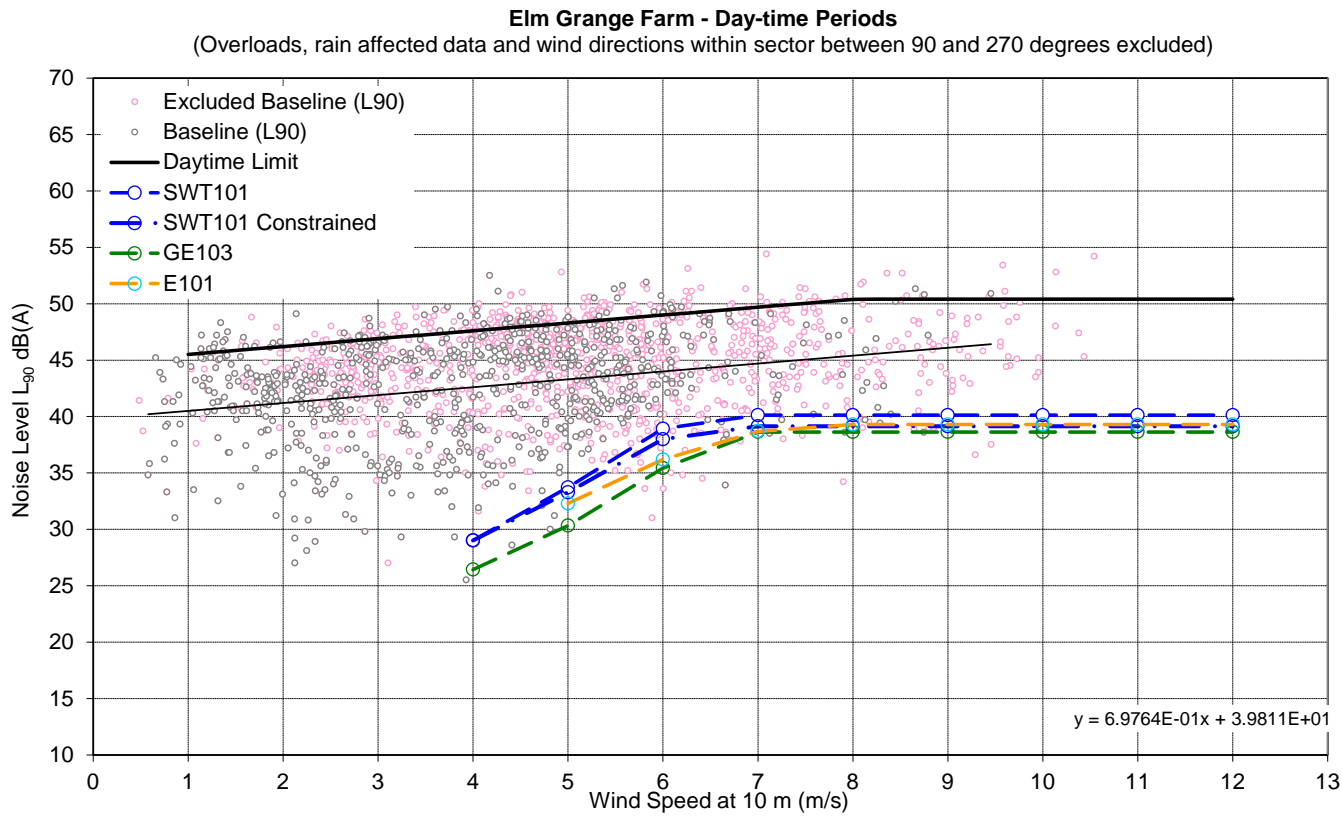
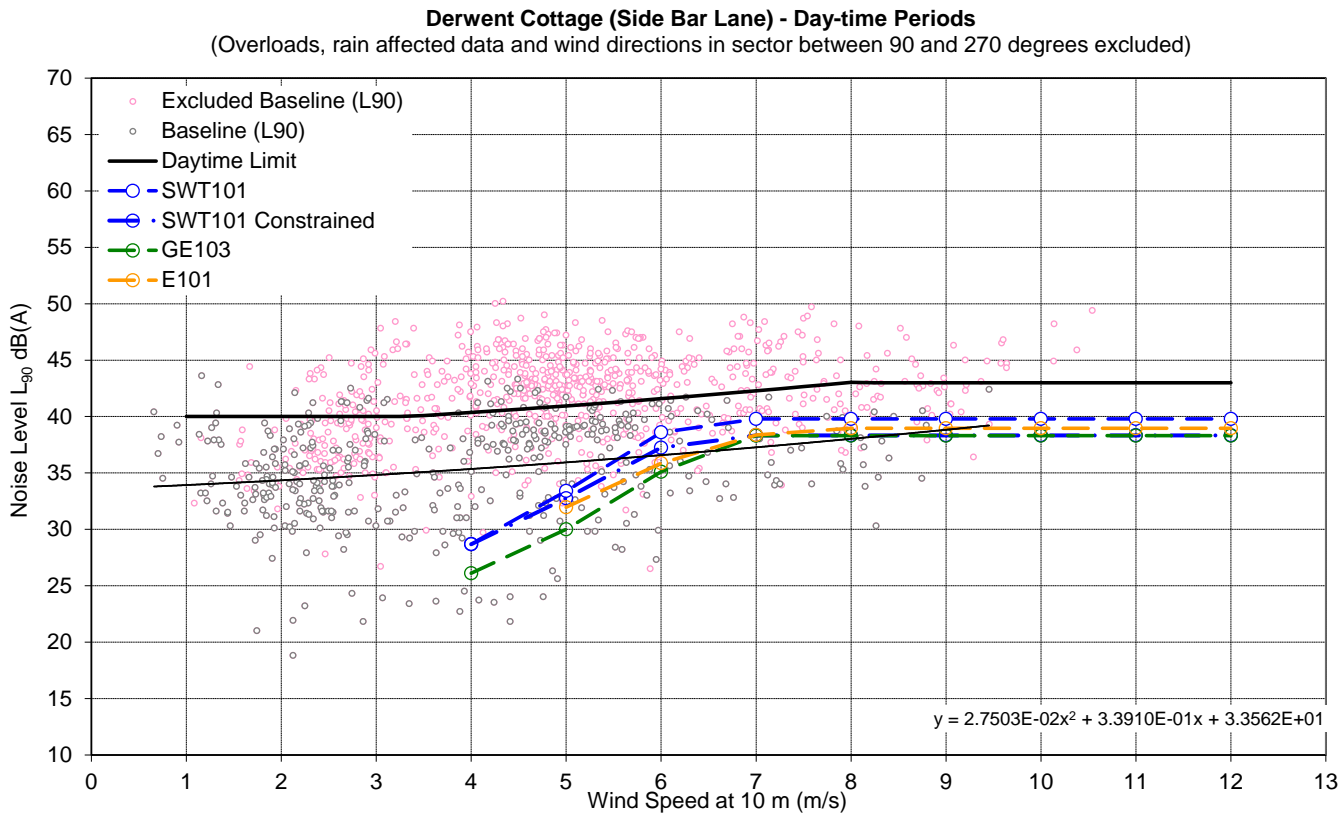
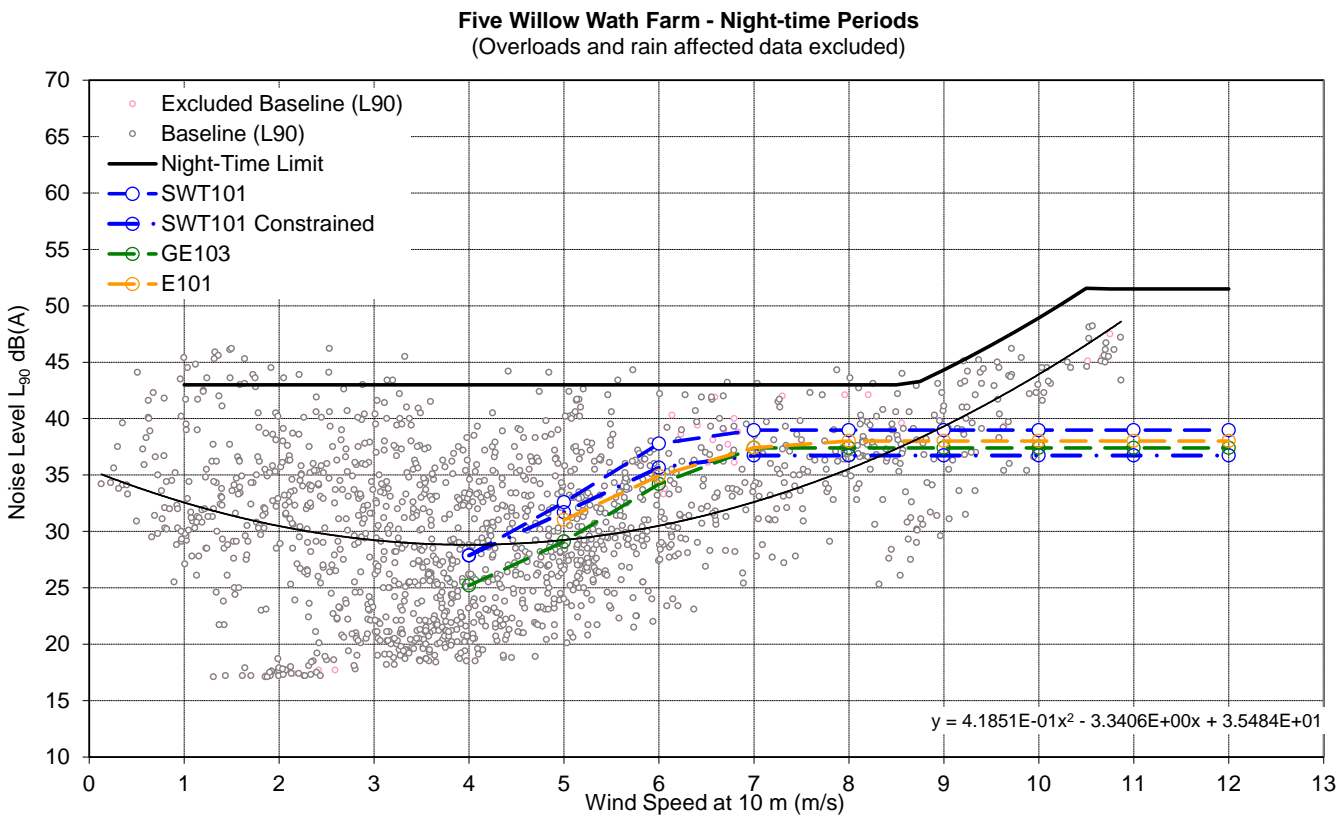
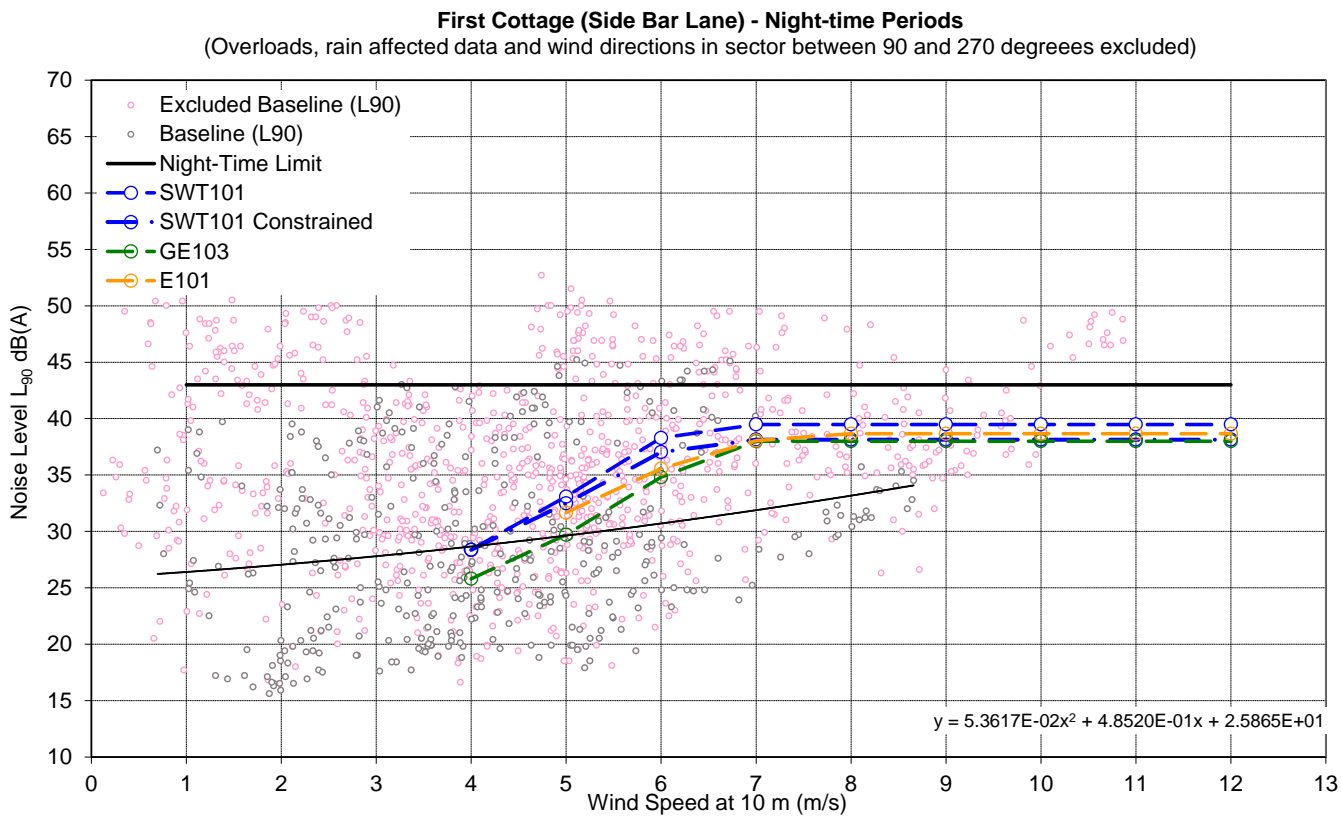
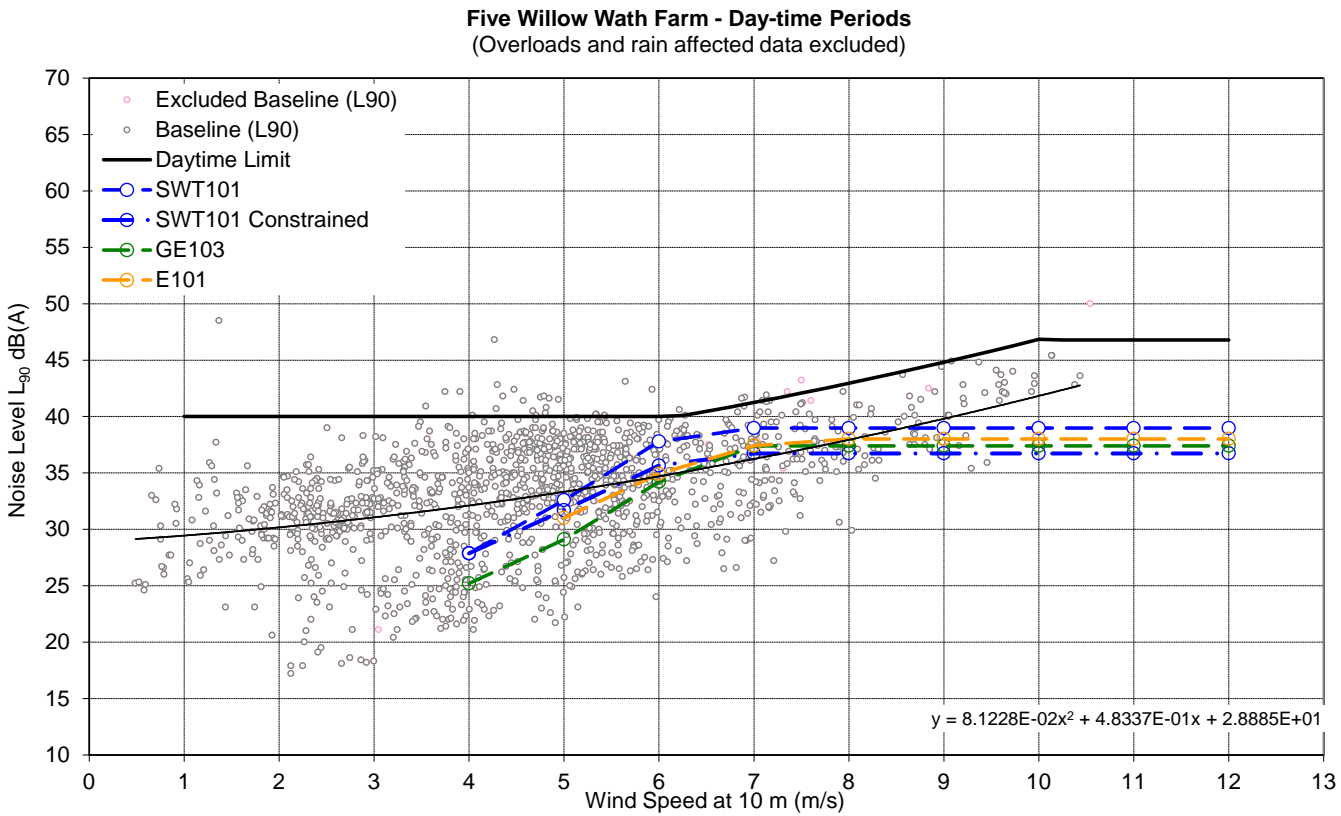
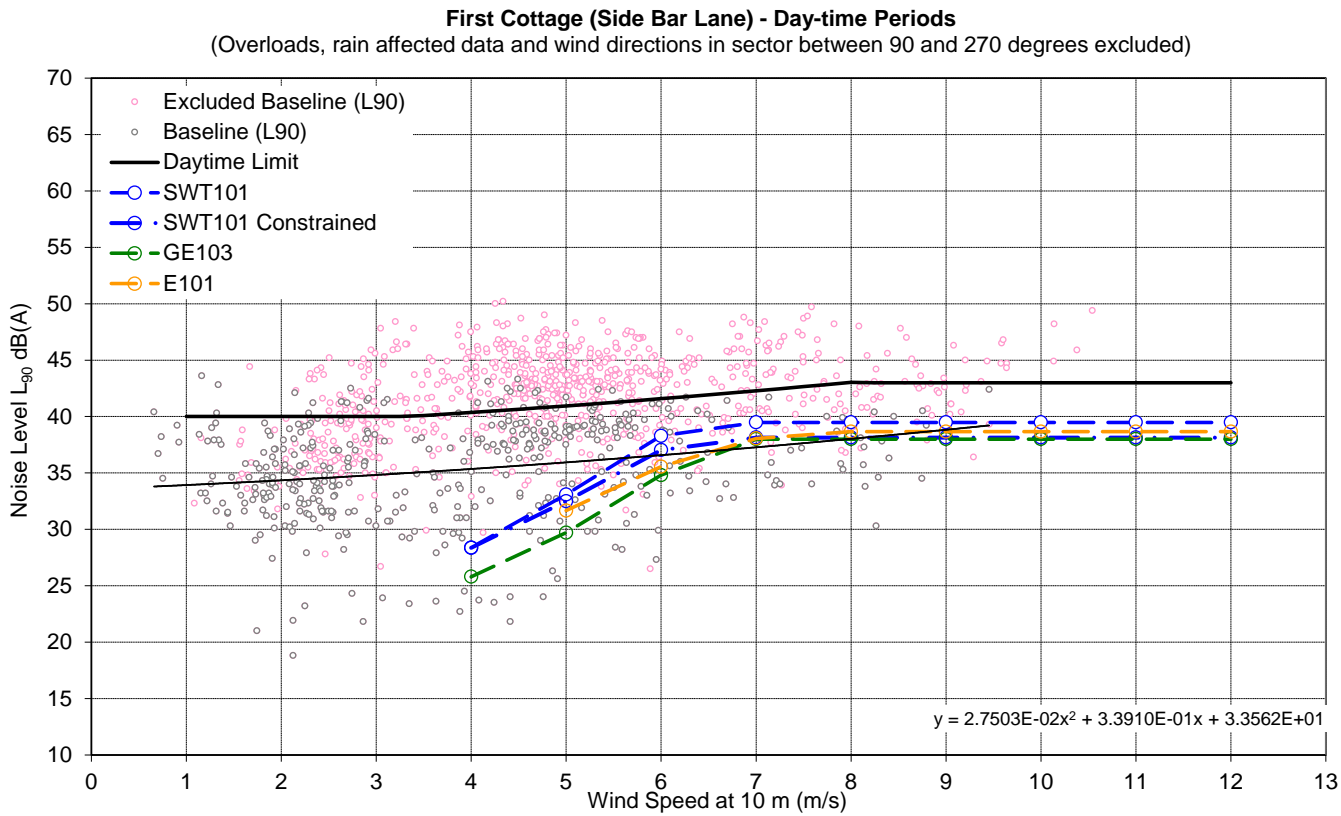
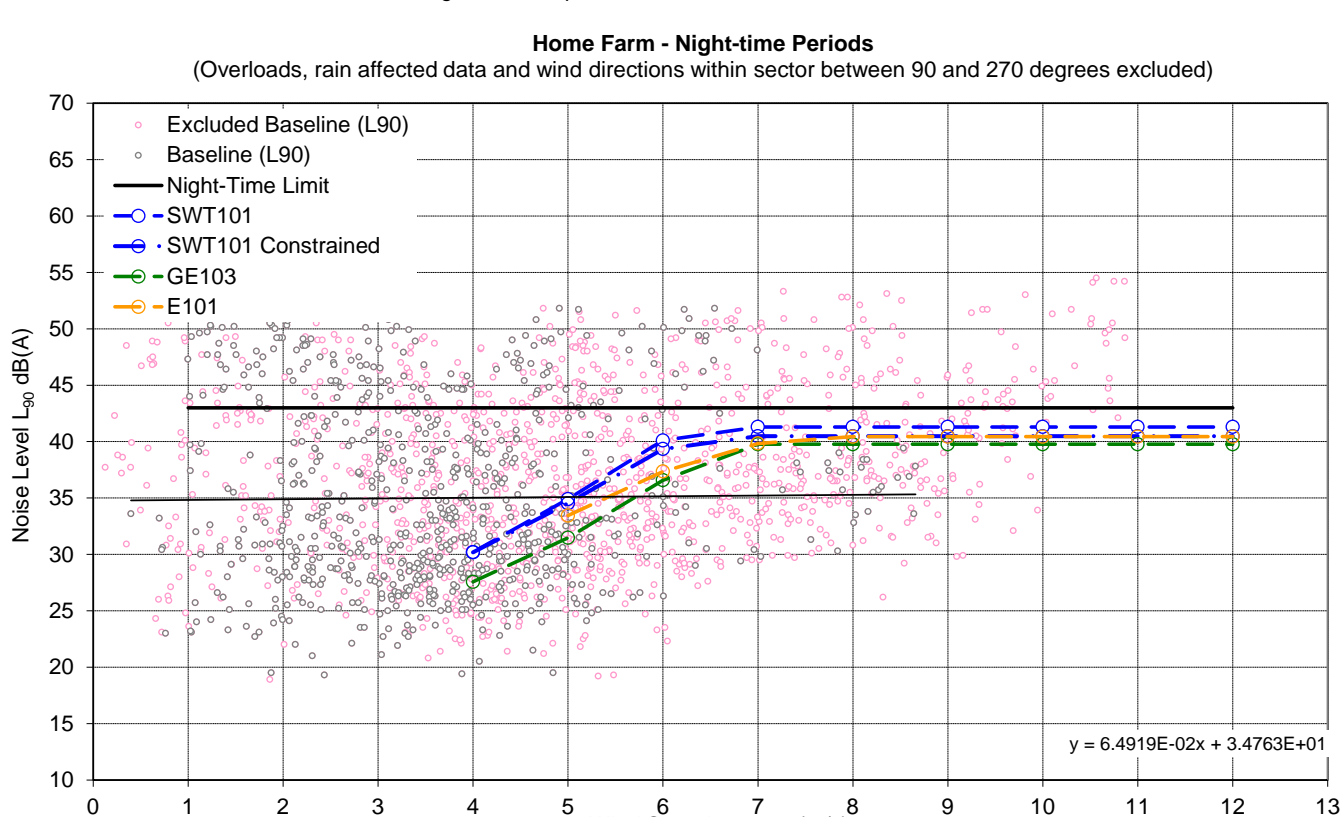
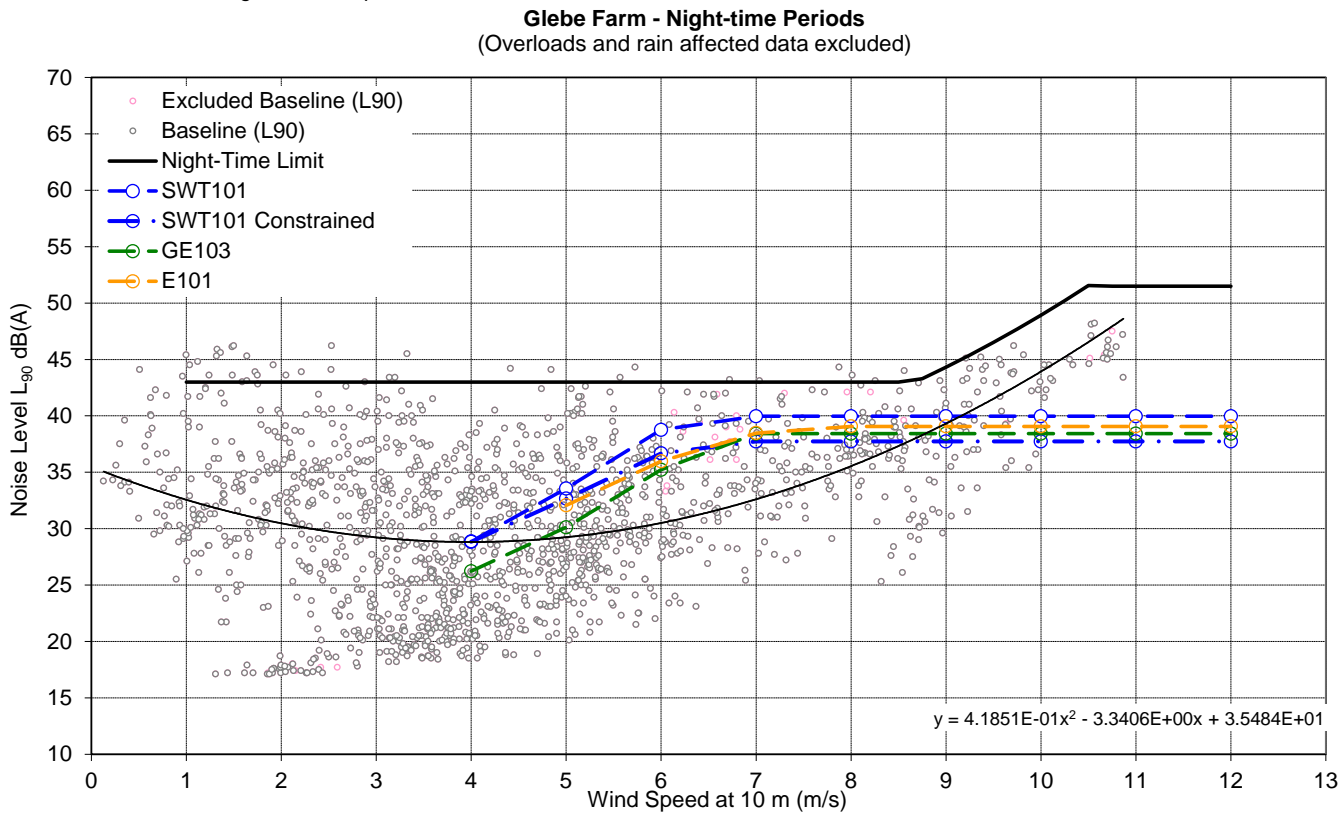
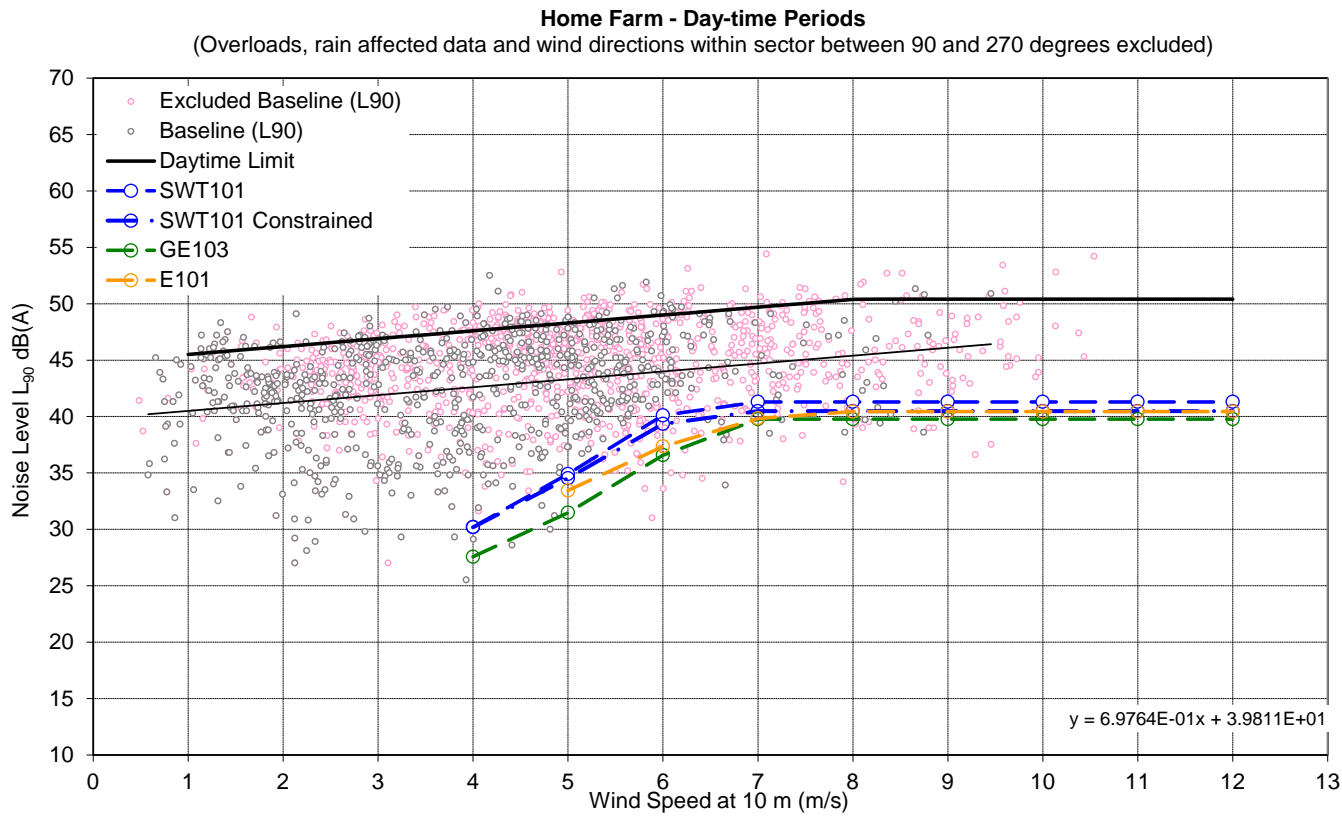
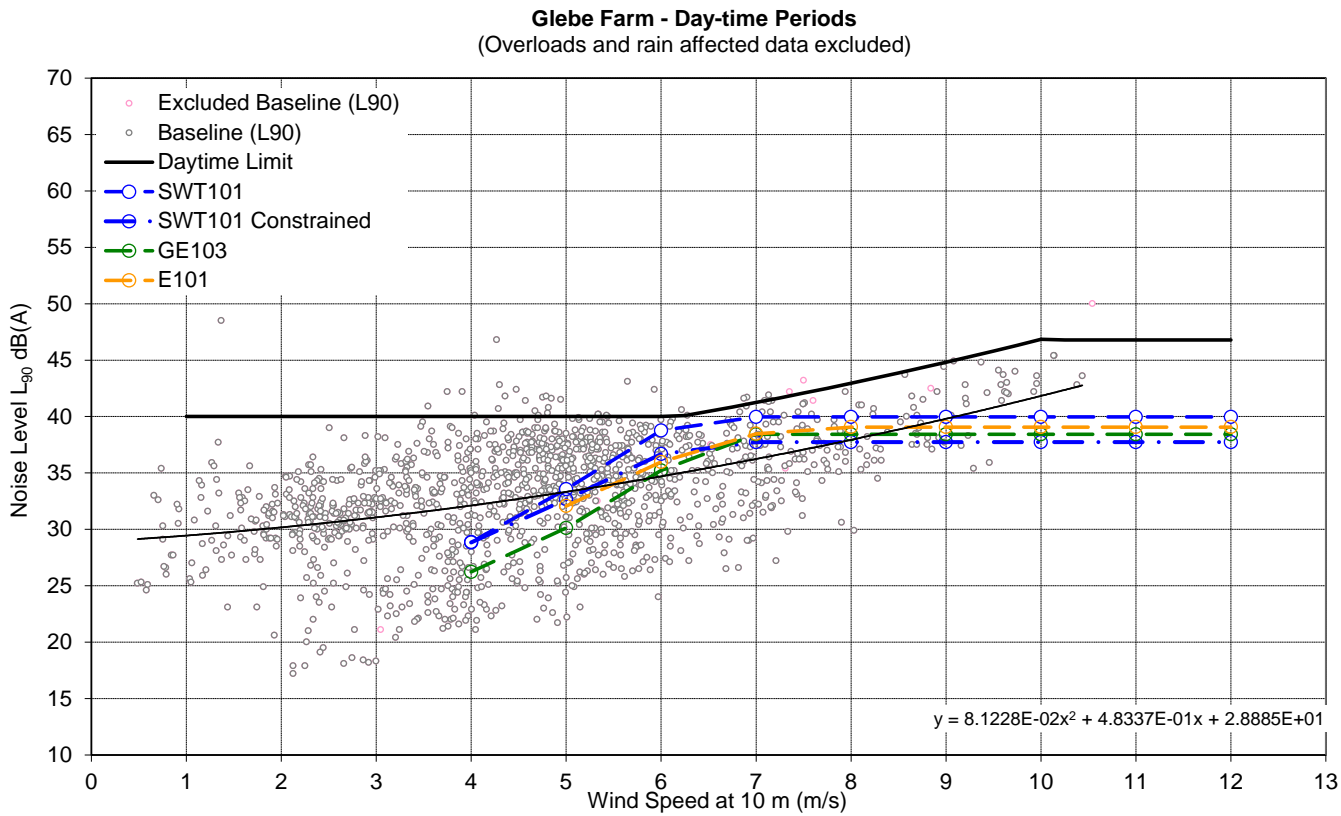


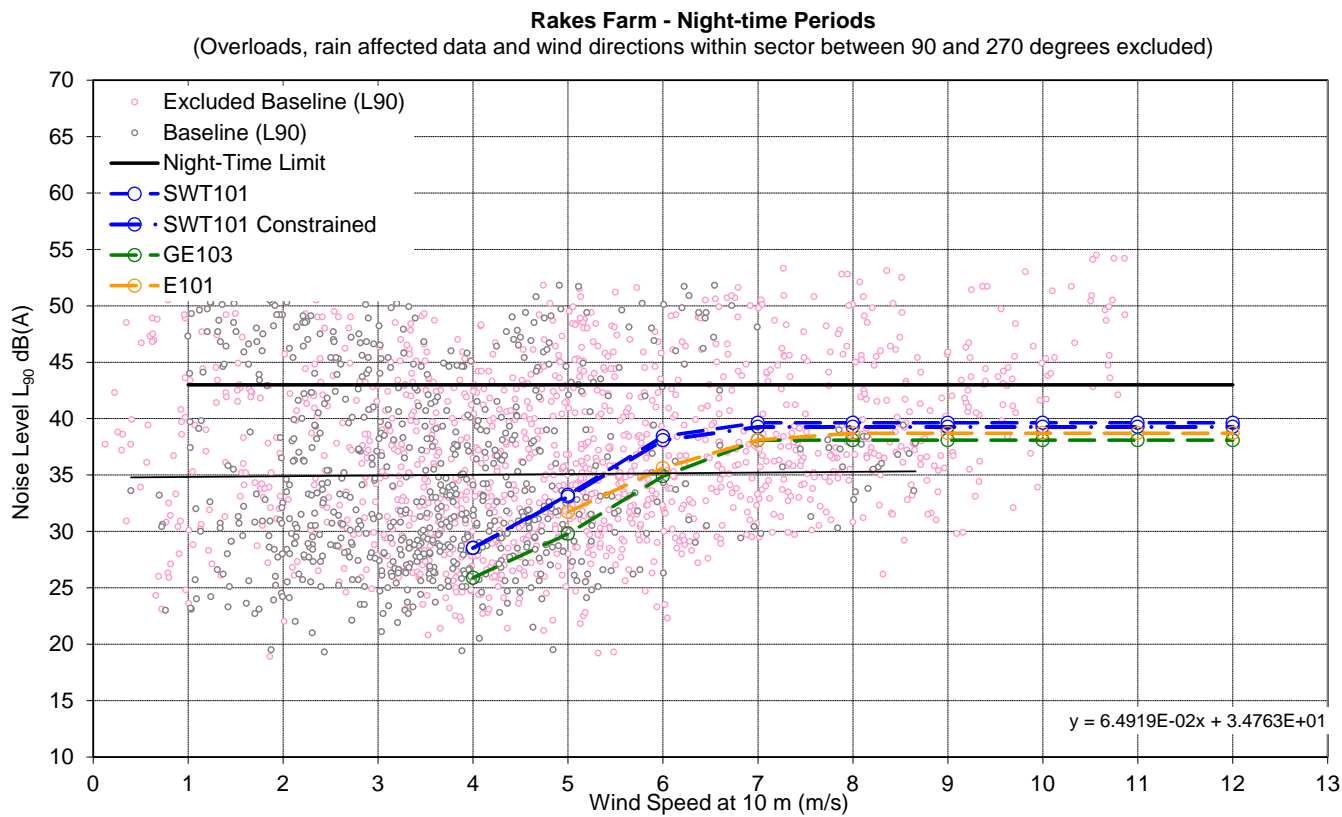
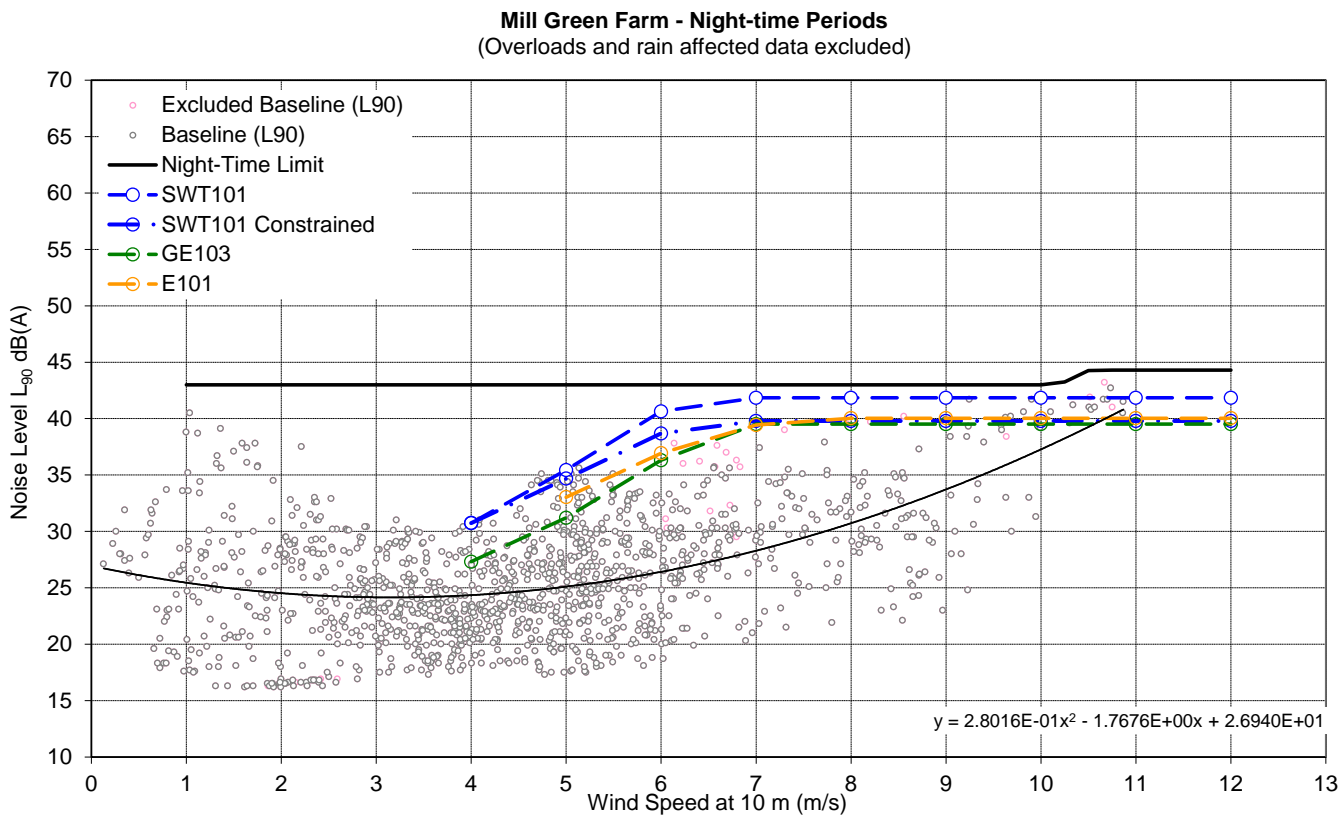
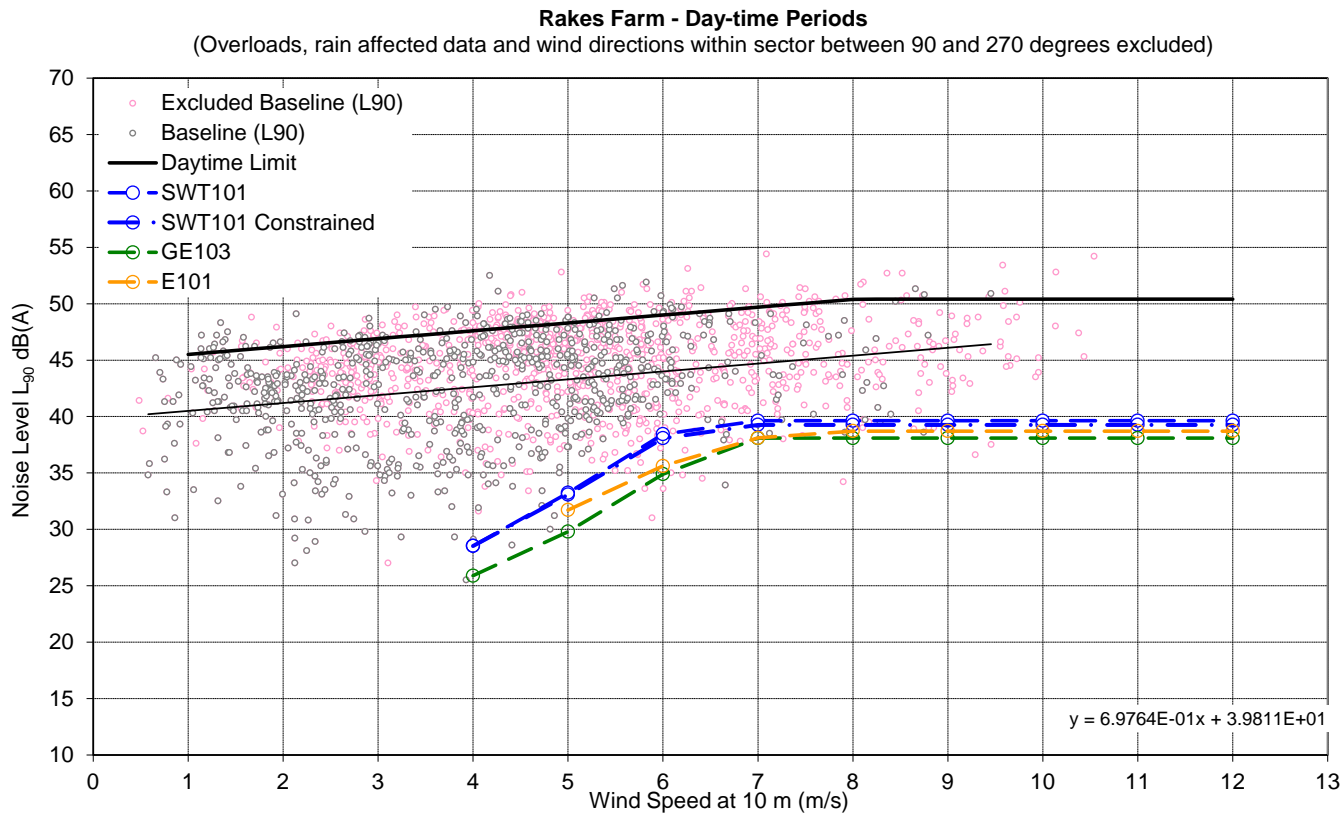
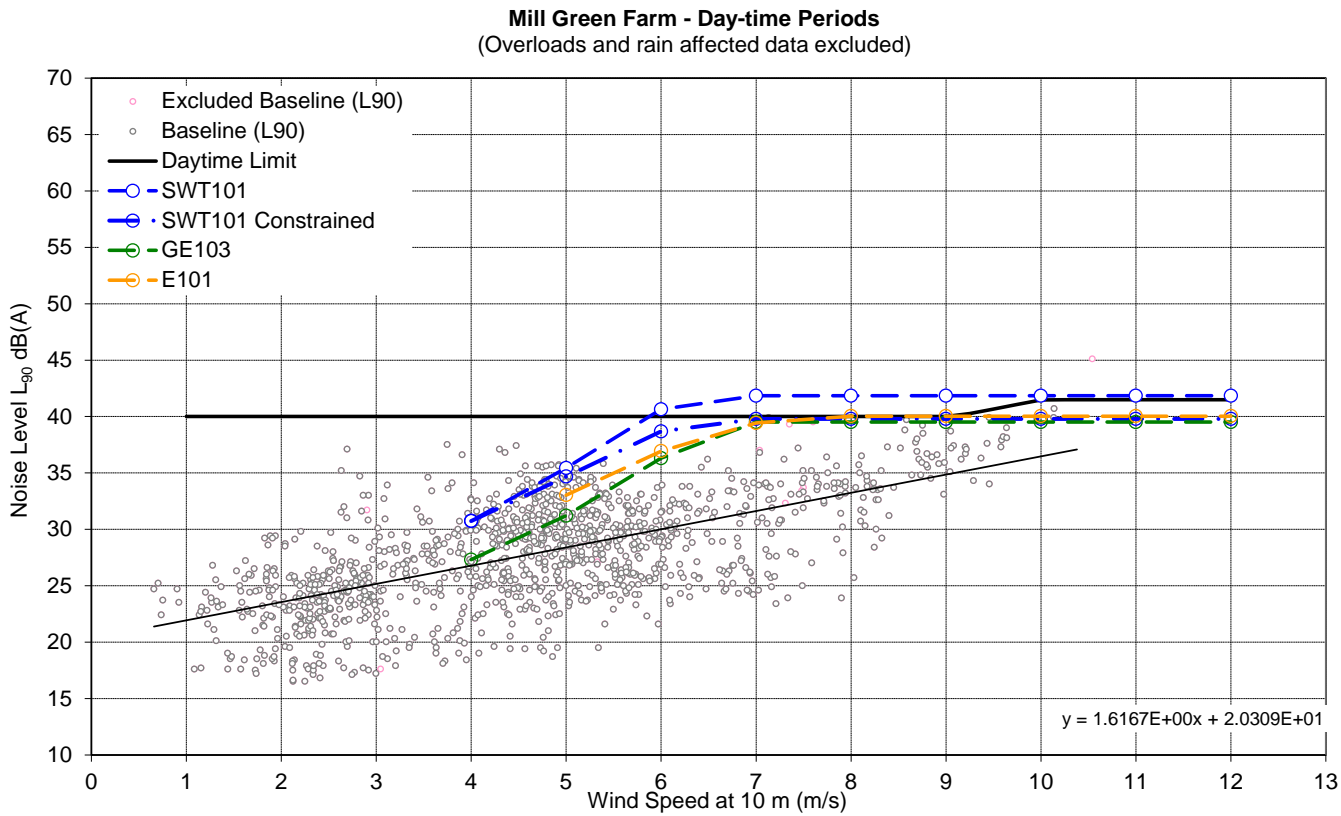
Chart of night-time background noise levels, night-time noise limit and predicted noise immission levels at 2 Council House against wind speeds.











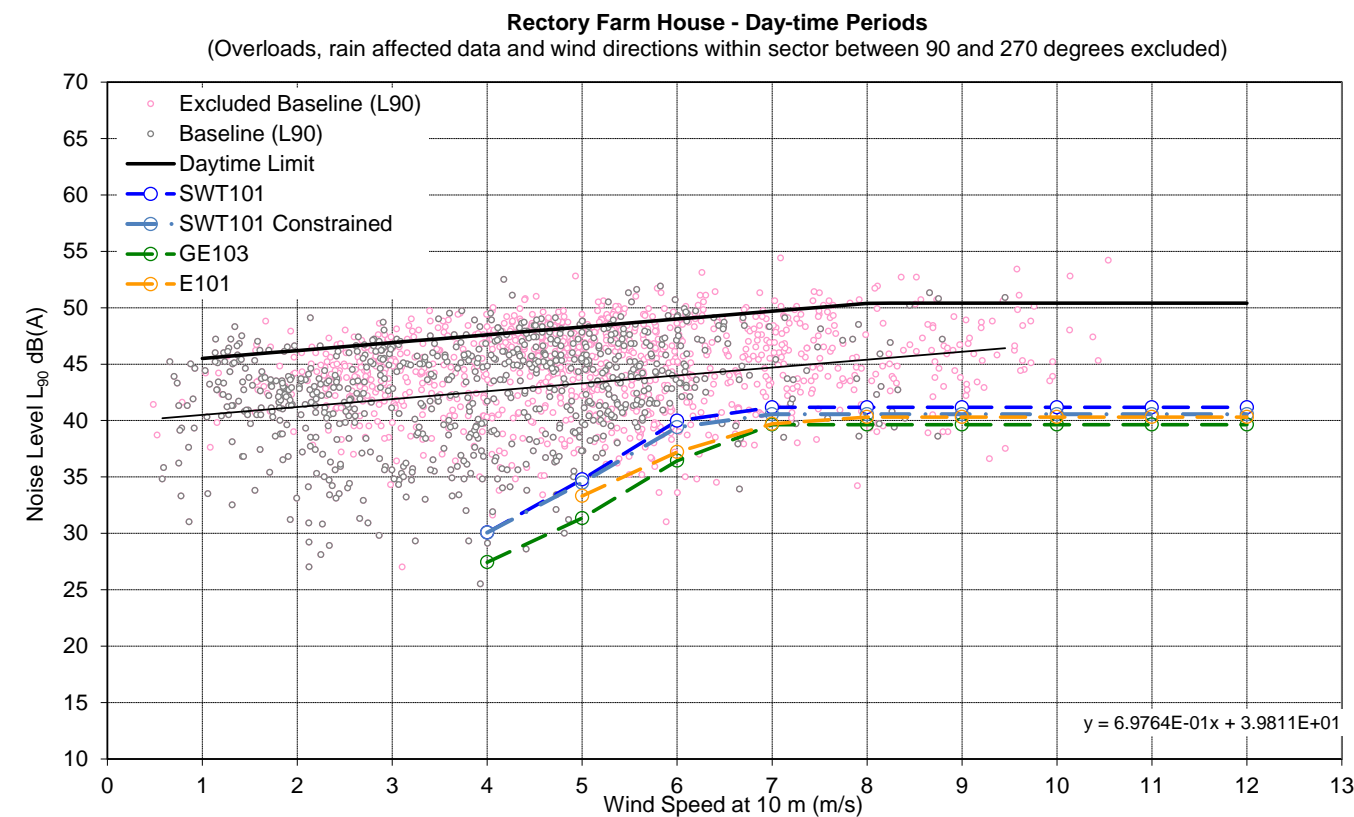


Figure B25 Chart of daytime background noise levels (from 2 Council House), daytime noise limit and predicted noise immission levels at Rectory Farm House against wind speeds.

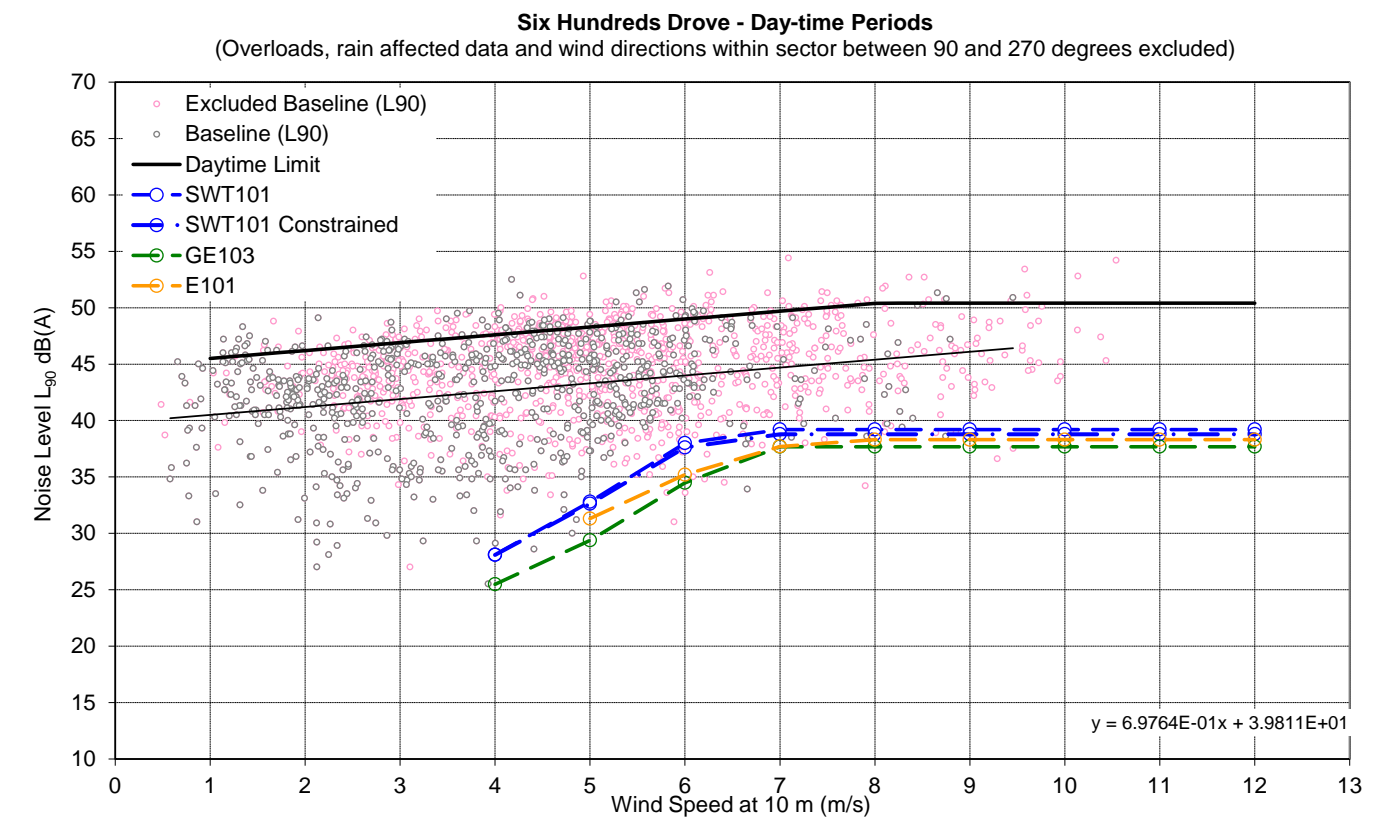


Figure B27 Chart of daytime background noise levels (from 2 Council House), daytime noise limit and predicted noise immission levels at Six Hundreds Drove against wind speeds.

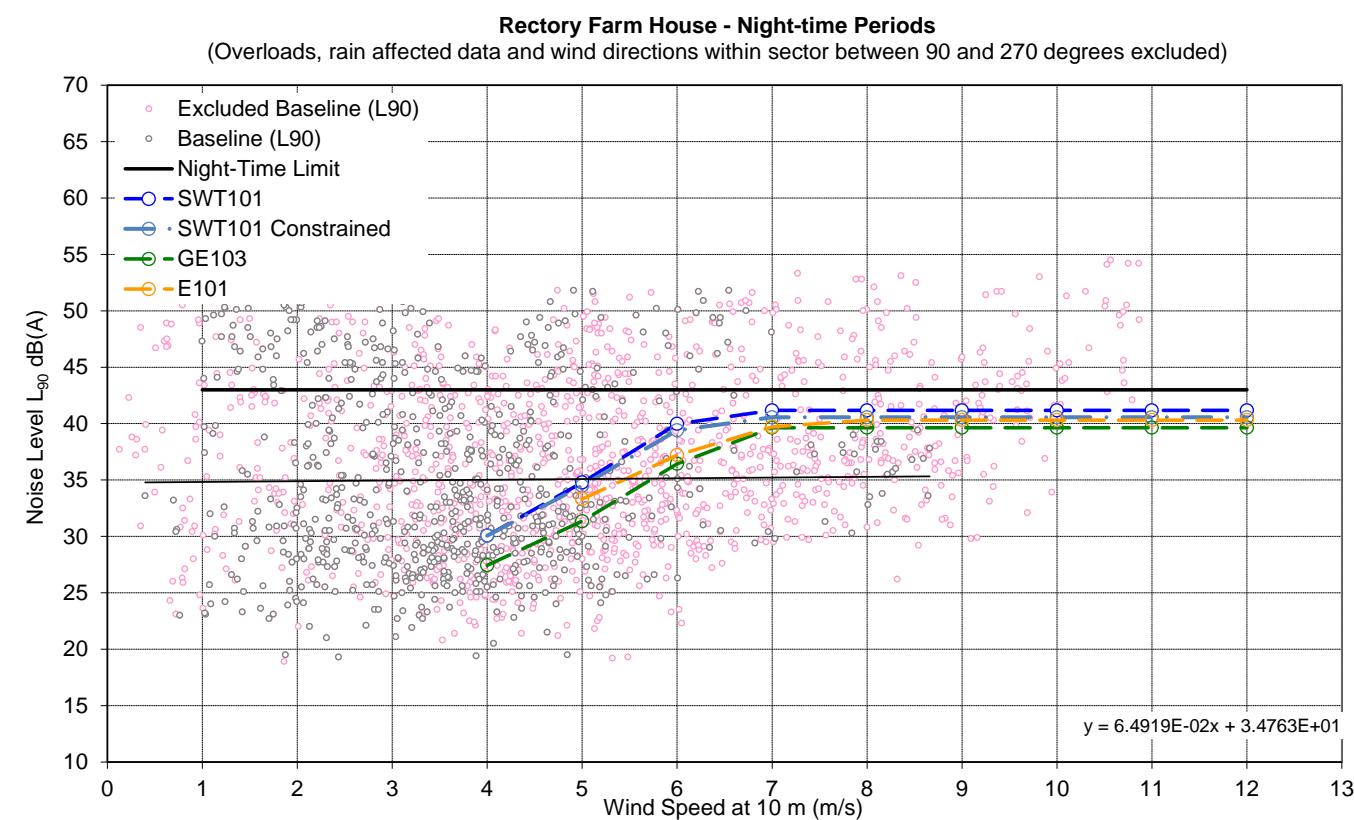


Figure B26 Chart of night-time background noise levels (from 2 Council House), night-time noise limit and predicted noise immission levels at Rectory Farm House against wind speeds.

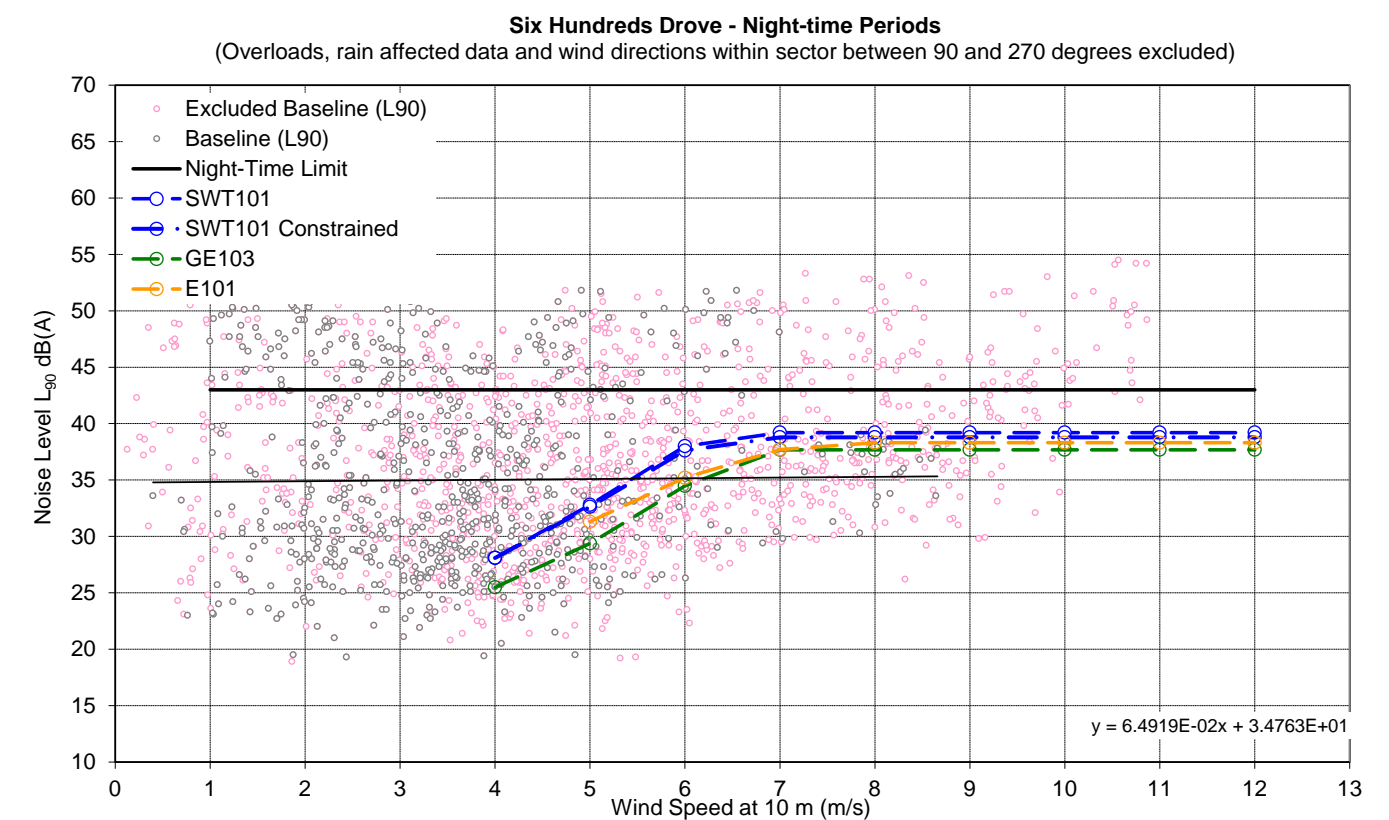


Figure B28 Chart of night-time background noise levels (from 2 Council House), night-time noise limit and predicted noise immission levels at Six Hundreds Drove against wind speeds.

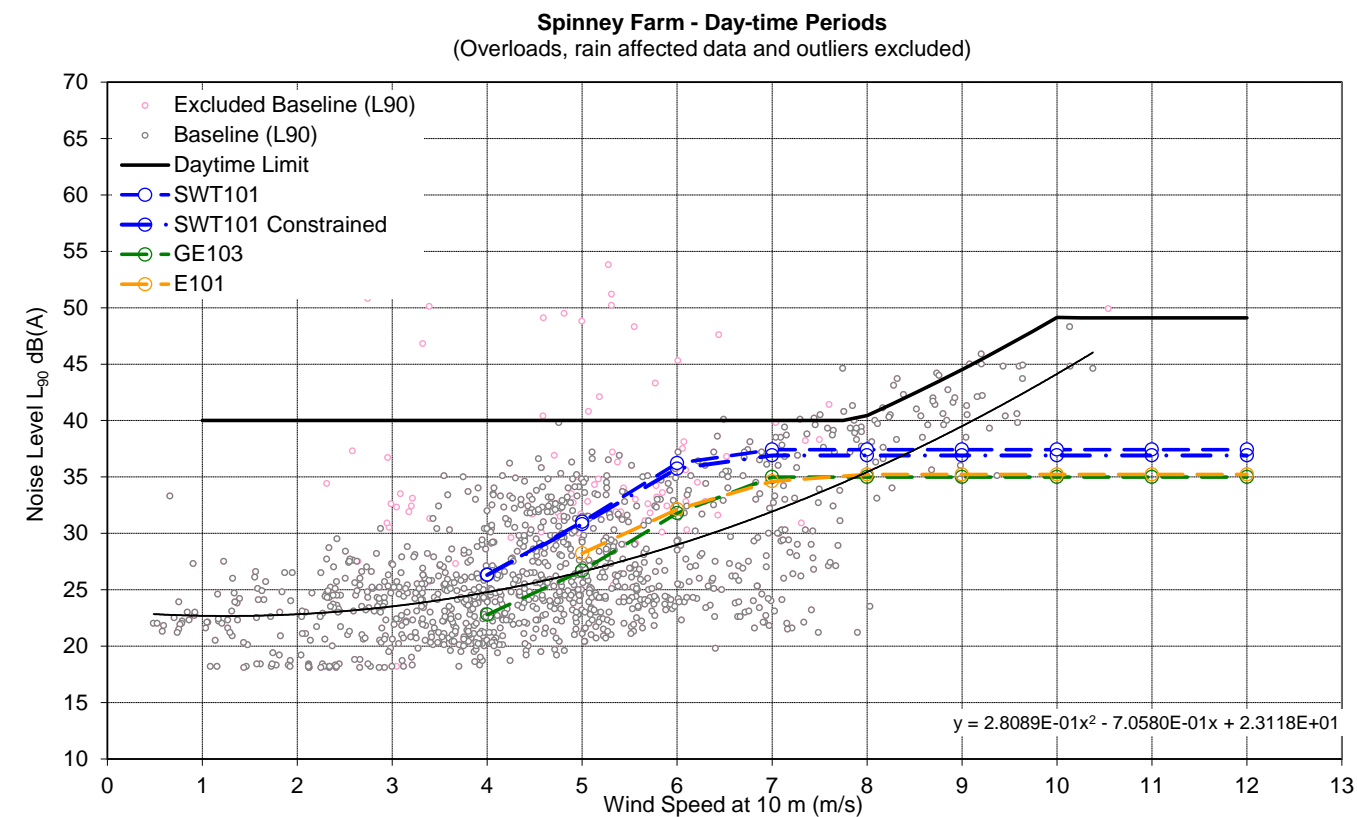


Figure B29 Chart of daytime background noise levels (from The Old Church), daytime noise limit and predicted noise immission levels at Spinney Farm against wind speeds.

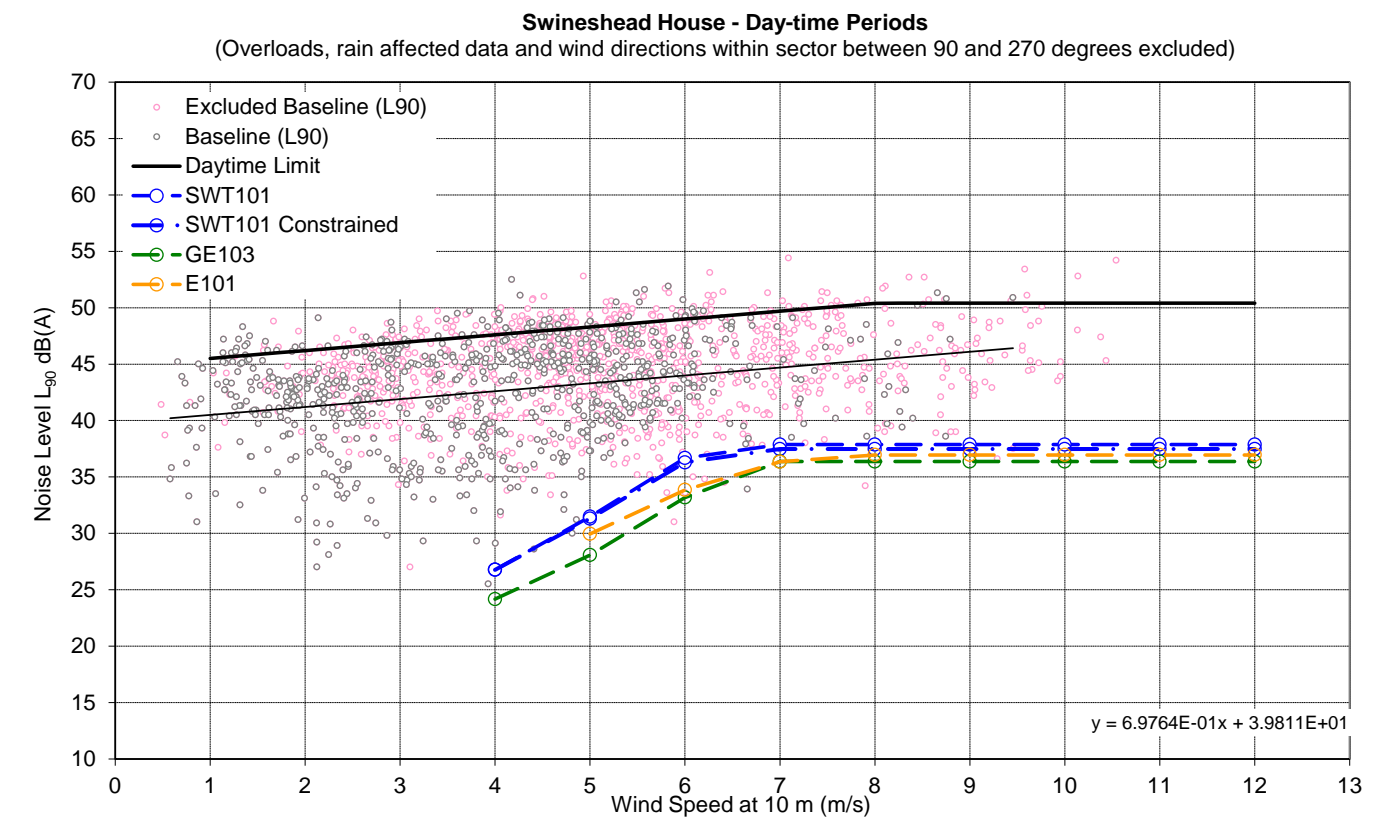


Figure B31 Chart of daytime background noise levels (from 2 Council House), daytime noise limit and predicted noise immission levels at Swineshead House against wind speeds.

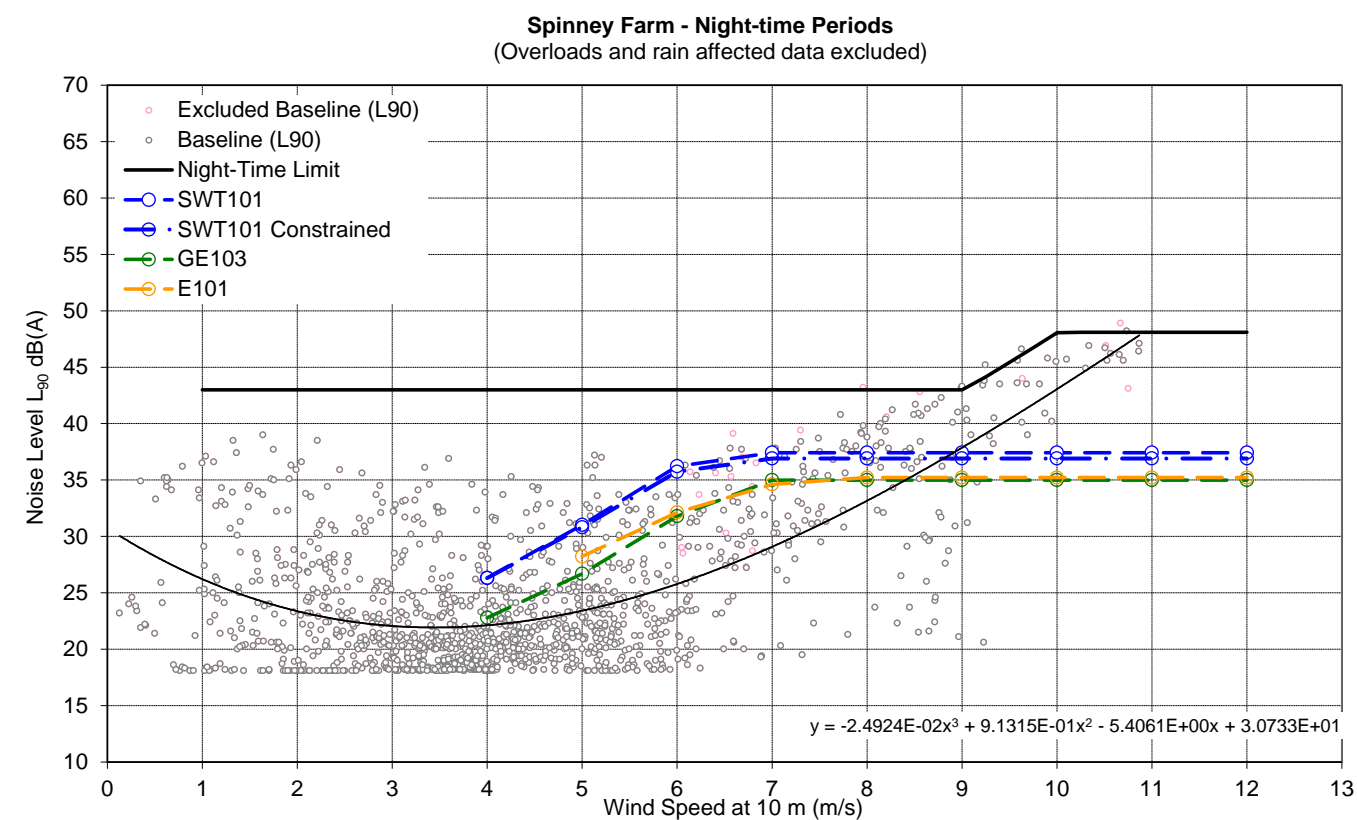


Figure B30 Chart of night-time background noise levels (from The Old Church), night time noise limit and predicted noise immission levels at Spinney Farm against wind speeds.

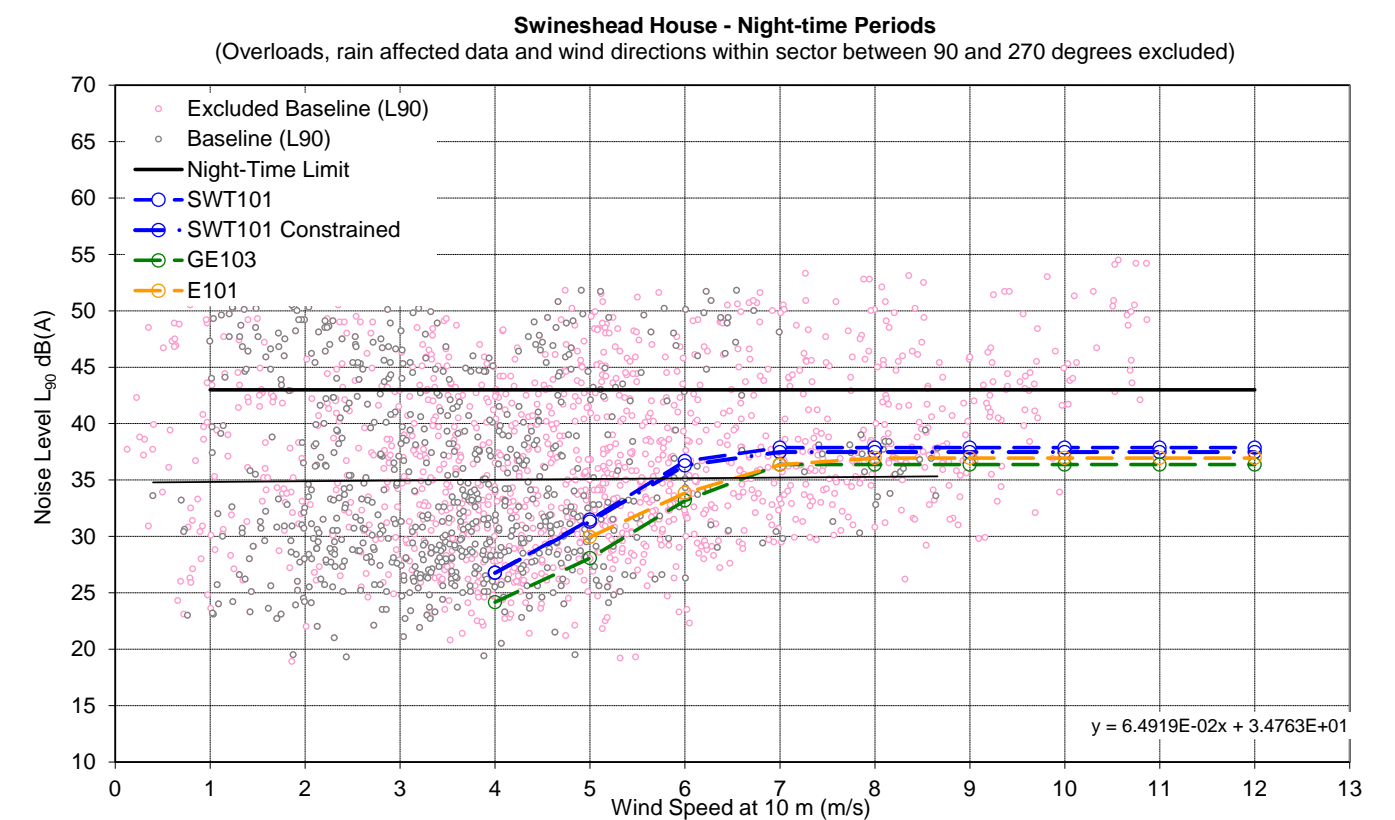


Figure B32 Chart of night-time background noise levels (from 2 Council House), night-time noise limit and predicted noise immission levels at Swineshead House against wind speeds.

