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TARALGA WIND FARM

New South Wales

Environmental Noise Compliance

S2570C61

November 2015



EXECUTIVE SUMMARY

Noise compliance testing has been conducted at the Taralga Wind Farm for the purpose of determining compliance with the Conditions of Consent and the Environment Protection Licence (EPL).

Continuous post-construction noise logging was conducted in accordance with the *Taralga Noise Management Plan* and *SA Environmental Noise Guidelines: Wind Farms (2003)* at six residences (H01, H05, H07, H12, H41 and H77) between the 3rd of August and the 23rd of September, 2015.

The noise logging demonstrated compliance with the relevant operational noise criteria at each of the residences at all wind speeds. However, H01 and H77 did not experience downwind conditions as often as the long term average. Therefore noise logging at these two locations is currently being repeated in months when a higher percentage of downwind conditions is expected.

The presence of excessive tonality was measured for each of the three turbine types located at the wind farm using the methodology in *ISO 1996.2: 2007 Acoustics — Description, measurement and assessment of environmental noise – Determination of environmental noise levels* which is equivalent to the method of Section 4 of *NSW Industrial Noise Policy* (EPA,2001)), and in accordance with the procedures described in Section 3.1 of this report. There was no tonality detected for any of the turbine types.

A low frequency noise assessment was conducted in accordance with the Conditions of Consent for dwelling H41. It was determined that there is no low frequency noise present at H41 and therefore no further action is required.

The post-construction noise measurements confirm that the Taralga Wind Farm complies with the Conditions of Consent, and with the Environment Protection Licence. An addendum to this report will be produced once the repeated measurements at H01 and H077 are complete.

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1 INTRODUCTION

Sonus has been engaged by Taralga Wind Farm Nominees to conduct noise compliance testing of the Taralga Wind Farm, New South Wales.

The purpose of the testing was to determine compliance with the Taralga Wind Farm Conditions of Consent and the Environment Protection Licence (EPL). Continuous noise monitoring at five non-associated receptors and one associated receptor has been conducted in accordance with the Taralga Wind Farm Noise Management Plan which was written in consultation with the NSW Environmental Protection Authority (EPA) and approved by the NSW Department of Planning and Environment (DPE).

Receptor locations selected for noise compliance monitoring are in accordance with the Conditions of Consent.

This report addresses:

- the operational noise levels from the Taralga Wind Farm at the closest noise sensitive receptors;
- an assessment of tonality; and,
- an assessment of low frequency noise.



2 OPERATIONAL NOISE LEVELS

2.1 Criteria

The *Taralga Wind Farm: Consolidated Conditions of Consent (Modification 8)* related to noise are detailed in Appendix E. They include:

41. *The Applicant must design, operate and maintain the development to ensure that for each non-associated residence, while they continue to be not associated with the development, the equivalent noise level $L_{Aeq}^{(10 \text{ minute})}$ from the development at each of these receiver locations does not exceed:*
- (a) 35 dB(A); or*
 - (b) the pre-existing background noise level $L_{Aeq}^{(10 \text{ minute})}$ at each receiver location (as determined under condition 41), respectively, by more than 5 dB(A), whichever is the greater, for each integer wind speed (at 10m height) during operation of the development measured in accordance with the SA Guidelines.*

Although Condition 41 states that the background noise level is to be measured with the L_{Aeq} descriptor, this report uses the L_{A90} descriptor which is the descriptor used by the Environment Protection Licence and the South Australian Environmental Noise Guidelines: Wind Farms (2003), which was the assessment guideline used in the approval. It is noted that if the L_{Aeq} were used, compliance would be more easy to achieve.

51. *Within six months of operation, the Applicant must engage an independent acoustic consultant(s), who is to receive the prior approval of the Secretary, and to undertake a program of noise monitoring to test the noise emission performance of the development at the locations identified in condition 42 at times without notice to the Applicant (but only where the consent of the landowner has been provided to undertake the program).*

The program must include, but not necessarily be limited to:

- (a) noise monitoring and assessment generally in accordance with procedures outlined in the SA Guidelines;*
- (b) assessment of the noise performance of the development against the noise limits specified in conditions 42 and where relevant, condition 43;*



- (c) details of any complaints received during monitoring and assessment in relation to noise generated by the proposal; and*
- (d) recommendations and a timetable for implementation for any Reasonable and Feasible additional measures necessary to ensure compliance with the relevant noise-related conditions of this consent.*

Condition 51(b) refers to the measurement of noise from the substation (Condition 43) "where relevant". No assessment of noise from the substation has been conducted as the closest non-associated dwelling is approximately 2.8km from the substation. At this distance, the noise from the substation would be inaudible and therefore the assessment is not relevant.

The Environment Protection Licence (EPL) includes:

L3.1 Noise generated from the premises must not exceed, at the nearest non-involved residential receivers:

- (a) 35 dB(A); or*
- (b) the existing background noise level (LA90 (10-minute)), correlated to the integer wind speed at 10 metres above ground level at the wind farm site, by more than 5 dB(A), whichever is greater, for each integer wind speed (measured at 10 metres above ground level) from cut-in to rated power of the wind turbine generator when determined in accordance with the methodology provided in the Environmental Noise Guidelines: Wind Farms (South Australia EPA, 2003).*

2.1.1 Pre-construction Noise Measurements

Prior to construction of the Taralga Wind Farm, background noise monitoring was conducted in April 2009 and December 2013 and was summarised in Sonus reports S2570C18 and S2570C34.



The background noise monitoring was conducted at the locations detailed in Table 2.1 below:

Table 2.1: Noise Monitoring Receptors

| Receptor | Involved | MGA94 Zone 55 | |
|----------------|----------|---------------|--------------|
| | | Easting [m] | Northing [m] |
| H01 | No | 764543 | 6191718 |
| H05 | No | 761679 | 6188622 |
| H07 | No | 765680 | 6189114 |
| H12 | Yes | 763878 | 6184103 |
| H41 | No | 767347 | 6187574 |
| H77 (The Farm) | No | 762285 | 6191175 |

Figure 2-1 below shows the locations of the dwellings relative to the turbine layout and wind masts.

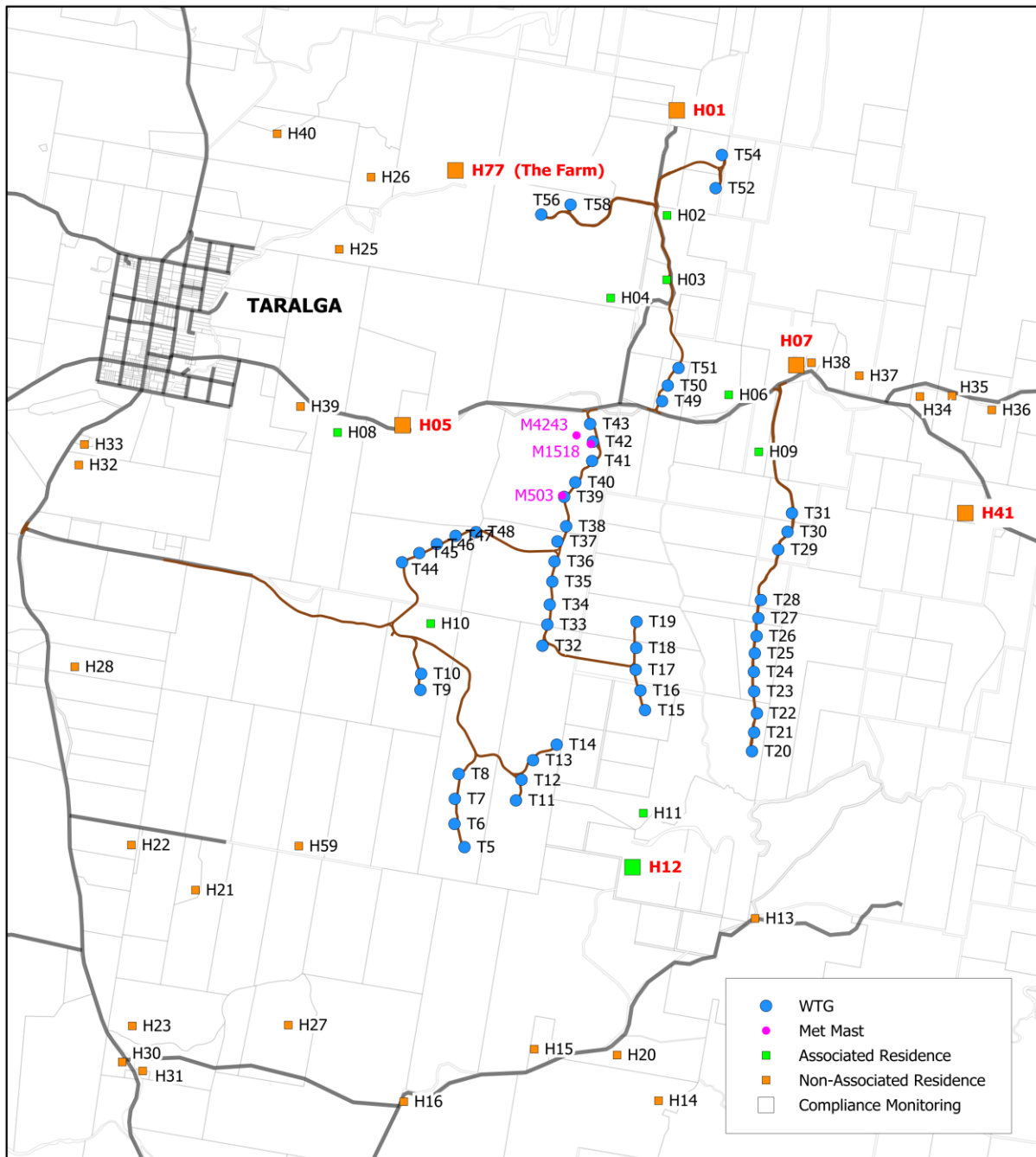


Figure 2-1: Location of Relevant Dwellings

During the pre-construction noise monitoring period, the average wind speed and direction was measured in 10 minute intervals at two meteorological masts located at the Taralga wind farm site. The first, named AUStrgm1518, was used for H01, H05, H07, H12 and H77 while the second named AUStrgm503 was used for H41. The logged noise levels were



correlated with wind speeds at the height of 10m above ground (AGL) before a least squares regression analysis of the data was conducted. The correlations were then used to determine the resultant noise criteria at each measurement location (receptor) in accordance with the *Environmental Noise Guidelines: Wind Farms* (South Australia EPA 2003) (SA Guidelines).

Based on the pre-construction noise logging, the Conditions of Consent and the Licence Conditions, the operational noise criteria are as tabulated below in Table 2.2.

Table 2.2: Operational Noise Criteria for the Taralga Wind Farm

| Receptor | Operational Noise Criteria (dB(A)) Referenced to wind speed at 10m AGL | | | | | | | | | |
|----------|---|----|----|----|----|----|----|----|----|----|
| | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| H01 | 35 | 35 | 35 | 36 | 38 | 41 | 44 | 47 | 50 | 53 |
| H05 | 40 | 41 | 41 | 42 | 44 | 45 | 47 | 49 | 51 | 54 |
| H07 | 35 | 35 | 37 | 40 | 44 | 47 | 51 | 54 | 57 | 59 |
| H12 | 41 | 40 | 40 | 40 | 41 | 43 | 44 | 46 | 48 | 50 |
| H41 | 35 | 35 | 35 | 36 | 38 | 40 | 42 | 43 | 44 | 45 |
| H77 | 35 | 36 | 37 | 39 | 41 | 44 | 46 | 49 | 51 | 53 |

It should be noted that while H12 is associated and therefore does not need to achieve an objective criterion, it is treated as a non-associated residence so that compliance may be demonstrated with non-associated criteria at that location. In this way it can be determined that other non-associated residences in close proximity to H12 will also comply.



2.2 Assessment

2.2.1 Post-construction Noise Measurements

To determine compliance with the operational noise criteria, post-construction continuous noise monitoring was conducted in accordance with the SA Guidelines at six receptors in to the vicinity of the Taralga Wind Farm, between the 3rd of August and the 23rd of September, 2015.

Post-construction noise monitoring was conducted at H01, H05, H07, H12, H41 and H77.

2.2.1.1 Monitoring Equipment

The noise loggers used at the nominated receptors were Rion NL-52 (Type 1) sound level meters, which have a noise floor of less than 20 dB(A). The sound level meters were calibrated at the beginning and end of the measurement period with a Rion NC-74 Calibrator. Each of the microphones was positioned approximately 1.5 m above ground level and fitted with either Rion WS-15 weatherproof double windshields or ACO Pacific WS7 windshields of approximately 175mm diameter.

Table 2.3 below provides information on the noise measurement instrumentation for the logging conducted at each of the receptors, and the calibration certificates are provided in Appendix A.



Table 2.3: Measurement Instrumentation for Noise Logging at Receptors

| Receptor | Instrument | Manufacturer | Model | Serial Number | Calibration Date |
|----------|-------------------|--------------|---------|---------------|------------------|
| H01 | Sound level meter | Rion | NL – 52 | 320654 | 14/08/2014 |
| | Microphone | Rion | UC – 59 | 3403 | 14/08/2014 |
| | Preamplifier | Rion | NH – 25 | 10662 | 14/08/2014 |
| H05 | Sound level meter | Rion | NL – 52 | 320651 | 14/08/2014 |
| | Microphone | Rion | UC – 59 | 3400 | 14/08/2014 |
| | Preamplifier | Rion | NH – 25 | 10659 | 14/08/2014 |
| H07 | Sound level meter | Rion | NL – 52 | 320656 | 11/08/2014 |
| | Microphone | Rion | UC – 59 | 3405 | 11/08/2014 |
| | Preamplifier | Rion | NH – 25 | 10664 | 11/08/2014 |
| H12 | Sound level meter | Rion | NL – 52 | 320646 | 14/08/2014 |
| | Microphone | Rion | UC – 59 | 3395 | 14/08/2014 |
| | Preamplifier | Rion | NH – 25 | 10654 | 14/08/2014 |
| H41 | Sound level meter | Rion | NL – 52 | 320648 | 31/05/2014 |
| | Microphone | Rion | UC – 59 | 3397 | 31/05/2014 |
| | Preamplifier | Rion | NH – 25 | 10656 | 31/05/2014 |
| H77 | Sound level meter | Rion | NL – 52 | 320653 | 15/08/2014 |
| | Microphone | Rion | UC – 59 | 3402 | 15/08/2014 |
| | Preamplifier | Rion | NH – 25 | 10661 | 15/08/2014 |
| All | Calibrator | Rion | NC – 74 | 35094478 | 14/07/2015 |



Two local weather loggers were also deployed, which measured rainfall and wind speed at the approximate height of the microphone. The rainfall and wind speed data were collected to determine the periods when weather directly on the microphone may have influenced the measured levels. The local weather loggers were placed at H01 and H77, and operated throughout the noise logging period.

Photographs of the noise loggers and weather loggers at the nominated receptors are provided in Appendix B with the pre-construction image on the left and the post-construction image on the right.

2.2.1.2 Collected Data

The noise level (L_{A90}) was measured in 10 minute intervals, at each nominated monitoring location over the monitoring period between the 3rd of August and the 23rd of September, 2015, in accordance with the SA Guidelines.

During the noise monitoring period for which post-construction data was collected, the average wind speed and direction was measured in 10 minute intervals at Meteorological Mast M4243 as this was the closest post construction meteorological mast to the pre-construction masts AUStrgM1518 and AUStrgM503 and a similar wind resource is predicted at this location.

2.2.1.3 Data Analysis

Prior to a correlation and regression analysis, the following data were removed:

- data points corresponding to any periods of measured rainfall (including the 60 minute periods before and after the recorded period) and/or measured wind speed exceeding 5 m/s at the microphone height for more than 90% of the measurement period; and,
- data points corresponding to wind speeds outside the wind speeds corresponding to cut-in and rated power of the wind turbine generator.



Table 2.4 below summarises the number of data points collected at each monitoring location and the number of data points considered for analysis following data removal.

Table 2.4: Number of Total Measurement Points Collected and Included in Analysis

| Noise Monitoring Location | Number of Data Points | |
|---------------------------|-----------------------|----------|
| | Collected | Included |
| H01 | 7348 | 4686 |
| H05 | 7346 | 4726 |
| H07 | 5162 | 3150 |
| H12 | 7336 | 4716 |
| H41 | 7307 | 4681 |
| H77 | 7344 | 4722 |

The percentage of downwind points collected has been compared to the long term average and is summarised in table 2.5 below:

Table 2.5: Comparison of Long Term Average and Collected Downwind Percentage

| Noise Monitoring Location | Long Term Average % Downwind | % Downwind Collected |
|---------------------------|------------------------------|----------------------|
| H01 | 21 | 15 |
| H05 | 14 | 16 |
| H07 | 45 | 57 |
| H12 | 45 | 62 |
| H41 | 45 | 61 |
| H77 | 25 | 14 |

From table 2.5 it can be concluded that during the monitoring period, H01 and H77 did not experience downwind conditions as often as the long term average. This was as a result of the noise monitoring being conducted in August and September, when less easterly winds



are experienced. Therefore noise logging at these two locations is currently being repeated in months when a higher percentage of downwind conditions is expected. An addendum to this report will be produced once this data has been collected.

2.2.1.4 Correlations at Receptors

The noise data for each monitoring location was correlated with the wind speed measured at Meteorological Mast M4243. A least squares regression analysis of the data was undertaken to determine the line of best fit for the correlations, in accordance with the SA Guidelines. The data and the regression curves are shown in Appendix C. Based on the regression analysis, the measured noise level ($L_{A90,10\text{minute}}$) referenced to the wind speed at 10m above ground are provided in Table 2.6 below.

The contribution of noise from the wind turbines has been estimated by subtracting the pre-construction background noise level from the post-construction measured noise level where the background level is lower than the measured level. This level is labelled "Turbines" in Table 2.6. From Table 2.6 it can be seen that the operational noise from the Taralga Wind Farm complies with the operational noise criterion for all wind speeds.

Table 2.6: Measured Operational Noise Levels based on Regression Curves

| Receptor | Operational Noise Level $L_{90,10 \text{ minute}}$ (dB(A)) for Wind Speed (m/s) at 10m AGL | | | | | | | | | | | | | | | | | | | | | | | |
|----------|--|-----------|----------|----------|-----------|----------|----------|-----------|----------|----------|-----------|----------|----------|-----------|----------|----------|-----------|----------|----------|-----------|----------|----------|-----------|----------|
| | 3 | | | 4 | | | 5 | | | 6 | | | 7 | | | 8 | | | 9 | | | 10 | | |
| | Measured | Criterion | Turbines | Measured | Criterion | Turbines | Measured | Criterion | Turbines | Measured | Criterion | Turbines | Measured | Criterion | Turbines | Measured | Criterion | Turbines | Measured | Criterion | Turbines | Measured | Criterion | Turbines |
| H01 | 29 | 35 | <25 | 30 | 35 | <25 | 31 | 35 | 27 | 34 | 36 | 31 | 37 | 38 | 34 | 39 | 41 | 37 | 42 | 44 | 39 | 43 | 47 | 37 |
| H05 | 31 | 40 | <25 | 31 | 41 | <25 | 32 | 41 | <25 | 34 | 42 | <25 | 37 | 44 | <25 | 40 | 45 | <25 | 43 | 47 | 38 | 46 | 49 | 42 |
| H07 | 32 | 35 | 31 | 32 | 35 | 30 | 33 | 37 | 29 | 36 | 40 | 28 | 39 | 44 | 25 | 42 | 47 | <25 | 46 | 51 | <25 | 49 | 54 | <25 |
| H12 | 32 | 41 | <25 | 34 | 40 | <25 | 36 | 40 | 30 | 38 | 40 | 34 | 39 | 41 | 36 | 40 | 43 | 37 | 41 | 44 | 37 | 42 | 46 | 35 |
| H41 | 28 | 35 | <25 | 30 | 35 | 26 | 33 | 35 | 29 | 34 | 36 | 32 | 36 | 38 | 33 | 38 | 40 | 34 | 39 | 42 | 34 | 39 | 43 | 33 |
| H77 | 29 | 35 | <25 | 29 | 36 | <25 | 31 | 37 | <25 | 33 | 39 | <25 | 37 | 41 | 26 | 40 | 43 | 35 | 43 | 46 | 39 | 45 | 48 | 41 |

3 TONALITY

3.1 Criteria

The conditions of consent include:

45. *The presence of excessive tonality shall be measured using the methodology in ISO 1996.2: 2007 Acoustics — Description, measurement and assessment of environmental noise – Determination of environmental noise levels, and in accordance with the procedures described in Attachment 6 of this consent.*

Attachment 6 Excerpt:

The presence of excessive tonality (a special noise characteristic) is consistent with that described in ISO 1996.2: 2007 Acoustics — Description, measurement and assessment of environmental noise – Determination of environmental noise levels and is defined as when the level of one-third octave band measured in the equivalent noise level $L_{eq(10minute)}$ exceeds the level of the adjacent bands on both sides by:

- 5dB or more if the centre frequency of the band containing the tone is in the range 500Hz to 10,000Hz;*
- 8dB or more if the centre frequency of the band containing the tone is in the range 160 to 400Hz; and/or*
- 5dB or more if the centre frequency of the band containing the tone is in the range 25Hz to 125Hz.*

If tonality is found to be a repeated characteristic of the wind turbine noise, 5 dB(A) should be added to measured noise levels from the wind farm. If tonality is only identified for certain wind directions and speeds, the penalty is only applicable under these conditions. The tonal characteristic penalty applies only if the tone from the wind turbine is audible at the relevant receiver. Absence of tone in noise emissions measured at an intermediate location is sufficient proof that the tone at the receiver is not associated with the wind farm's operation. The assessment for tonality should only be made for frequencies of concern from 25 Hz to 10 KHz and for sound pressure levels above the threshold of hearing (as defined in ISO 389.7: 2005 Acoustics - Reference zero for the calibration of audiometric equipment - Part 7: Reference threshold of hearing under free-field and diffuse-field listening conditions).



The Environmental Protection Licence (EPL) includes:

L3.4 To determine compliance with Condition L3.1, 5dB(A) must be added to measured noise levels where tonality is present. The presence of tonality must be determined using a methodology based on the modifying factor for tonality presented in Section 4 of the NSW Industrial Noise Policy (EPA, 2001).

It is noted that although the Conditions of Consent refer to the method in ISO1996.2 and the Licence refers to the *NSW Industrial Noise Policy (EPA, 2001)*, both methods are essentially the same.

3.2 Assessment

The Taralga wind farm includes three models of Vestas turbines; the Vestas V90 2MW, Vestas V90 3MW and Vestas V100 1.8MW. Therefore, the presence of tonality was measured for each of the turbine types using the methodology in *the NSW Industrial Noise Policy*, and in accordance with the procedures described above.

A one third octave band tonality analysis was conducted for each wind turbines based on data collected for near field testing. The tonality assessment was conducted on each 1 minute interval used in the apparent sound power level analysis. The results of the tonality assessment for all one minute intervals determined that there were no tones associated with the turbines. Figures 2, 3 and 4 below provide examples of the one third octave band data for the wind speed closest to each integer wind speed.

The graphs indicate that none of the tested wind turbines exhibit a tonal character of noise when tested in accordance with the *NSW Industrial Noise Policy* or *ISO1996.2:2007*.

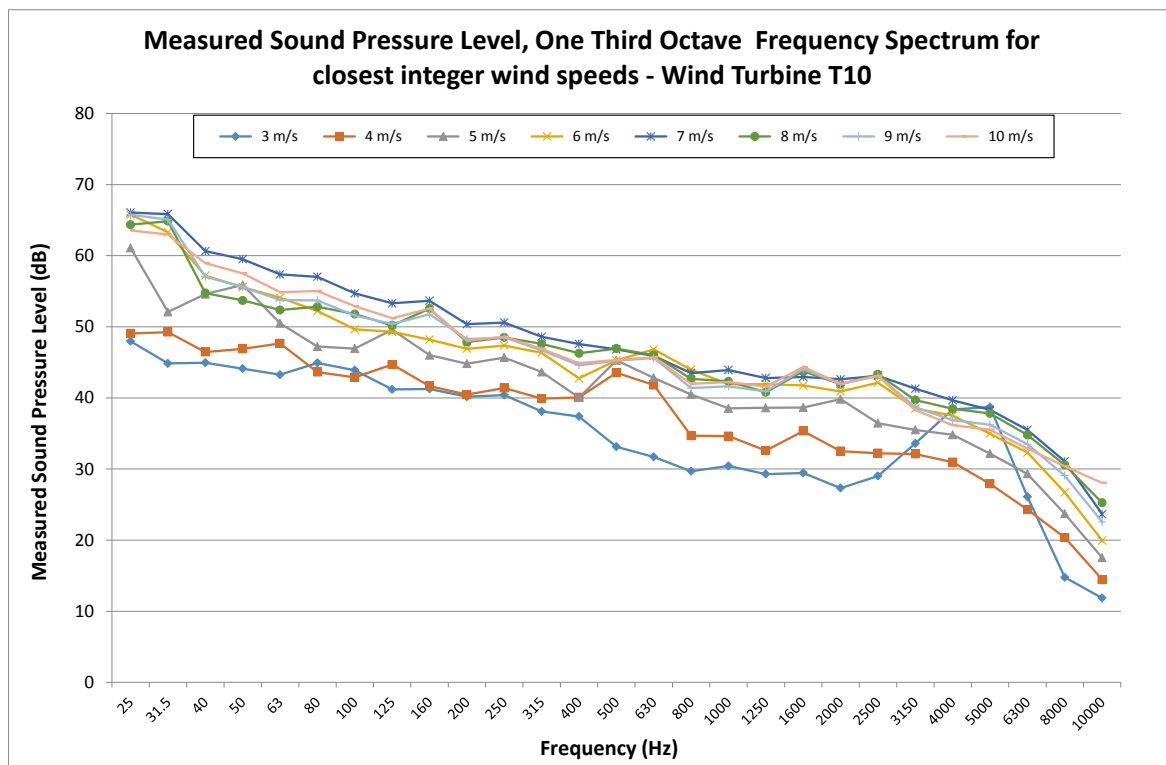


Figure 3-1: 1/3 Octave band sound pressure level for Vestas V90 2MW

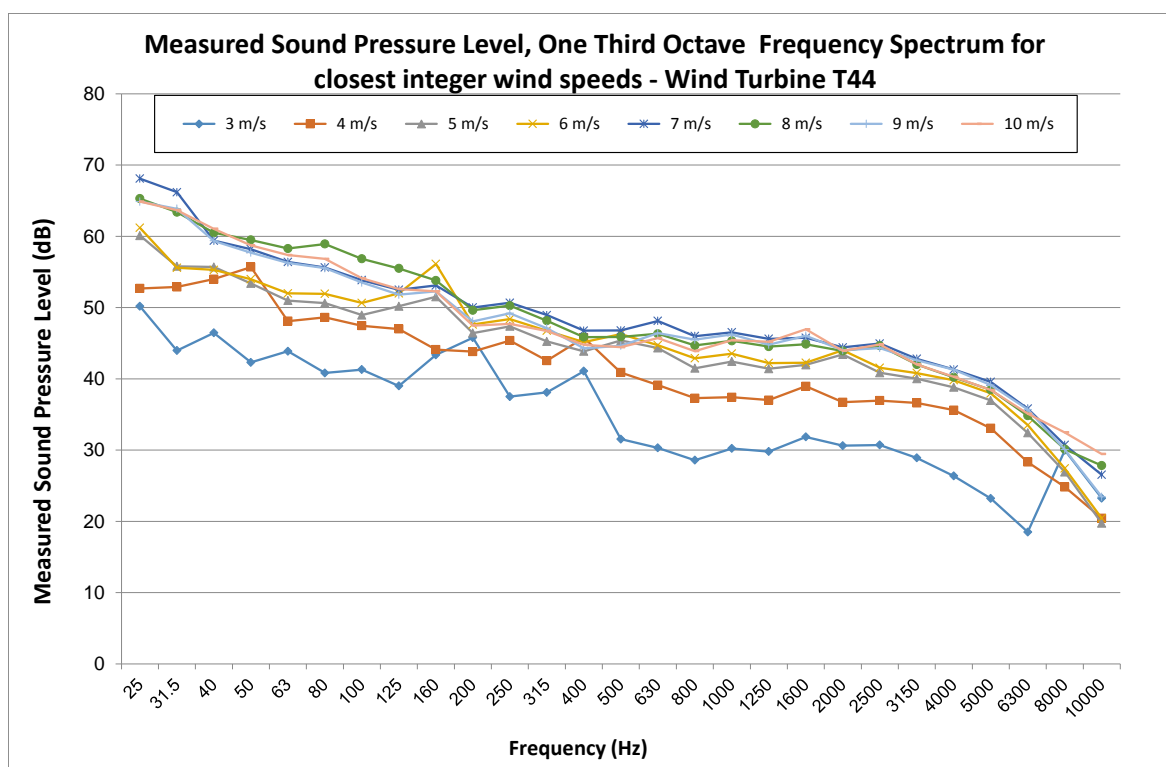


Figure 3-2: 1/3 Octave band sound pressure level for Vestas V100 2MW

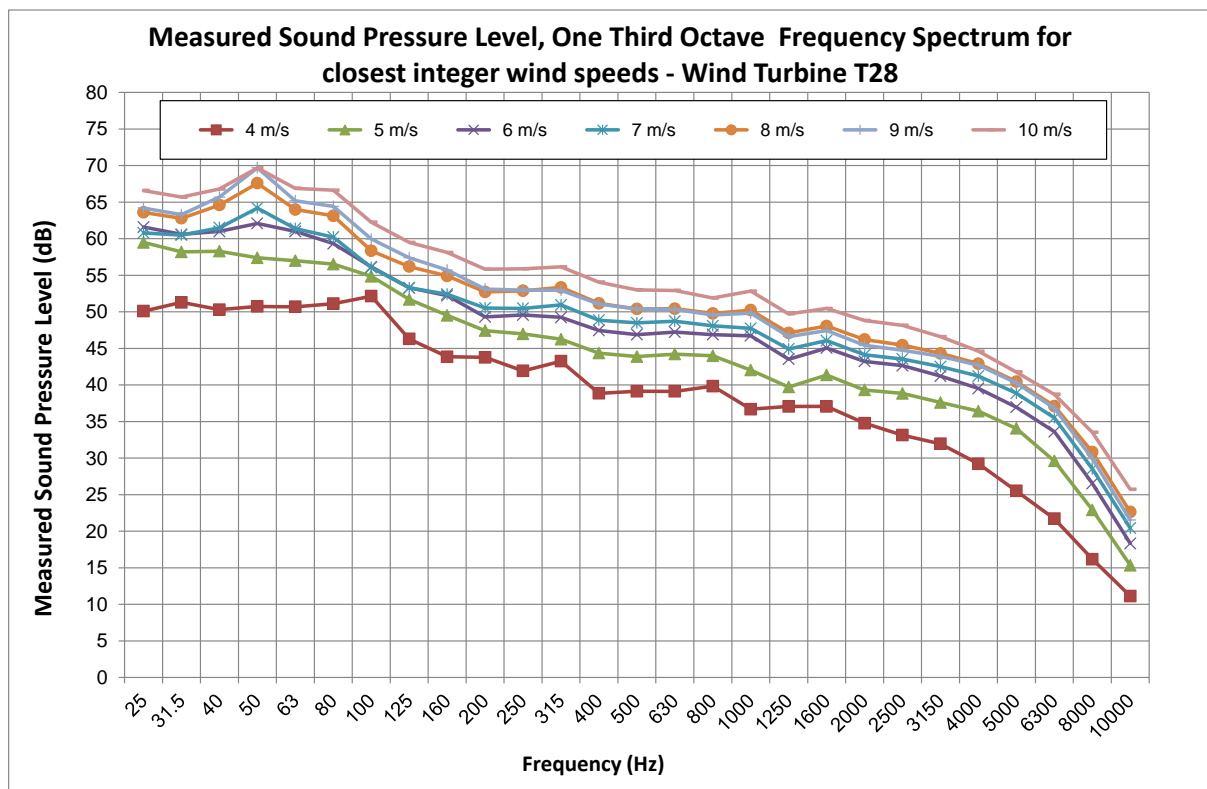


Figure 3-3: 1/3 Octave band sound pressure level for Vestas V90 3MW



4 LOW FREQUENCY NOISE

4.1 Criteria

The conditions of consent include:

48A. *Low frequency noise shall be managed in accordance with the procedures described in Attachment 6 of this consent (Section 4.1 of this report).*

Attachment 6 includes:

The presence of excessive low frequency noise (a special noise characteristic) [i.e. noise from the wind farm that is repeatedly greater than 65 dB(C) during the day time or 60 dB(C) during the night time at any relevant receiver] will incur a 5 dB(A) penalty, to be added to the measured noise level for the wind farm, unless a detailed internal low frequency noise assessment demonstrates compliance with the proposed criteria for the assessment of low frequency noise disturbance (UK Department for Environment, Food and Rural Affairs (DEFRA, 2005)) for a steady state noise source.

Notes:

- *For the purposes of these conditions, a special noise characteristic is defined as a repeated characteristic if it occurs for more than 10% of an assessment period. This equates to being identified for more than 54 minutes during the 9 hour night from 10pm – 7am, or for more than 90 minutes during the 15 hour day from 7am – 10pm. This definition refers to verified wind farm noise only.*
- *The maximum penalty to be added to the measured noise level from the wind farm for any special noise characteristic individually or cumulatively is 5 dB(A).*
- *Notwithstanding conditions F7 and F8 of this project approval, the noise limits specified under these conditions do not apply to any residence where a noise agreement is in place between the Applicant and the owner(s) of those residences in relation to noise impacts and/or noise limits. For this condition to take effect, the noise agreements shall satisfy the relevant requirements of Guidelines for Community Noise (WHO, 1999).*



4.2 Assessment

To determine the level of low frequency noise present at nearby receptors, a low frequency noise analysis was conducted at H41. This analysis was conducted for both pre-construction and post-construction data in order to confirm that the level of low frequency noise present at the wind farm had not significantly increased. Table 5.1 below shows the percentage of low frequency noise present at H41 for the pre-construction data while Table 5.2 shows the same for the post-construction data. As seen in tables 5.1 and 5.2, the level of low frequency noise present at H41 is less than 10% for both pre-construction and post-construction and therefore in accordance with the Conditions of Consent any further analysis is unnecessary. However, this also demonstrates that the level of low frequency noise present at H41 has not increased. Graphical representation of these data sets can be found in Appendix D.

Table 4.1: Low Frequency Noise at H41 Pre-construction

| | Total Points | Low Frequency Noise Points | Percentage (%) |
|-------|---------------------|-----------------------------------|-----------------------|
| ALL | 3317 | 75 | 2.3 |
| Day | 2017 | 26 | 1.3 |
| Night | 1300 | 49 | 3.8 |

Table 4.2: Low Frequency Noise at H41 Post-construction

| | Total Points | Low Frequency Noise Points | Percentage (%) |
|-------|---------------------|-----------------------------------|-----------------------|
| ALL | 4676 | 63 | 1.4 |
| Day | 2877 | 16 | 0.6 |
| Night | 1799 | 47 | 2.6 |



APPENDIX A: CALIBRATION CERTIFICATES

| | | | |
|---|--|---|----------------------------|
| | | Level 7 Building 2 423 Pennant Hills Rd Pennant Hills NSW AUSTRALIA 2120 Ph: +61 2 9484 0800 A.B.N. 65 160 399 119 www.acousticresearch.com.au | |
| Sound Calibrator IEC 60942-2004 | | | |
| Calibration Certificate Calibration Number C15335 | | | |
| Client Details | | Sonus Pty Ltd (Sonus Acoustics) 17 Ruthven Ave Adelaide SA 5000 | |
| Equipment Tested/ Model Number : NC-74 Instrument Serial Number : 35094478 | | | |
| Atmospheric Conditions Ambient Temperature : 24.6°C Relative Humidity : 32.1% Barometric Pressure : 98.93kPa | | | |
| Calibration Technician : Calvin Simpfendorfer Calibration Date : 14/07/2015 | | Secondary Check: Kate Alchin Report Issue Date : 15/07/2015 | |
| Approved Signatory : | | Ken Williams | |
| Clause and Characteristic Tested | | Result | |
| 5.2.2: Generated Sound Pressure Level 5.2.3: Short Term Fluctuation | | Pass Pass | |
| Clause and Characteristic Tested | | Result | |
| 5.3.2: Frequency Generated 5.5: Total Distortion | | Pass Pass | |
| The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2004 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed. | | | |
| Least Uncertainties of Measurement - Environmental Conditions | | | |
| Specific Tests Generated SPL Short Term Fluct. Frequency Distortion | ±0.09dB ±0.02dB ±0.01% ±0.26% | Temperature Relative Humidity Barometric Pressure | ±0.3°C ±4.1% ±0.1kPa |
| All uncertainties are derived at the 95% confidence level with a coverage factor of 2. | | | |
| This calibration certificate is to be read in conjunction with the calibration test report. | | | |
| Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172. Accredited for compliance with ISO/IEC 17025. | | | |
| The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/National standards. | | | |
| PAGE 1 OF 1 | | | |



| | |
|---|---|
| | NATAcoustic |
| | Acoustic Calibration & Testing Laboratory Level 1, 418A Elizabeth Street., Surry Hills NSW 2010 AUSTRALIA Ph: (02) 8218 0570 email: service@nataacoustic.com.au website: www.nataacoustic.com.au A division of Renzo Torin & Associates (NSW) Pty Ltd ABN 29 117 462 861 |
| Certificate of Calibration Sound Level Meter | |

| | | |
|---|--------------|-------------|
| Calibration Date 14/08/2014 | Job No RB283 | Operator SD |
| Client Name SONUS PTY LTD | | |
| Client Address 17 RUTHVEN AVE ADELAIDE 5000 | | |

| Test Item |
|-----------|
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| | | |
|------------------------|-------------|------------------|
| Instrument Make RION | Model NL-52 | Serial No 320651 |
| Microphone Make RION | Model UC-59 | Serial No 3400 |
| Preamplifier Make RION | Model NH-25 | Serial No 10659 |
| Ext'n Cable Make NI | Model N/A | Serial No N/A |
| Accessories NI | | |

| | |
|---------------|-----|
| SLM Type | 1 |
| Filters Class | N/A |

| | |
|------------------|------|
| Temp deg C | 25.4 |
| RH % | 33.4 |
| Bar Pressure hPa | 1028 |

Applicable Standards:
Australian Standard AS1259.1 1990 "Sound Level Meters Part 1: Non-integrating"
Australian Standard AS1259.2 1990 "Sound Level Meters Part 2: Integrating-averaging"

Applicable Work Instruction:
RWI-06 SLM Verification.doc


Traceability:
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Scope:
This certificate is issued on the basis that the instrument complies with the manufacturer's specification. See "Sound Level Meter Verification - Summary of Tests" page for an itemised list of results for each test.

Uncertainty:
Unless otherwise stated, the uncertainty of measurement is $\pm 0.14\text{dB}$. The uncertainty is stated at a confidence level of 95% using a k factor of 2.

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| NATA WORLD-RECOGNISED ACCREDITATION | NATA Accredited Laboratory Number 14966 | Authorized Signatory: |
| | | Print Name: Renzo Torin Date: 14 August 2014 |



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|  | NATAcoustic |
| | Acoustic Calibration & Testing Laboratory Level 1, 418A Elizabeth Street, Surry Hills NSW 2010 AUSTRALIA Ph: (02) 8218 0570 email: service@natacoustic.com.au website: www.natacoustic.com.au A division of Renzo Tonin & Associates (NSW) Pty Ltd ABN 29 117 462 861 |
| Certificate of Calibration Sound Level Meter | |

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|---|--------------|-------------|
| Calibration Date 15/08/2014 | Job No RB283 | Operator SD |
| Client Name SONUS PTY LTD | | |
| Client Address 17 RUTHVEN AVE ADELAIDE 5000 | | |



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| Test Item |
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|------------------------|-------------|------------------|
| Instrument Make RION | Model NL-52 | Serial No 320653 |
| Microphone Make RION | Model UC-59 | Serial No 3402 |
| Preamplifier Make RION | Model NH-25 | Serial No 10661 |
| Ext'n Cable Make Nil | Model N/A | Serial No N/A |
| Accessories Nil | | |

| | |
|---------------|---|
| SLM Type | 1 |
| Filters Class | 1 |

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|------------------|------|
| Temp deg C | 24.8 |
| RH % | 33.3 |
| Bar Pressure hPa | 1026 |

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| <p>Applicable Standards: Australian Standard AS1259.1 1990 "Sound Level Meters Part 1: Non-integrating" Australian Standard AS1259.2 1990 "Sound Level Meters Part 2: Integrating-averaging"</p> <p>Applicable Work Instruction: RWI-08 SLM Verification.doc</p> <p>Traceability: The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements which include the requirements of ISO/IEC 17025 and are traceable to Australian national standards of measurement. This document shall not be reproduced, except in full.</p> <p>Scope: This certificate is issued on the basis that the instrument complies with the manufacturer's specification. See "Sound Level Meter Verification - Summary of Tests" page for an itemised list of results for each test.</p> <p>Uncertainty: Unless otherwise stated, the uncertainty of measurement is ± 0.14dB. The uncertainty is stated at a confidence level of 95% using a k factor of 2.</p> |
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|  <p>NATA Accredited Laboratory Number 14966</p> | <p>Authorized Signatory:</p>  |
| | <p>Print Name: Renzo Tonin Date: 15 Aug 2014</p> |



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| Certificate of Calibration Sound Level Meter | |

| | | |
|---|--------------|-------------|
| Calibration Date 14/08/2014 | Job No RB283 | Operator SD |
| Client Name SONUS PTY LTD | | |
| Client Address 17 RUTHVEN AVE ADELAIDE 5000 | | |



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| Test Item |
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| | | |
|------------------------|-------------|------------------|
| Instrument Make RION | Model NL-52 | Serial No 320654 |
| Microphone Make RION | Model UC-59 | Serial No 3403 |
| Preamplifier Make RION | Model NH-25 | Serial No 10662 |
| Ext'n Cable Make NI | Model N/A | Serial No N/A |
| Accessories NI | | |

| | |
|---------------|-----|
| SLM Type | 1 |
| Filters Class | N/A |

| | |
|------------------|------|
| Temp deg C | 25.4 |
| RH % | 32.4 |
| Bar Pressure hPa | 1028 |

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| <p>Applicable Standards: Australian Standard AS1259.1 1990 "Sound Level Meters Part 1: Non-Integrating" Australian Standard AS1259.2 1990 "Sound Level Meters Part 2: Integrating-averaging"</p> <p>Applicable Work Instruction: RWI-08 SLM Verification.doc</p> <p>Traceability: The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements which include the requirements of ISO/IEC 17025 and are traceable to Australian national standards of measurement. This document shall not be reproduced, except in full.</p> <p>Scope: This certificate is issued on the basis that the instrument complies with the manufacturer's specification. See "Sound Level Meter Verification - Summary of Tests" page for an itemised list of results for each test.</p> <p>Uncertainty: Unless otherwise stated, the uncertainty of measurement is ± 0.14 dB. The uncertainty is stated at a confidence level of 95% using a k factor of 2.</p> |
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|  NATA WORLD RECOGNISED ACCREDITATION | NATA Accredited Laboratory Number 14966 | Authorized Signatory:  Print Name: Renzo Tonin Date: 14 Aug 2014 |
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| Certificate of Calibration Sound Level Meter | |

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|---|--------------|-------------|
| Calibration Date 11/08/2014 | Job No RB283 | Operator SD |
| Client Name SONUS PTY LTD | | |
| Client Address 17 RUTHVEN AVE ADELAIDE 5000 | | |



| Test Item |
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|------------------------|-------------|------------------|
| Instrument Make RION | Model NL-52 | Serial No 320656 |
| Microphone Make RION | Model UC-59 | Serial No 3405 |
| Preamplifier Make RION | Model NH-25 | Serial No 10664 |
| Ext'n Cable Make Nil | Model N/A | Serial No N/A |
| Accessories Nil | | |

| | |
|---------------|-----|
| SLM Type | 1 |
| Filters Class | N/A |

| | |
|------------------|------|
| Temp deg C | 25.3 |
| RH % | 27.3 |
| Bar Pressure hPa | 1021 |

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| <p>Applicable Standards: Australian Standard AS1259.1 1990 "Sound Level Meters Part 1: Non-integrating" Australian Standard AS1259.2 1990 "Sound Level Meters Part 2: Integrating-averaging"</p> <p>Applicable Work Instruction: RWI-08 SLM Verification.doc</p> <p>Traceability: The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements which include the requirements of ISO/IEC 17025 and are traceable to Australian national standards of measurement. This document shall not be reproduced, except in full.</p> <p>Scope: This certificate is issued on the basis that the instrument complies with the manufacturer's specification. See "Sound Level Meter Verification - Summary of Tests" page for an itemised list of results for each test.</p> <p>Uncertainty: Unless otherwise stated, the uncertainty of measurement is ± 0.14dB. The uncertainty is stated at a confidence level of 95% using a k factor of 2.</p> |
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|  NATA WORLD RECOGNISED ACCREDITATION | NATA Accredited Laboratory Number 14966 | Authorized Signatory:  Print Name: Renzo Tonin Date: 14 Aug 2014 |
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| Certificate of Calibration Sound Level Meter | |

| | | |
|---|--------------|-------------|
| Calibration Date 14/08/2014 | Job No RB283 | Operator SD |
| Client Name SONUS PTY LTD | | |
| Client Address 17 RUTHVEN AVE ADELAIDE 5000 | | |

| Test Item |
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|------------------------|-------------|------------------|
| Instrument Make RION | Model NL-52 | Serial No 320646 |
| Microphone Make RION | Model UC-59 | Serial No 3395 |
| Preamplifier Make RION | Model NH-25 | Serial No 10654 |
| Ext'n Cable Make Nil | Model N/A | Serial No N/A |
| Accessories Nil | | |

| | |
|---------------|-----|
| SLM Type | 1 |
| Filters Class | N/A |

| | |
|------------------|------|
| Temp deg C | 25.6 |
| RH % | 33.2 |
| Bar Pressure hPa | 1028 |

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| <p>Applicable Standards: Australian Standard AS1259.1 1990 "Sound Level Meters Part 1: Non-integrating" Australian Standard AS1259.2 1990 "Sound Level Meters Part 2: Integrating-averaging"</p> <p>Applicable Work Instruction: RWI-08 SLM Verification.doc</p> <p>Traceability: The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements which include the requirements of ISO/IEC 17025 and are traceable to Australian national standards of measurement. This document shall not be reproduced, except in full.</p> <p>Scope: This certificate is issued on the basis that the instrument complies with the manufacturer's specification. See "Sound Level Meter Verification - Summary of Tests" page for an itemised list of results for each test.</p> <p>Uncertainty: Unless otherwise stated, the uncertainty of measurement is ± 0.14dB. The uncertainty is stated at a confidence level of 95% using a k factor of 2.</p> |
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|  | NATA Accredited Laboratory Number 14966 |
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| <p>Authorized Signatory:</p>  <p>Print Name: Renzo Tonin Date: 15 Aug 2014</p> |
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| | Level 1, 418A Elizabeth Street, Surry Hills NSW 2010 AUSTRALIA Ph: (02) 8218 0570 email: service@natacoustic.com.au website: www.natacoustic.com.au A division of Renzo Tonin & Associates (NSW) Pty Ltd ABN 29 117 462 881 |
| Certificate of Calibration Sound Level Meter | |

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|--|--------------|--------------|
| Calibration Date 31/05/2014 | Job No RB275 | Operator GGC |
| Client Name SONUS PTY LTD. | | |
| Client Address 17 RUTHVEN AVENUE ADELAIDE 5000 | | |


| Test Item |
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|-----------------------|-------------|---------------------|
| Instrument Make RION | Model NL-52 | Serial No #00320648 |
| Microphone Make RION | Model UC-59 | Serial No #03397 |
| Preampifier Make RION | Model NH-25 | Serial No #10656 |
| Ext'n Cable Make NI | Model N/A | Serial No N/A |
| Accessories NI | | |

| | |
|---------------|---|
| SLM Type | 1 |
| Filters Class | 1 |

| | |
|------------------|------|
| Temp deg C | 25.0 |
| RH % | 43.0 |
| Bar Pressure hPa | 1013 |

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|--|
| <p>Applicable Standards: Australian Standard AS1259.1 1990 "Sound Level Meters Part 1: Non-integrating" Australian Standard AS1259.2 1990 "Sound Level Meters Part 2: Integrating-averaging"</p> <p>Applicable Work Instruction: RWI-08 SLM Verification.doc</p> <p>Traceability: The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements which include the requirements of ISO/IEC 17025 and are traceable to Australian national standards of measurement. This document shall not be reproduced, except in full.</p> <p>Scope: This certificate is issued on the basis that the instrument complies with the manufacturer's specification. See "Sound Level Meter Verification - Summary of Tests" page for an itemised list of results for each test.</p> <p>Uncertainty: Unless otherwise stated, the uncertainty of measurement is ± 0.14dB. The uncertainty is stated at a confidence level of 95% using a k factor of 2.</p> |
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|  <p>NATA Accredited Laboratory Number 14966</p> | <p>Authorized Signatory:</p>  <p>Print Name: Renzo Tonin Date: 2 June 2014</p> |
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APPENDIX B: NOISE LOGGER AND WEATHER LOGGER PHOTOGRAPHS

Pre-Construction



Post-Construction



Figure A-1: Noise Logger and Weather Logger at H01

Weather Logger

Noise Logger

Noise Logger

Weather Logger

Pre-Construction



Post-Construction



Figure A-2: Noise Logger at H05

Pre-Construction



Post-Construction



Figure A-3: Noise Logger at H07

Pre-Construction



Post-Construction



Figure A-4: Noise Logger at H12

Pre-Construction



Post-Construction



Figure A-5: Noise Logger at H41

Pre-Construction



Post-Construction



Figure A-6: Noise Logger and Weather Logger at H77

Weather Logger

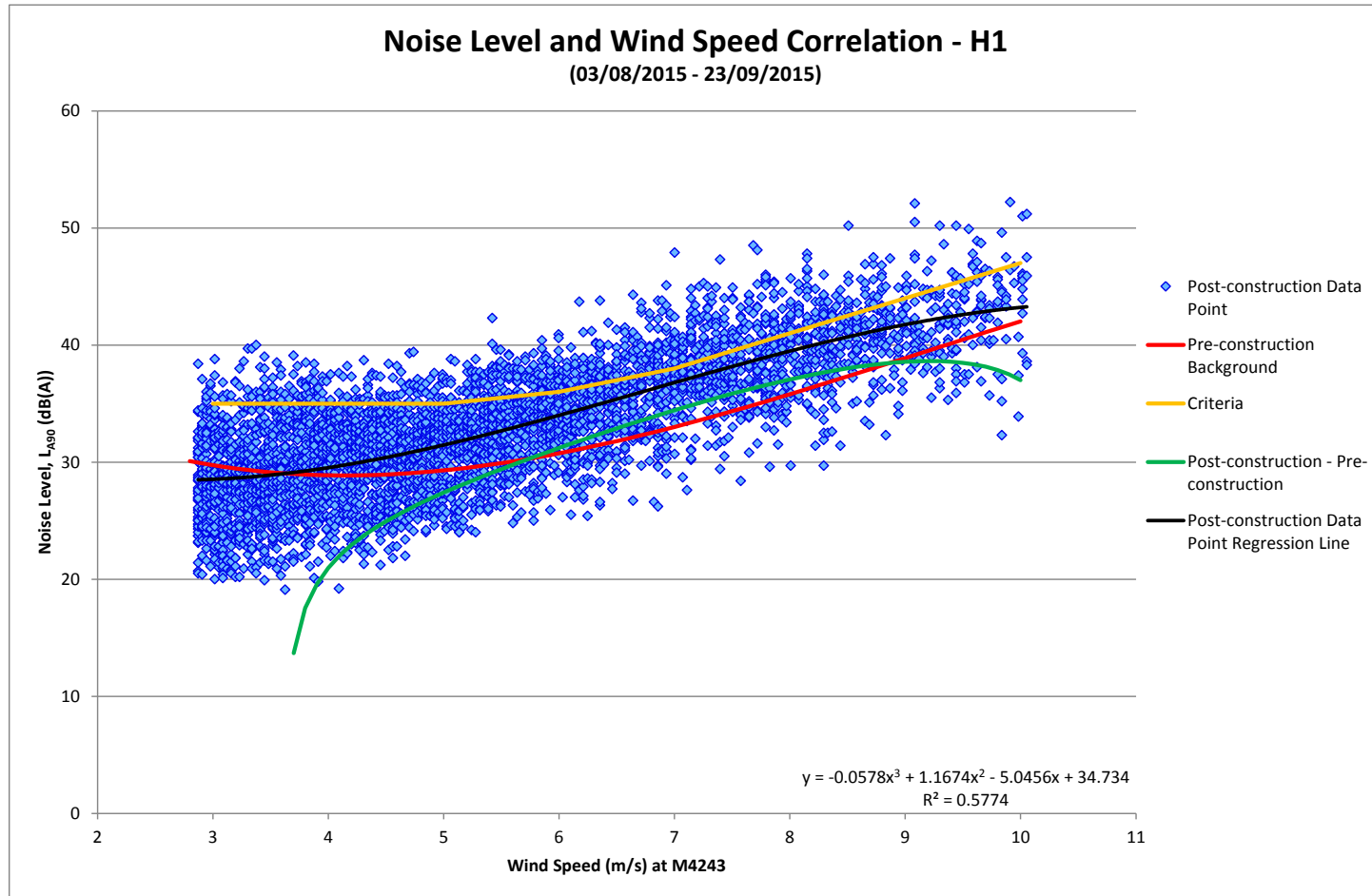
Noise Logger

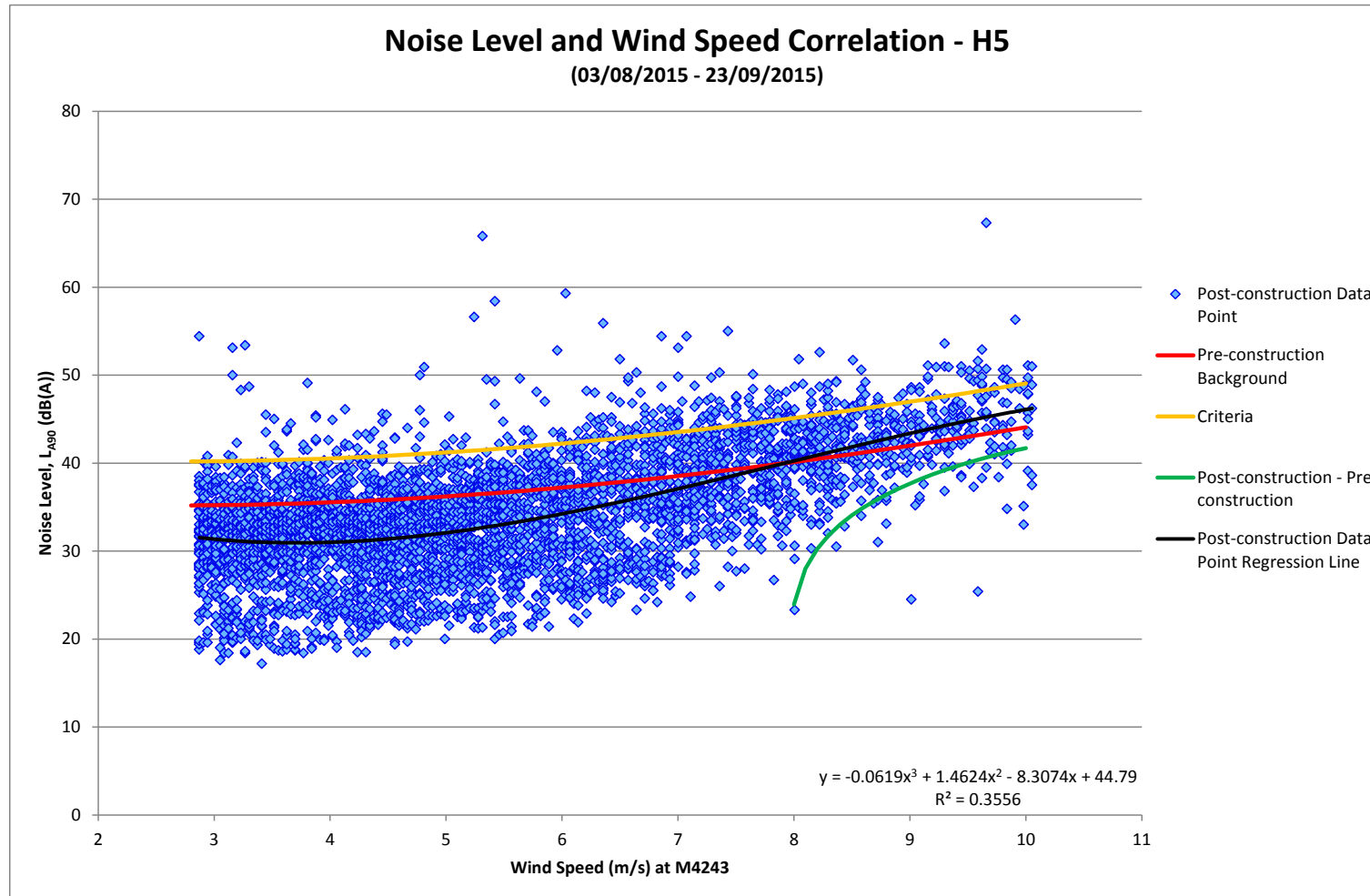
Noise Logger

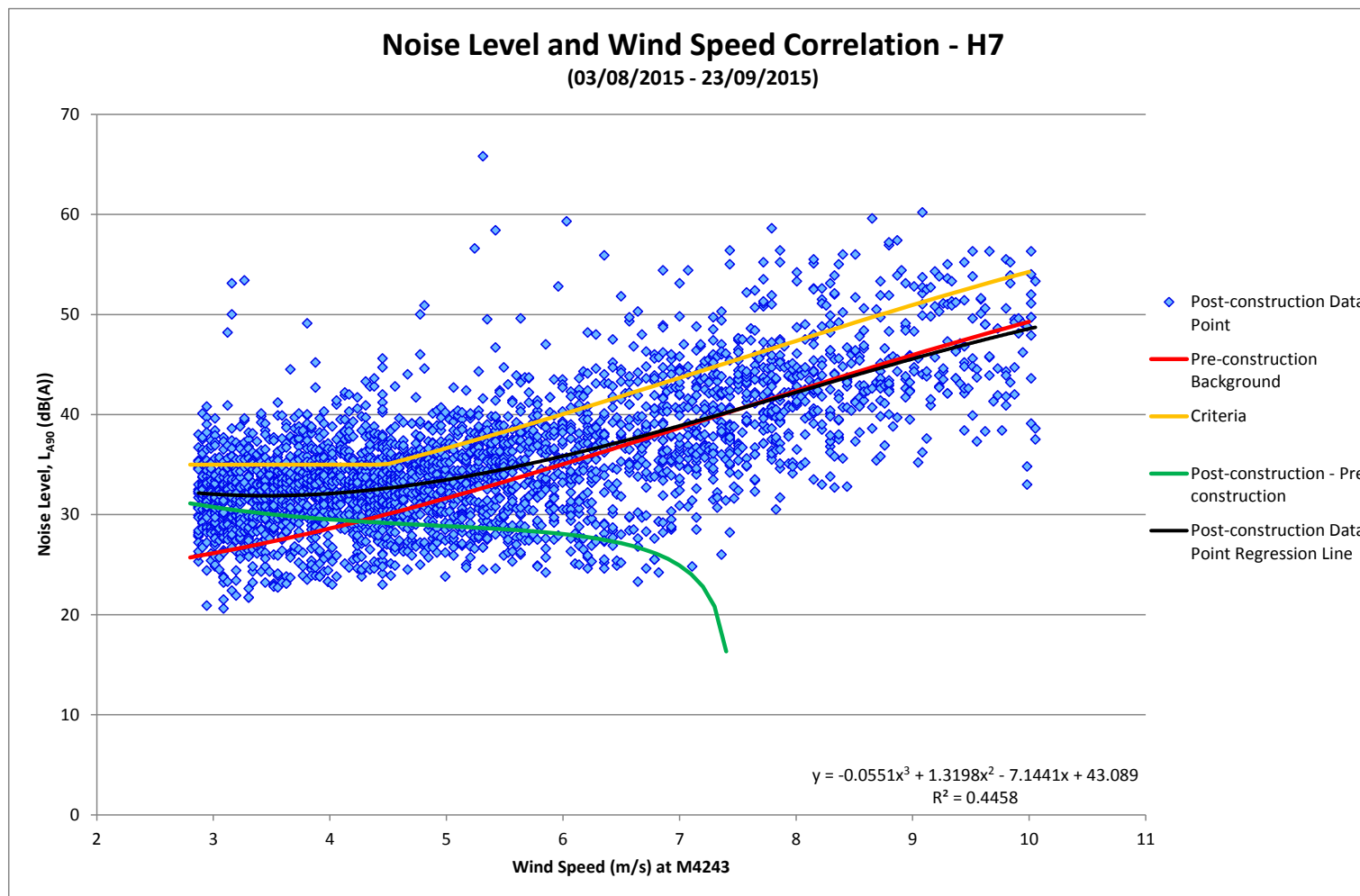
Weather Logger

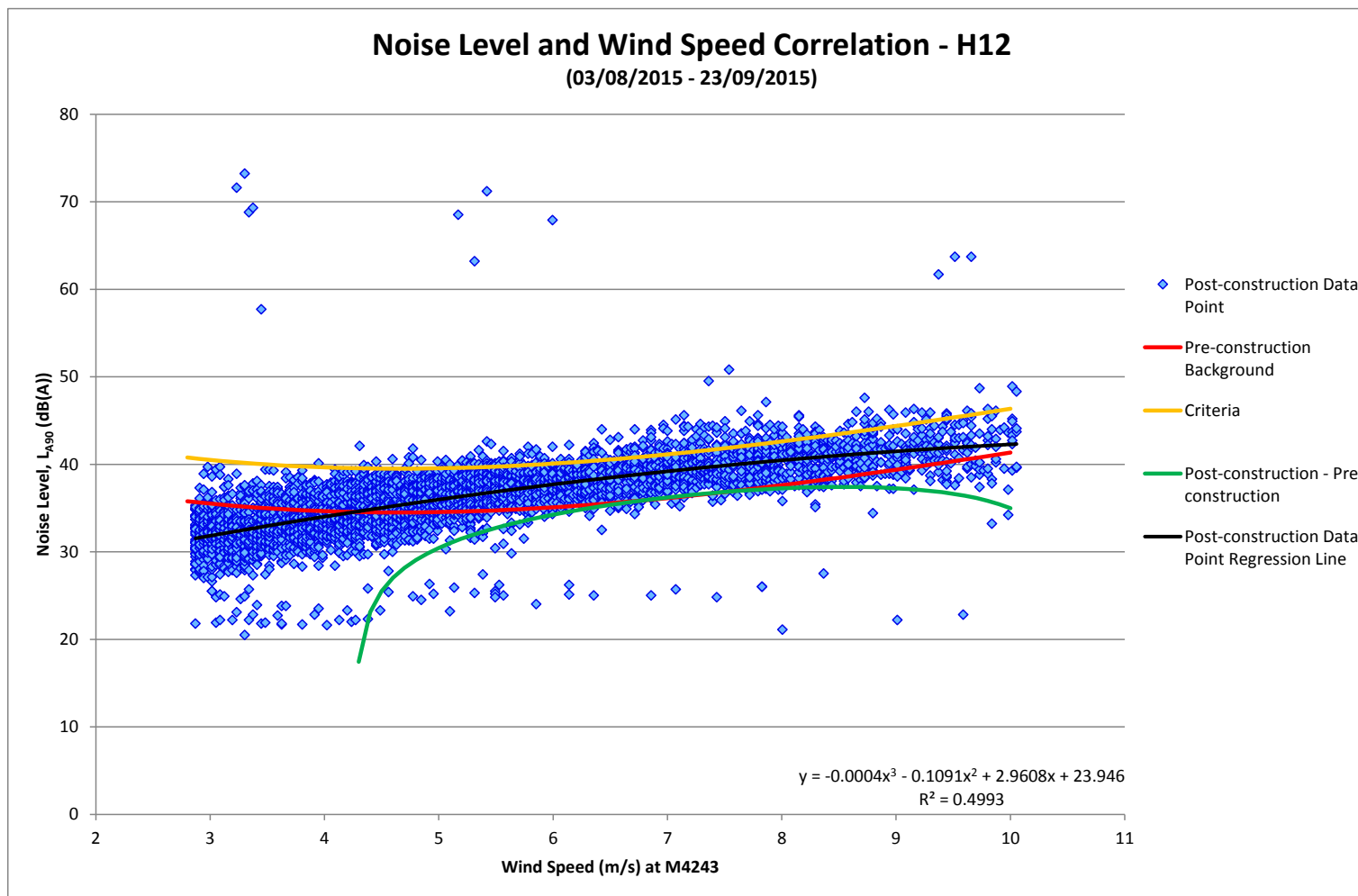


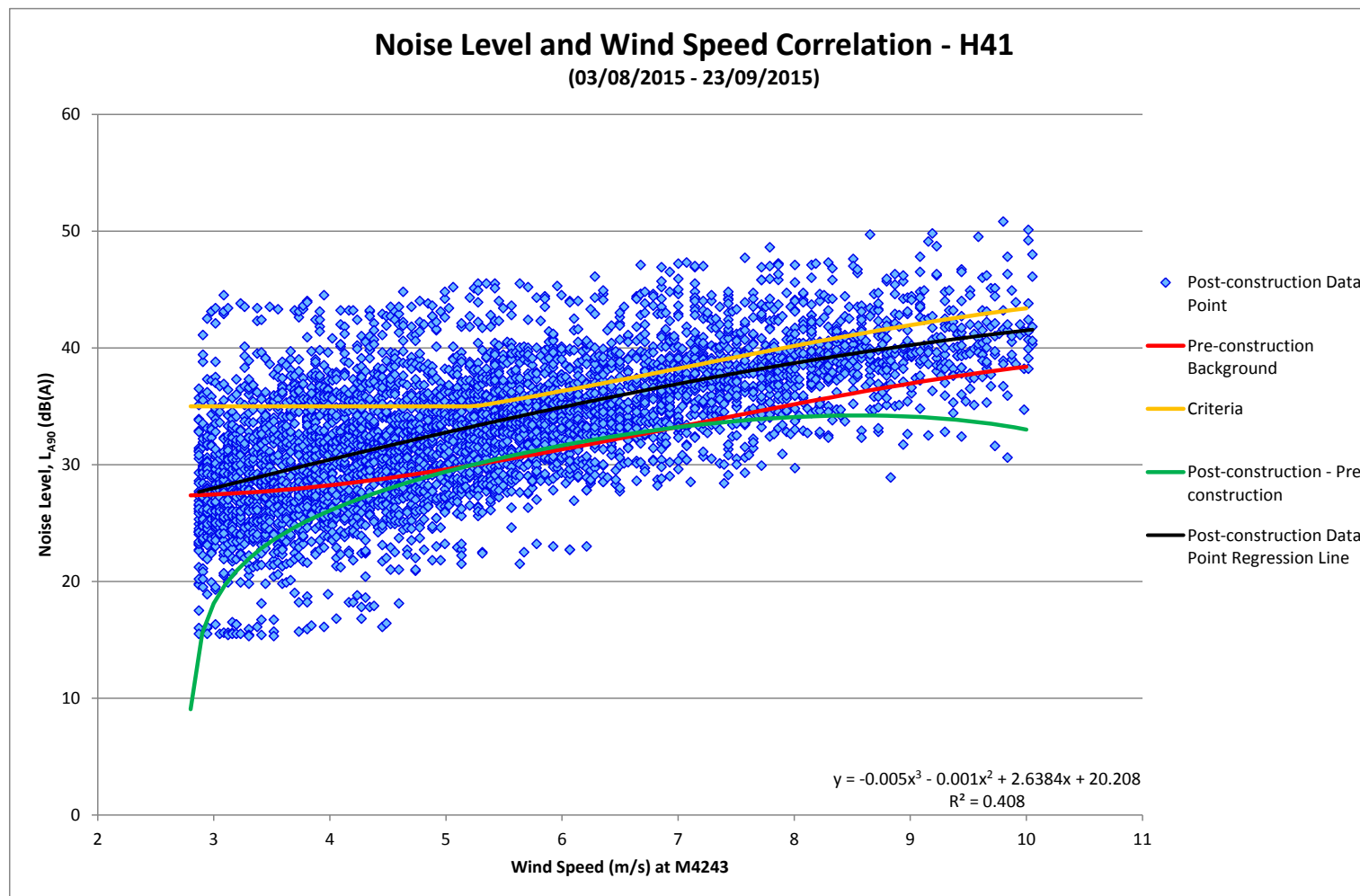
APPENDIX C: NOISE LEVEL AND WIND SPEED CORRELATIONS

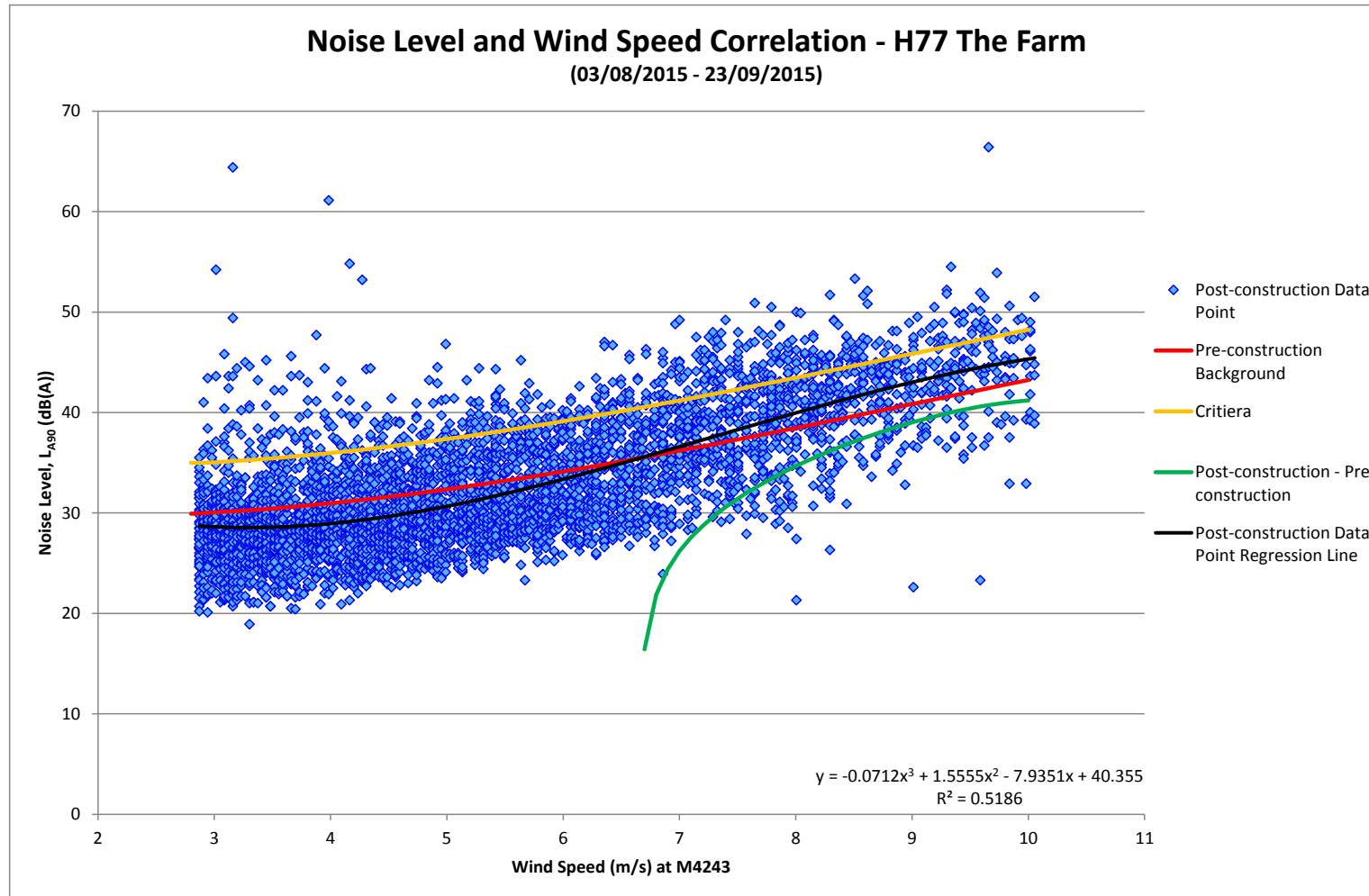




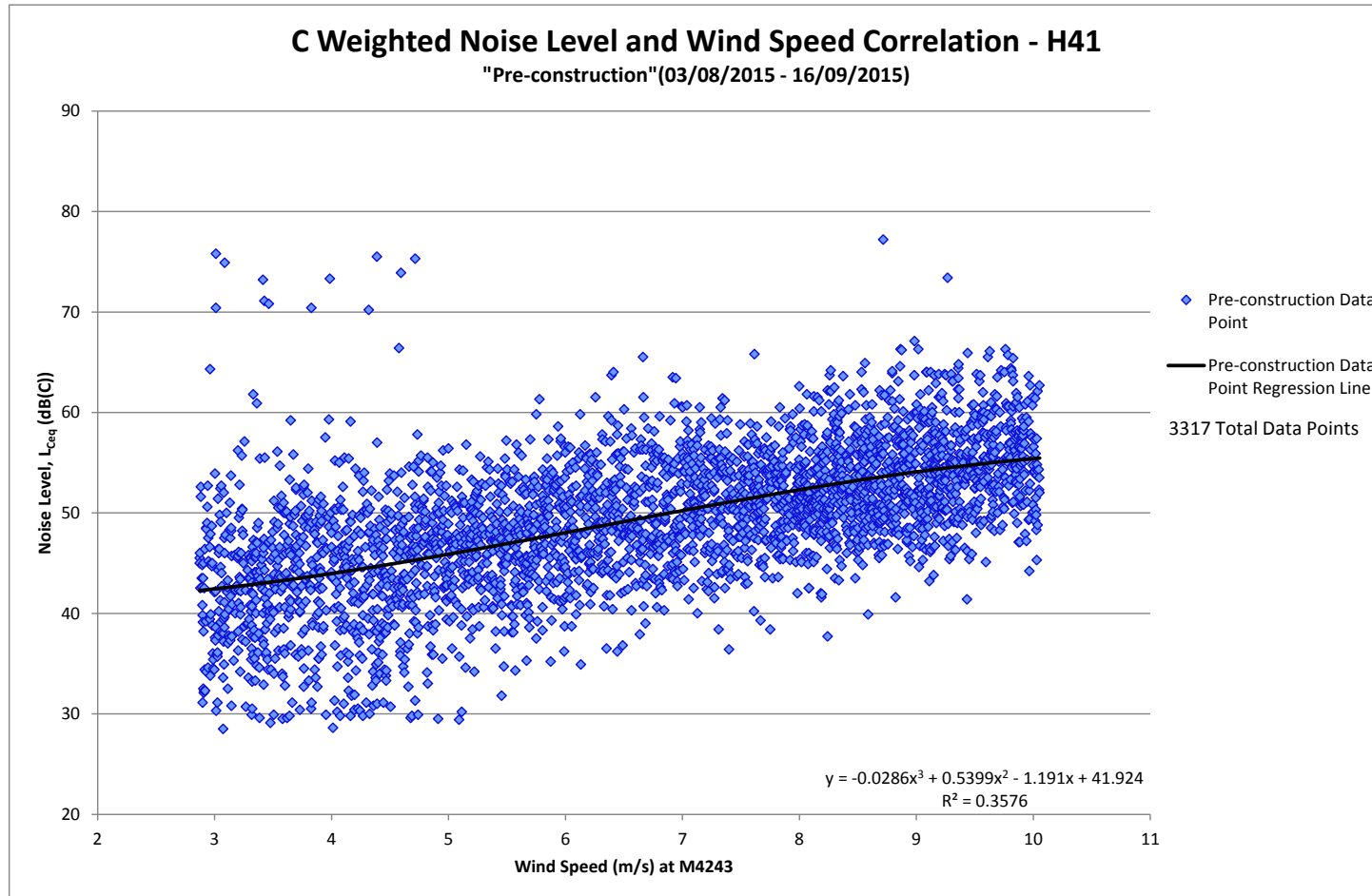


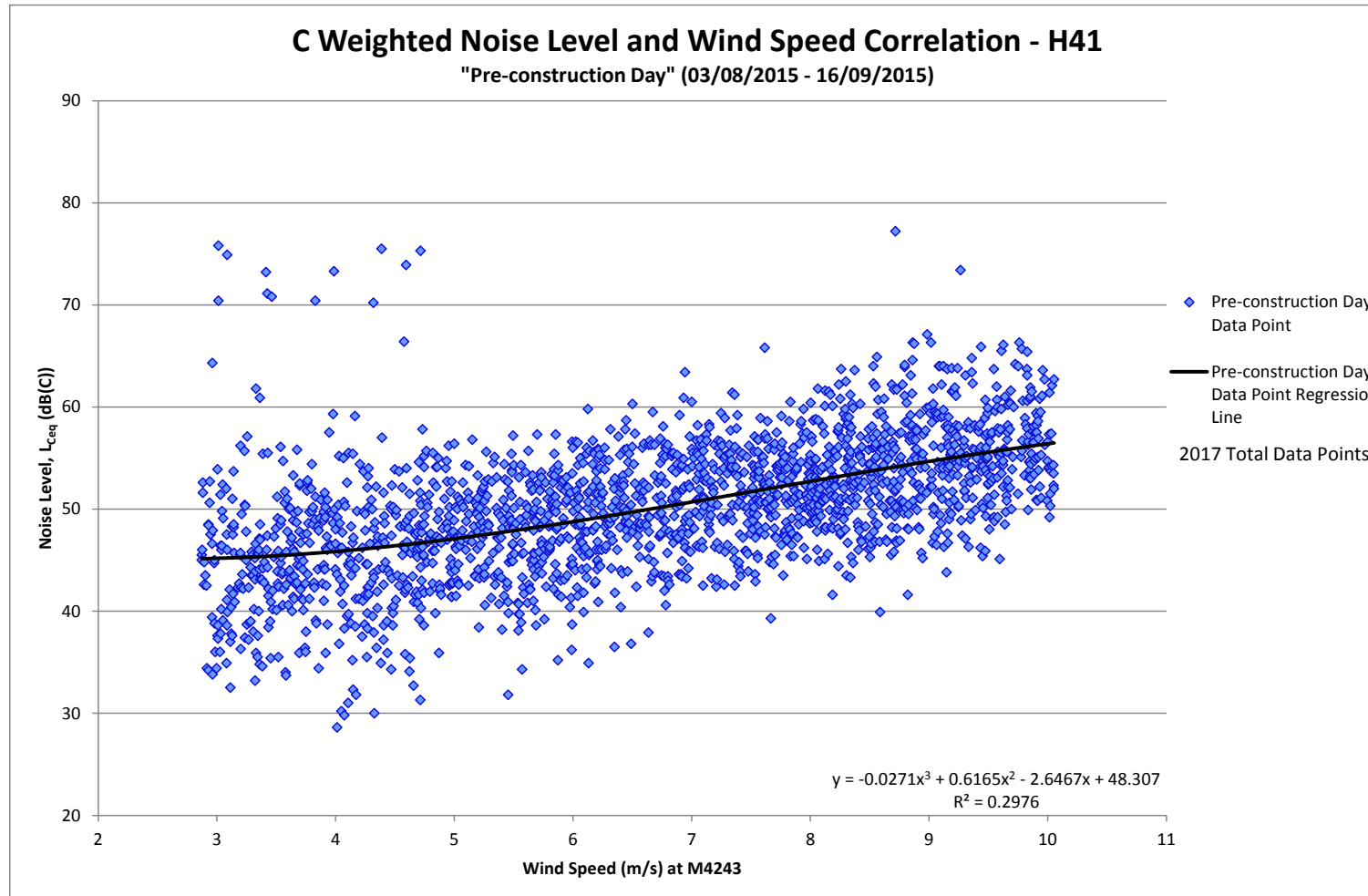


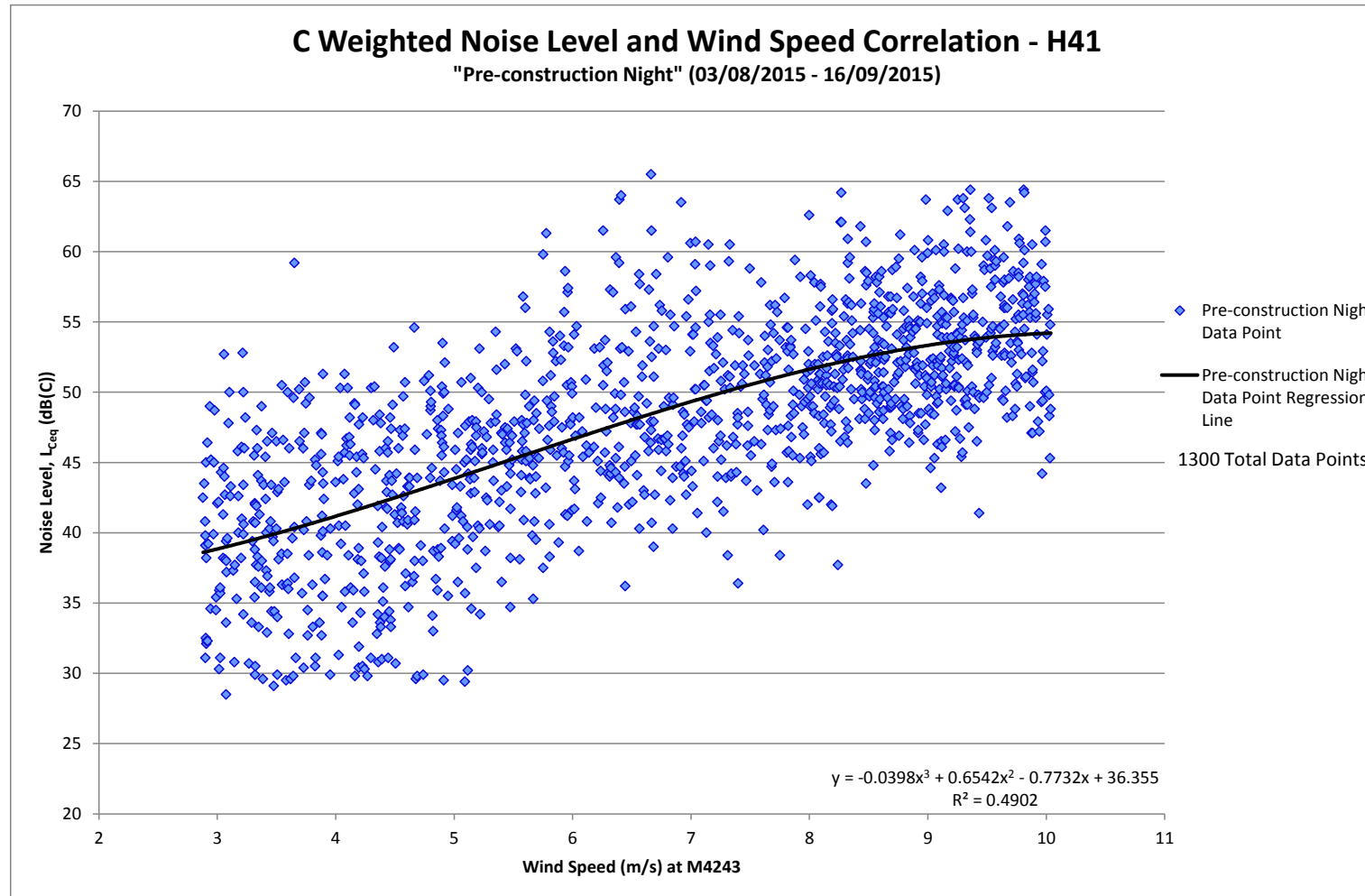


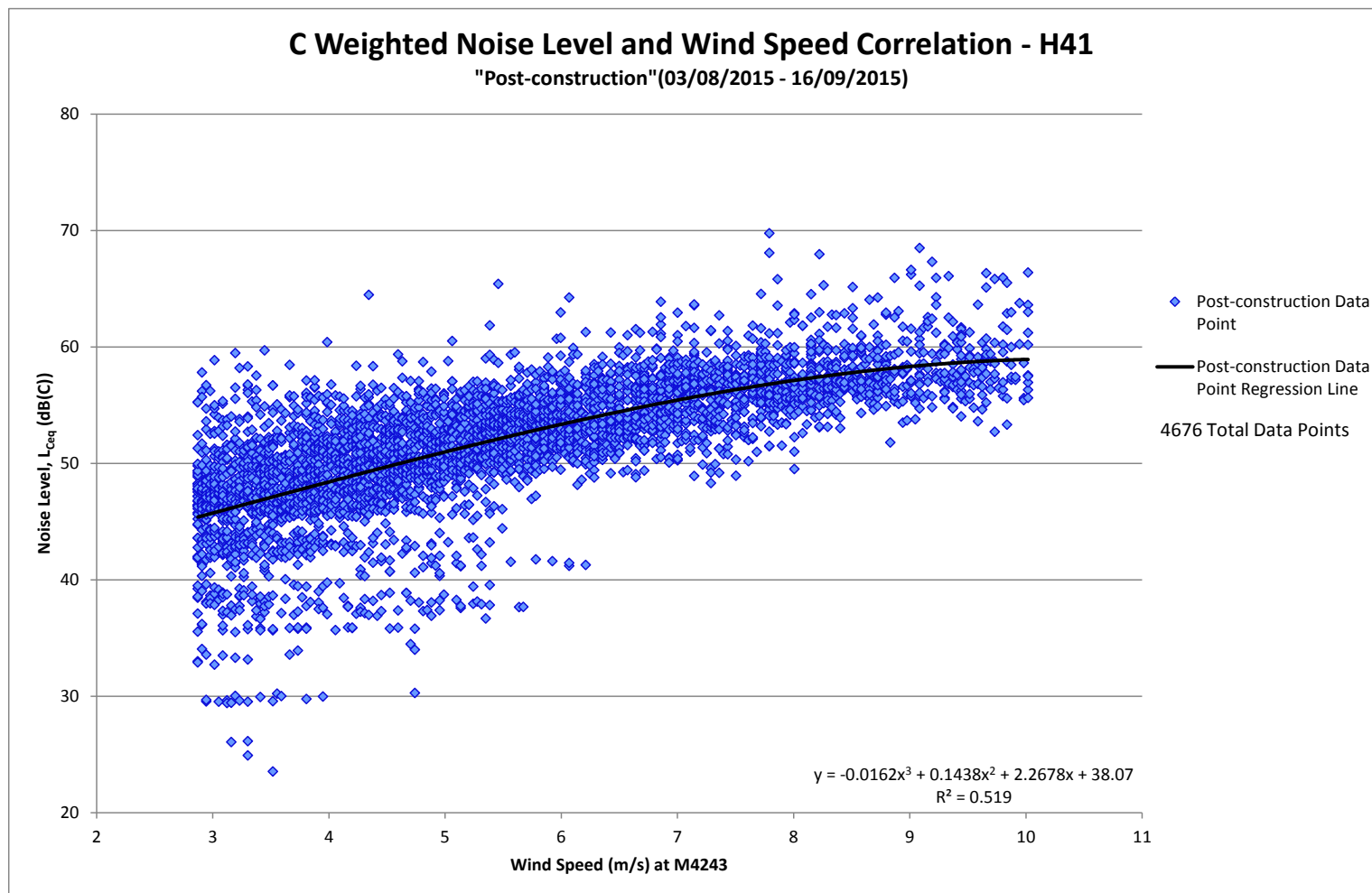


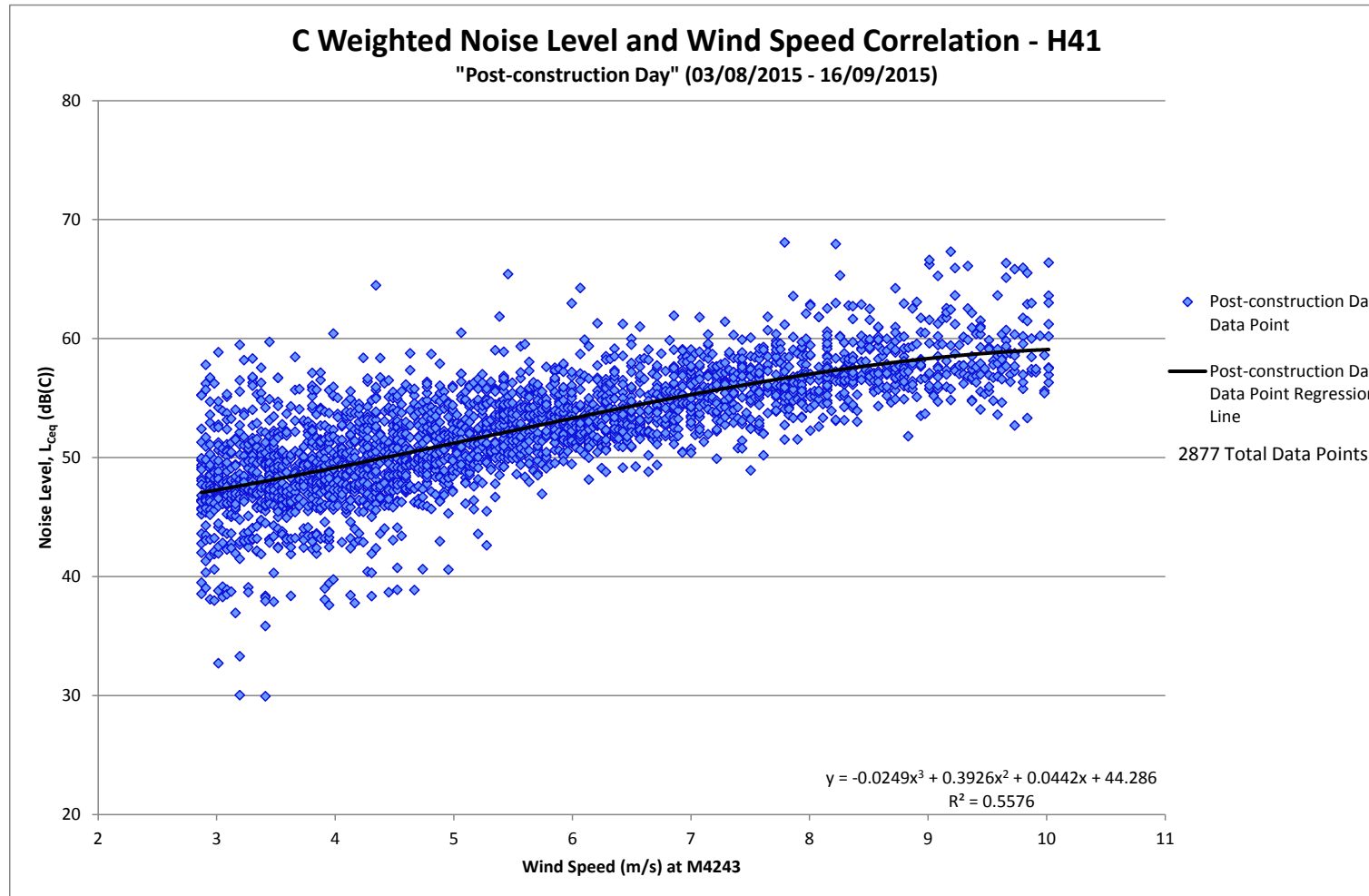
APPENDIX D: LOW FREQUENCY NOISE LEVEL AND WIND SPEED CORRELATIONS

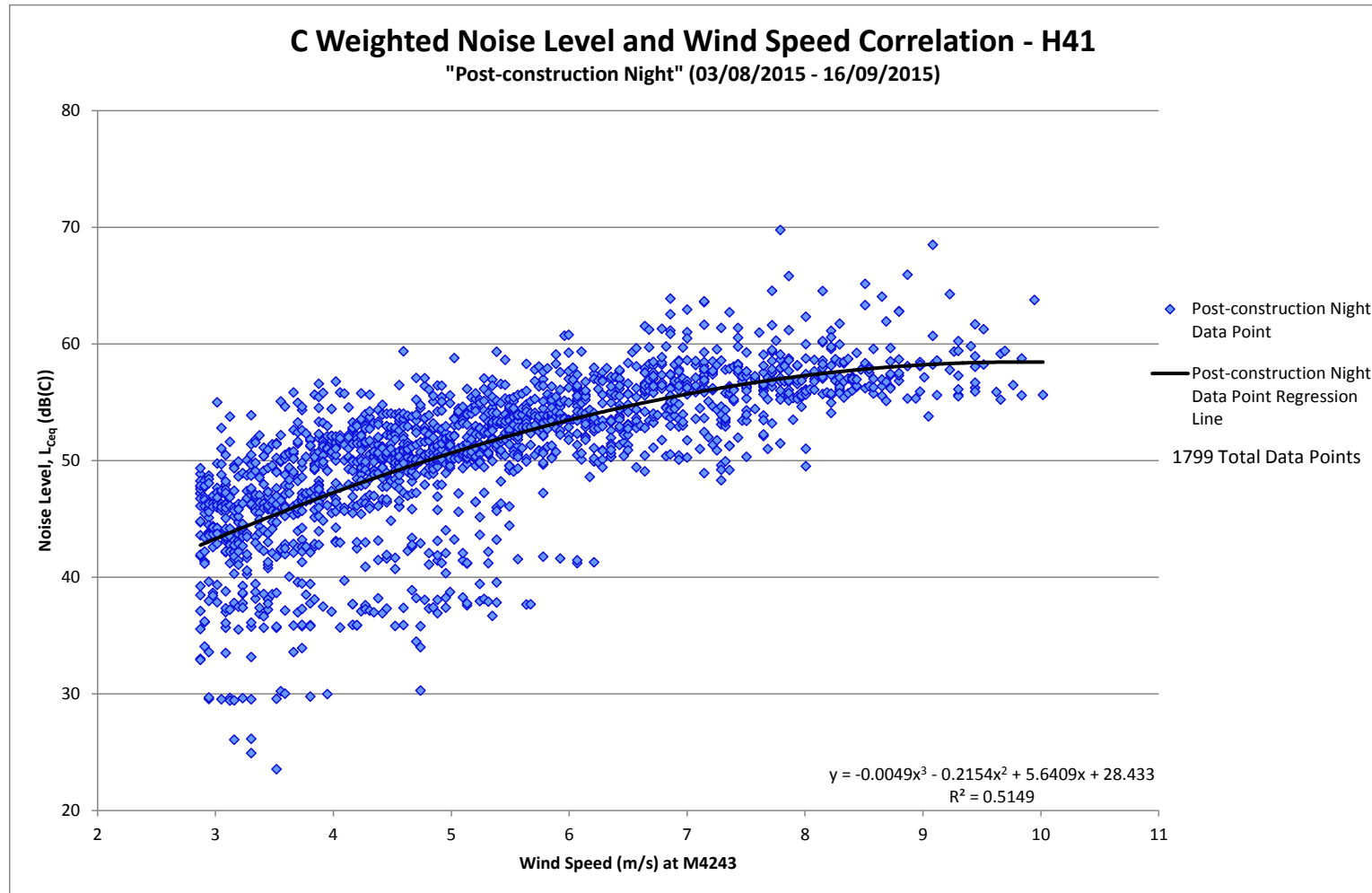














APPENDIX E: TARALGA WIND FARM: CONDITIONS OF CONSENT

41. *Prior to the commencement of construction, the Applicant must implement a monitoring program to determine the pre-existing background noise level ($L_{Aeq}^{(10 \text{ minute})}$) at each relevant receiver location specified in condition 42. The monitoring program is to be undertaken in accordance with the requirements of the SA Guidelines.*

A report prepared by a qualified acoustic consultant, who is to receive the prior approval of the Secretary, must be submitted to the Secretary and EPA and contain the results of the survey and analysis.

42. *The Applicant must design, operate and maintain the development to ensure that for each non-associated residence, while they continue to be not associated with the development, the equivalent noise level $L_{Aeq}^{(10 \text{ minute})}$ from the development at each of these receiver locations does not exceed:*
- a. 35 dB(A); or*
 - b. the pre-existing background noise level $L_{Aeq}^{(10 \text{ minute})}$ at each receiver location (as determined under condition 41), respectively, by more than 5 dB(A), whichever is the greater, for each integer wind speed (at 10m height) during operation of the development measured in accordance with the SA Guidelines.*

43. *The Applicant shall ensure that the noise generated by the operation of the substation does not exceed 35 dB(A) $L_{Aeq(15 \text{ minute})}$ at any non-associated residence. Noise generated by the project is to be assessed in accordance with the relevant requirements of the NSW Industrial Noise Policy (as may be updated from time-to-time), as modified by the provision in Attachment 6.*

However, these criteria do not apply if the Applicant has an agreement with the owner/s of the relevant residence or land to generate higher noise levels, and has advised the Department in writing of the terms of this agreement.

45. *Noise from the development is to be measured at the most affected point within the residential boundary or at the most affected point within 20 metres of the dwelling, where the dwelling is more than 20 metres from the boundary, to determine compliance with the noise level limits in conditions 42.*
46. *All noise measurements taken for the purposes of this development consent must be undertaken using microphones fitted with a special purpose wind shield such that noise*



generated by wind on the wind shield is, to the extent practicable, at least 10 dB(A) below the noise being measured and which does not influence the noise level being measured.

47. *The noise limits specified in conditions 42 do not apply to on-site residences H2, H3, H4, H6, H8, H9, H10, H11 and any additional residences whilst agreements are in place between the Applicant and the respective owners of the residences. For this condition to take effect for additional residences, the agreements must satisfy the requirements of Section 2.3 of the SA guidelines.*
48. *The presence of excessive tonality shall be measured using the methodology in ISO 1996.2: 2007 Acoustics — Description, measurement and assessment of environmental noise – Determination of environmental noise levels, and in accordance with the procedures described in Attachment 6 of this consent (Section 3.1 of this report).*
- 48A. *Low frequency noise shall be managed in accordance with the procedures described in Attachment 6 of this consent (Section 4.1 of this report).*
49. *At the relevant receiver locations of H1, H5, H7, H12 and 'The Farm', while they continue to be not associated with the development, the Applicant must, at the owner's request, provide Reasonable and Feasible ameliorative measures such that the acoustic suppression of the facade would increase the noise mitigation of the facade of that dwelling by 5 dB(A), beyond that existing at the date of the owner's request, to a maximum facade suppression effect of 15 dB(A). Any such request from an owner must be made to the Applicant no later than two (2) years after commencement of operation.*

If the Applicant and the landowner disagree on the ameliorative measures, then either party may refer the matter to the Secretary for resolution, in which case, the Applicant must carry out such ameliorative measures required by the Secretary.

52. *Within six months of operation, the Applicant must engage an independent acoustic consultant(s), who is to receive the prior approval of the Secretary, and to undertake a program of noise monitoring to test the noise emission performance of the development at the locations identified in condition 42 at times without notice to the Applicant (but only where the consent of the landowner has been provided to undertake the program).*

The program must include, but not necessarily be limited to:



- (e) *noise monitoring and assessment generally in accordance with procedures outlined in the SA Guidelines;*
- (f) *assessment of the noise performance of the development against the noise limits specified in conditions 42 and where relevant, condition 43;*
- (g) *details of any complaints received during monitoring and assessment in relation to noise generated by the proposal; and*
- (h) *recommendations and a timetable for implementation for any Reasonable and Feasible additional measures necessary to ensure compliance with the relevant noise-related conditions of this consent.*

52. *Within 28 days of undertaking the noise compliance programs referred to under condition 51 of this consent, the Applicant shall provide the Secretary, each landowner on which the program was carried out and make publicly available a report prepared by the acoustic consultant(s) on the results of the program. If the noise monitoring report identifies any non-compliance with the noise limits specified under this consent, the Applicant shall detail what additional mitigation measures would be implemented to ensure compliance, clearly indicating who would implement these measures, when these measures would be implemented, and how the effectiveness of these measures would be measured and reported to the Secretary.*

Additional mitigation measures shall include, in the first instance, all Reasonable and Feasible source control measures to reduce noise emissions from the development (such as sector management). Once all Reasonable and Feasible source controls are exhausted, mitigation measures may include offering building acoustic treatments and/ or noise screening to affected residents, but may only be used to address noise limit exceedances at the absolute discretion of the relevant landowner. The Applicant shall also demonstrate that the relevant landowner has been made fully aware of the noise levels and other implications of making any agreement

53. *Following consideration of the outcomes of the noise compliance program referred to under condition 51 of this consent, the Secretary may require the Applicant to implement additional noise mitigation, monitoring or management measures to address noise associated with the development. The Secretary may require any or all of the measures proposed by the Applicant in the noise compliance report(s), or other measures considered appropriate by the Secretary to be implemented having regard to the SA Guidelines (2003). The Applicant shall implement the measures required by the Secretary within such period as the Secretary may specify.*

53A. *In the event of:*



- (a) any complaint from any resident at a relevant receiver about noise of operating turbines being received which the Secretary considers, after investigation, to be a valid complaint, or*
- (b) after any alteration to the noise operating strategy of the development, the noise compliance testing procedure in condition 51 is to be repeated for any relevant receiver.*

The Environment Protection Licence (EPL) includes:

L3.1 Noise generated from the premises must not exceed, at the nearest non-involved residential receivers:

- (c) 35 dB(A); or*
- (d) the existing background noise level (LA90 (10-minute)), correlated to the integer wind speed at 10 metres above ground level at the wind farm site, by more than 5 dB(A), whichever is greater, for each integer wind speed (measured at 10 metres above ground level) from cut-in to rated power of the wind turbine generator when determined in accordance with the methodology provided in the Environmental Noise Guidelines: Wind Farms (South Australia EPA, 2003).*

L3.3 Notwithstanding Condition L3.1, the noise limit specified under that condition does not apply to any sensitive receiver where a noise agreement is in place between the licensee and the respective landowner(s) in relation to noise impacts and/or noise limits.

L3.4 To determine compliance with Condition L3.1, 5dB(A) must be added to measured noise levels where tonality is present. The presence of tonality must be determined using a methodology based on the modifying factor for tonality presented in Section 4 of the NSW Industrial Noise Policy (EPA, 2001).

L3.5 To determine compliance with Condition L3.1, noise from the premises must be measured at the most affected point within the residential boundary, or at the most affected point within 20 metres of the dwelling, where the dwelling is more than 20 metres from the boundary. Noise levels are determined in accordance with the methodology provided in the Environmental Noise Guidelines: Wind Farms (South Australia EPA, 2003).