Waddi Wind Farm

Background Noise Monitoring

S4802C9A

December 2023

sonus.

Sonus Pty Ltd
17 Ruthven Ave
Adelaide SA 5000
Phone: +61 (8) 8231 2100
Email: info@sonus.com.au
www.sonus.com.au

Document Title	: Waddi Wind Farm Background Noise Monitoring
Client	: Tilt Renewables
Document Reference	: S4802C9A
Date	: December 2023
Author	: Simon Moore, MAAS
Reviewer	: Chris Turnbull, MAAS

1 INTRODUCTION

Background noise monitoring has been conducted by Sonus in the vicinity of the proposed Waddi Wind Farm (the **Project**). This report provides the methodology and results of the noise monitoring. The noise monitoring was conducted during the period between 8 September 2023 and 23 November 2023.

Condition 15 of the *Notice of Planning Approval* (the **Planning Approval**) issued by the Shire of Dandaragan for the Project states that "The background noise levels for the proposed development are to be based on the pre-recorded background noise measurements (Refer to Table 16.1 of the development application)." It is proposed that Condition 15 be updated to reflect the more contemporary background noise levels stated in this report, as the original background noise measurements (referenced by Condition 15) were taken over 10-years ago.

Noise monitoring was conducted at each of the noise sensitive receptors listed in Table 16.3 of the development application (the **Compliance Locations**), as described in Condition 16 of the Planning Approval. The noise data at each of the Compliance Locations was correlated with wind speed (referenced to a hub height of 99m). Criteria have been assigned to each residence on the basis of the updated background noise levels.

2 THE ENVIRONMENTAL NOISE GUIDELINES

Condition 12 of the Planning Approval refers to the South Australian EPA *Environmental Noise Guidelines for Wind Farms* dated February 2003 (the **2003 Guidelines**). It is noted that the 2003 Guidelines have since been superseded by the SA EPA *Wind Farms Environmental Noise Guidelines*, originally issued in July 2009 and subsequently updated in November 2021 (the **2009 Guidelines**). The Western Australian Department of Planning, Lands and Heritage's *Position Statement: Renewable energy facilities* (published March 2020) states that the 2009 Guidelines should be referenced for assessment purposes. As such, the background noise monitoring and data analysis was conducted in accordance with the requirements of the 2009 Guidelines (November 2021).

3 NOISE MONITORING

Background noise monitoring was conducted at each of the five Compliance Locations between 8 September 2023 and 23 November 2023. A noise logger was positioned at the side of each dwelling facing the Project, at an equivalent distance to each dwelling as nearby major trees, and within 30m of the dwelling (in accordance with the 2009 Guidelines). The noise monitoring locations are provided in Table 1 and highlighted in Appendix A. Photographs of the noise monitoring equipment at each location are provided in Appendix B. A full list of the residence locations is provided in Appendix C.

Table 1: Noise Monitoring Locations

Measurement Location	Residence Status	Coordinates (GDA 2020 / MGA Zone 50)		Bearing from nearest turbine
		Easting	Northing	
R002	Non-Associated	365758	6609578	119°
R018a	Associated (Neighbour)	356304	6609206	275°
R035a	Non-Associated	361205	6604002	133°
R048	Associated (Neighbour)	367141	6620422	81°
R063	Non-Associated	356111	6620587	276°

3.1 Equipment

The background noise was measured continuously in 10-minute intervals using a combination of Rion Class 1 and Class 2 sound level meters with a noise floor of less than 20 dB(A), calibrated at the beginning and end of the period with a Rion NC-74 calibrator, with no significant drift observed. The microphones were positioned approximately 1.5m above ground level and fitted with Rion WS-15 double layer all weather windshields. Details of the noise logging equipment is shown in Table 2.

Table 2: Noise Logging Equipment

Measurement Location	Make and Model	Serial Number
R002	*Rion NL-52A* *Rion NL-42A*	00331166 00923595
R018a	*Rion NL-52*	00520898
R035a	*Rion NL-42A*	01224054
R048	*Rion NL-52*	00598175
R063	*Rion NL-52A*	00331168

Local wind speed conditions were measured at 1-minute intervals using *Rainwise* wind loggers positioned at two locations around the Project site, as summarised in Table 3. Rainfall data were obtained from the nearest Bureau of Meteorology (**BOM**) weather station, at Badgingarra Research Station.

Table 3: Local Weather Monitoring Locations

Measurement Location	Equipment Type	Coordinates (GDA 2020 / MGA Zone 50)		Measurement Period	
		Easting	Northing	Start	End
R048	*Rainwise* Wind	367099	6620496	8/9/2023	25/10/2023
R035a	*Rainwise* Wind	361169	6603988	8/9/2023	25/10/2023
R002	*Rainwise* Wind	365691	6609624	25/10/2023	23/11/23

An example of typical on-site setup for noise and weather monitoring is shown in Figure 1 and Figure 2.

Figure 1: Typical Noise Monitoring Equipment Setup

Figure 2: Typical Local Wind Monitoring Equipment Setup

3.2 Hub Height Wind Speed

During the background noise monitoring period, the wind speed was measured in 10-minute intervals at the Project site referenced to a hub height of 99m before being provided to Sonus. Table 4 provides the location of the wind measurement mast. The location is also shown in Appendix A.

Table 4: Wind Measurement Location

Measurement Location	Equipment Type	Coordinates (GDA 2020 / MGA Zone 50)	
		Easting	Northing
WAD02	Mast	359693	6608906

3.3 Data Analysis

The rainfall and local wind speed data were used to determine the periods where local weather (at ground level adjacent to the noise loggers) may have affected the background noise measurements. Data were excluded where rainfall was present in a 10-minute measurement period (and each of the 10-minute periods either side of this were also excluded), and/or where the measured wind speed at the microphone height exceeded 5m/s for more than 90% of the measurement period. The weather conditions at the nearest weather monitoring location have been taken as representative at other monitoring locations.

Typically, data for wind speeds below the cut-in wind speed and above the rated power of the turbine would also be removed, however, the cut-in wind speed and wind speed at rated power of the turbine is still to be confirmed. For the purposes of this report, wind speeds greater than 3m/s and less than 13m/s (inclusive) have been considered. Additionally, data points where equipment was being set up or collected have also been removed. Intermittent noise sources, such as the noise from dogs barking or passing cars, have a negligible effect as the measured $L_{A90,10min}$ considers only the level of noise that is exceeded for 90% of the 10-minute time period (and as such these noise sources are inherently excluded).

Following the data filtering procedure described above, the number of data points remaining for each of the monitoring locations are shown in Table 5.

Table 5: Data Points at each Monitoring Location

Measurement Location	Data points	Data points after filtering	Downwind points	Downwind points after filtering
R002	7009	6084	2974	2610
R018a	5997	5397	1636	1462
R035a	5997	5392	2098	1992
R048	5794	5202	1251	1081
R063	5998	5357	1630	1416

Table 5 shows that the 2000 data points and 500 downwind points, required by the 2009 Guidelines, were collected at each of the measurement locations.

3.4 Background Noise Correlation

The filtered background noise data collected at each monitoring location were correlated with the hub height wind speed for each 10-minute monitoring period.

The data were then sorted and averaged into 1m/s wide wind speed bins in accordance with the 2009 Guidelines. The data and the average noise levels for each integer wind speed are shown in the figures in Appendix D.

Table 6 summarises the background noise level for each integer wind speed at a hub height of 99m between 3m/s and 13m/s.

Table 6: Background Noise Levels ($L_{A90,10min}$) at Monitoring Locations

Measurement Location	Background Noise Level for Hub Height (99m) Wind Speed Bins [dB(A)]										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
R002	27	28	29	31	32	33	34	35	38	41	44
R018a	24	24	26	27	28	29	30	34	37	41	43
R035a	25	26	27	28	30	30	29	31	31	32	33
R048	23	24	26	28	29	30	30	32	35	37	38
R063	26	26	29	30	30	30	29	30	30	32	33

4 WIND TURBINE CRITERIA

The noise limits for the Project at each Compliance Location and integer wind speed were determined based on Condition 13 and Condition 14 of the Planning Approval, that being:

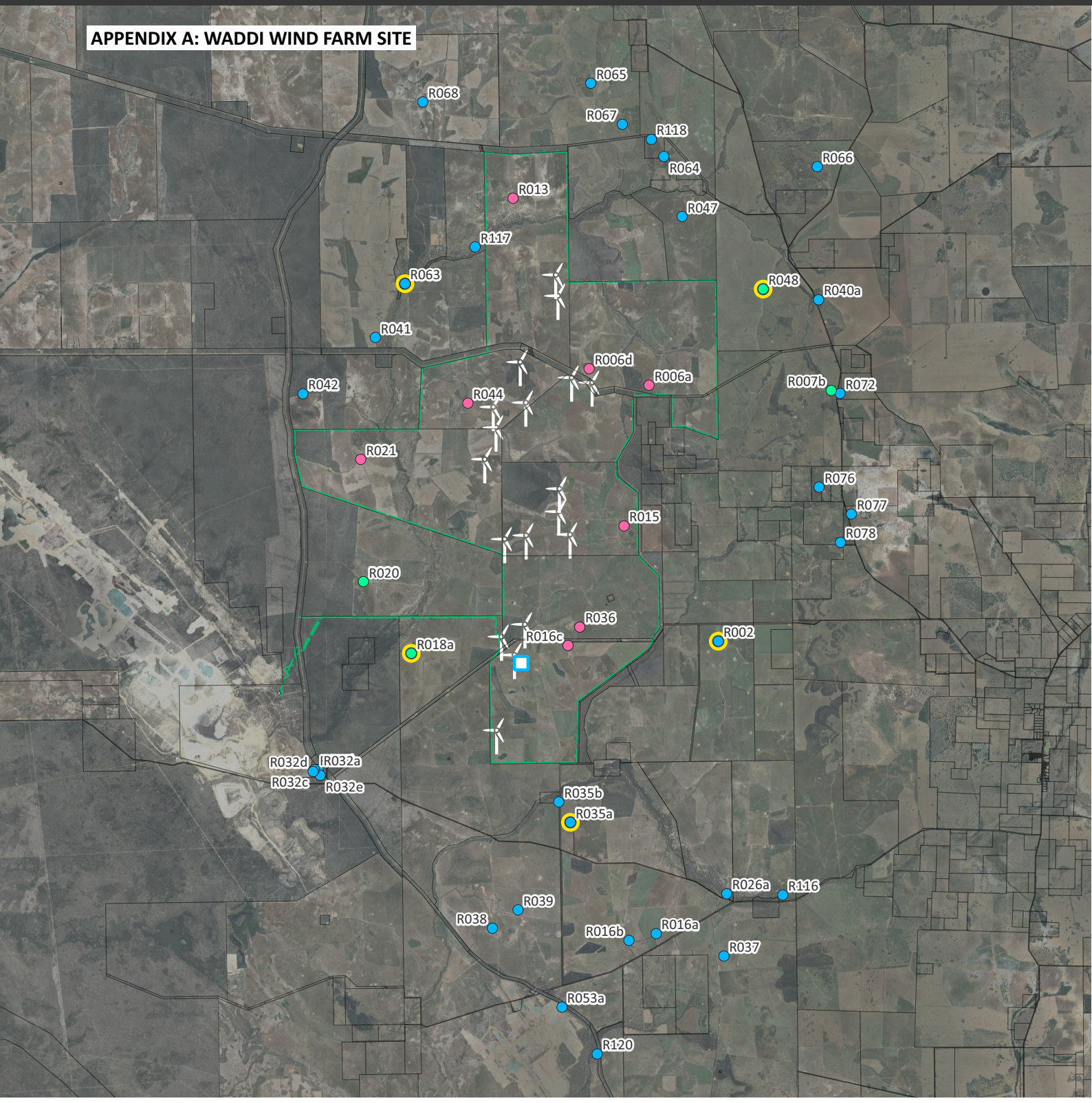
- For dwellings in which an agreement has been made with the respective landowner (**Associated** dwellings), and for dwellings within the Project boundary: 45 dB(A) or 5 dB(A) above background noise level, whichever is the greater.
- For dwellings outside the Project boundary, for which an agreement has not been made with the respective landowner (**Non-Associated** dwellings): 35 dB(A) or 5 dB(A) above background noise level, whichever is the greater.

For dwellings where background noise monitoring was not conducted, the background monitoring location that best represents the dwelling, when considering factors such as separation distance, orientation from the Project, elevation, and level of vegetation, has been selected. The representative monitoring location for each dwelling can be seen in Appendix C. Based on the background noise measurements, applicable criteria have been determined for both Associated and Non-Associated dwellings based on the representative monitoring locations. The resultant criteria can be seen in Appendix E.

Waddi Wind Farm
Background Noise Monitoring
S4802C9A
December 2023

sonus.

APPENDIX A: WADDI WIND FARM SITE



Map Data ©2023 Google, Image ©2023 CNES / Airbus, Image ©2023 Airbus, Image ©2023 Maxar Technologies

Legend

- Site Boundary
- Wind Mast
- Monitoring Location
- Associated (Host)
- Associated (Neighbour)
- Non-Associated

N

0 1,500 3,000 m

APPENDIX B: PHOTOGRAPHS OF MONITORING EQUIPMENT

Appendix B.1: Dwelling R002 Monitoring Equipment

Appendix B.2: Dwelling R018a Monitoring Equipment

Appendix B.3: Dwelling R035a Monitoring Equipment

Appendix B.4: Dwelling R048 Monitoring Equipment

Appendix B.5: Dwelling R063 Monitoring Equipment

APPENDIX C: RESIDENCE LOCATIONS

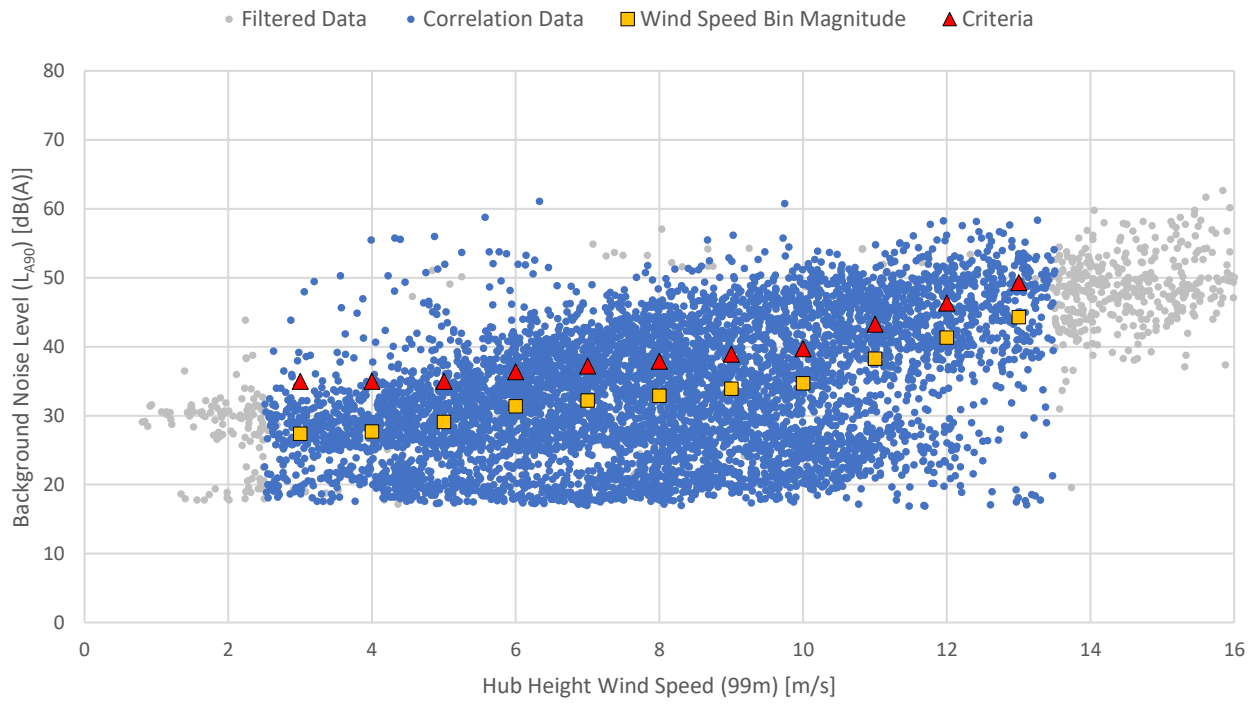
Residence ID*	Coordinates (GDA 2020 / MGA Zone 50)		Status	Nearest Logging Location
	Easting	Northing		
R002	365758	6609578	Non-Associated	R002
R015	362858	6613128	Associated (Host)	R002
R016c	361132	6609447	Associated (Host)	R002
R036	361493	6610013	Associated (Host)	R002
R076	368864	6614324	Non-Associated	R002
R077	369858	6613494	Non-Associated	R002
R078	369522	6612622	Non-Associated	R002
R018a	356304	6609206	Associated (Neighbour)	R018a
R020	354831	6611415	Associated (Neighbour)	R018a
R032a	353433	6605629	Non-Associated	R018a
R032b	353324	6605623	Non-Associated	R018a
R032c	353292	6605597	Non-Associated	R018a
R032d	353284	6605566	Non-Associated	R018a
R032e	353501	6605451	Non-Associated	R018a
R016a	363846	6600574	Non-Associated	R035a
R016b	363008	6600365	Non-Associated	R035a
R026a	366020	6601801	Non-Associated	R035a
R035a	361205	6604002	Non-Associated	R035a
R035b	360847	6604630	Non-Associated	R035a
R037	365933	6599884	Non-Associated	R035a
R038	358805	6600740	Non-Associated	R035a
R039	359593	6601306	Non-Associated	R035a
R053a	360947	6598311	Non-Associated	R035a
R116	367744	6601763	Non-Associated	R035a
R120	362029	6596869	Non-Associated	R035a
R006a	363626	6617461	Associated (Host)	R048
R006d	361782	6617970	Associated (Host)	R048
R007b	369256	6617399	Associated (Neighbour)	R048
R040a	368848	6620093	Non-Associated	R048
R047	364644	6622657	Non-Associated	R048

Residence ID*	Coordinates (GDA 2020 / MGA Zone 50)		Status	Nearest Logging Location
	Easting	Northing		
R048	367141	6620422	Associated (Neighbour)	R048
R064	364083	6624504	Non-Associated	R048
R065	361832	6626758	Non-Associated	R048
R066	368807	6624191	Non-Associated	R048
R067	362806	6625495	Non-Associated	R048
R072	369557	6617214	Non-Associated	R048
R118	363698	6625031	Non-Associated	R048
R013	359438	6623217	Associated (Host)	R063
R021	354748	6615178	Associated (Host)	R063
R041	355200	6618931	Non-Associated	R063
R042	352970	6617197	Non-Associated	R063
R044	358048	6616908	Associated (Host)	R063
R063	356111	6620587	Non-Associated	R063
R068	356661	6626184	Non-Associated	R063
R117	358270	6621722	Non-Associated	R063

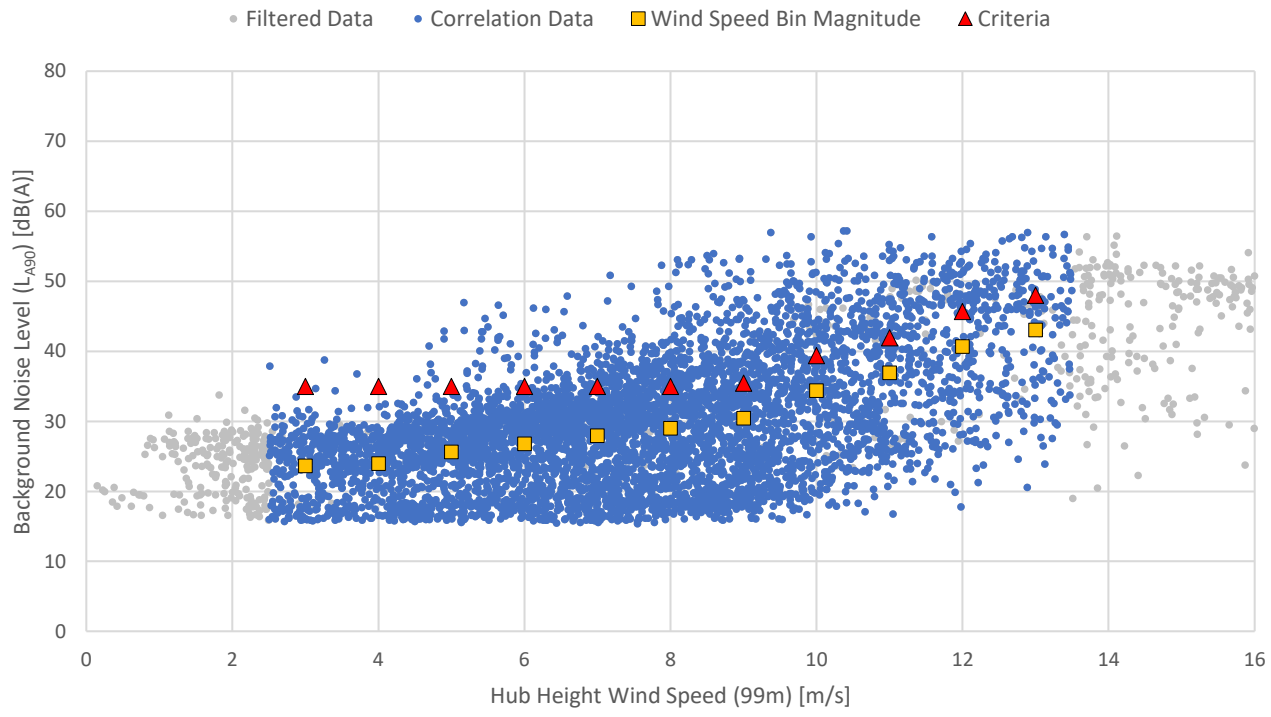
** All of the residence IDs included in this report are the 'IDCode' specified in the data provided to Sonus (including zero padding)*

APPENDIX D: BACKGROUND NOISE AND WIND SPEED CORRELATION GRAPHS

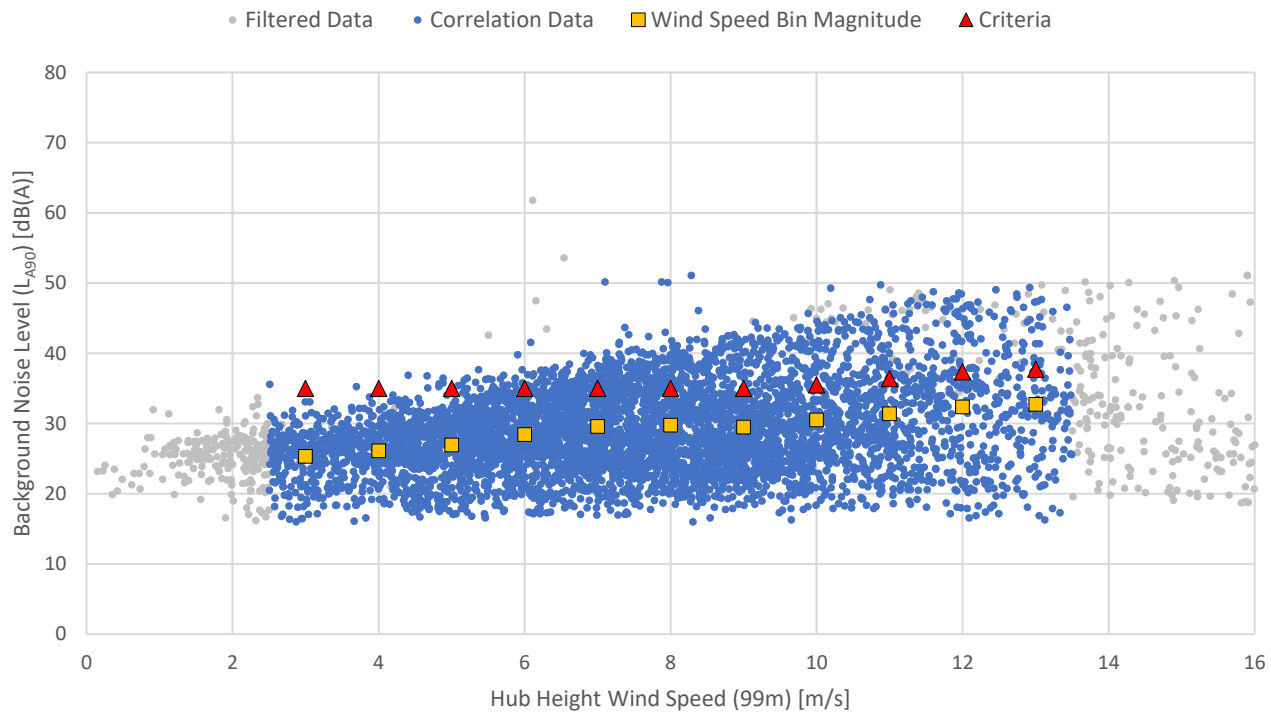
Appendix D.1: Dwelling R002 Correlation Graph



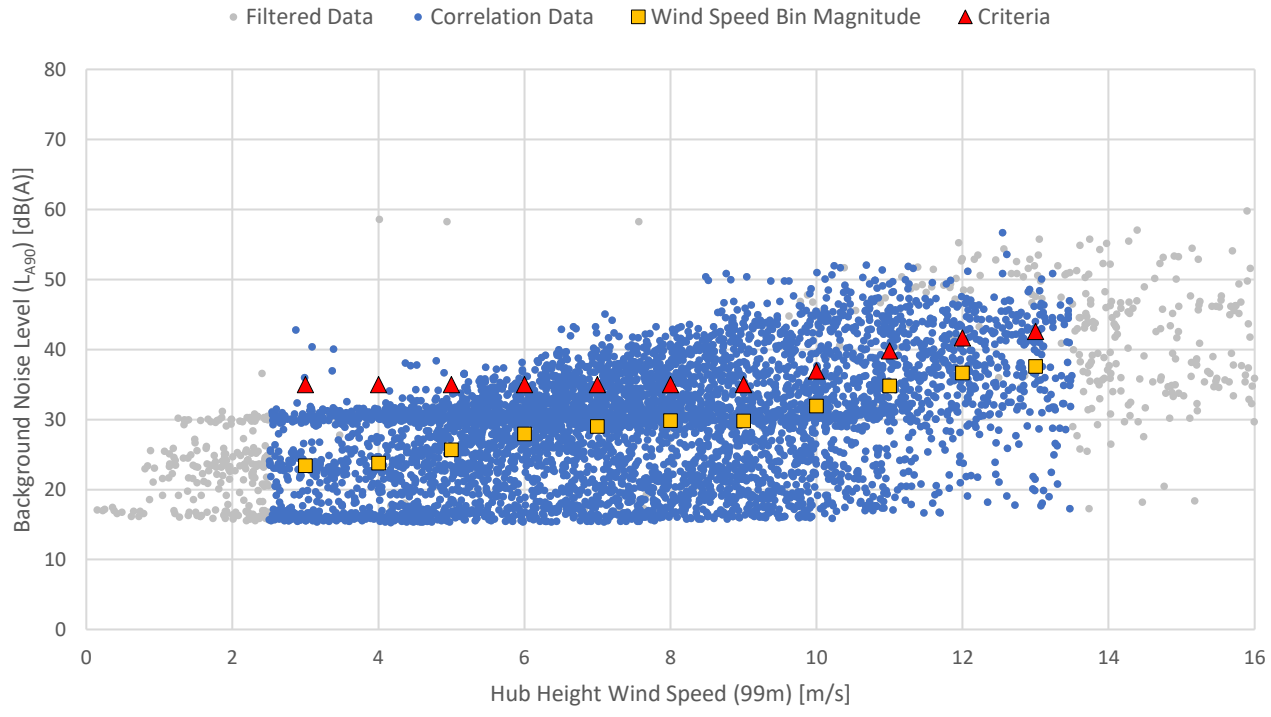
Appendix D.2: Dwelling R018a Correlation Graph



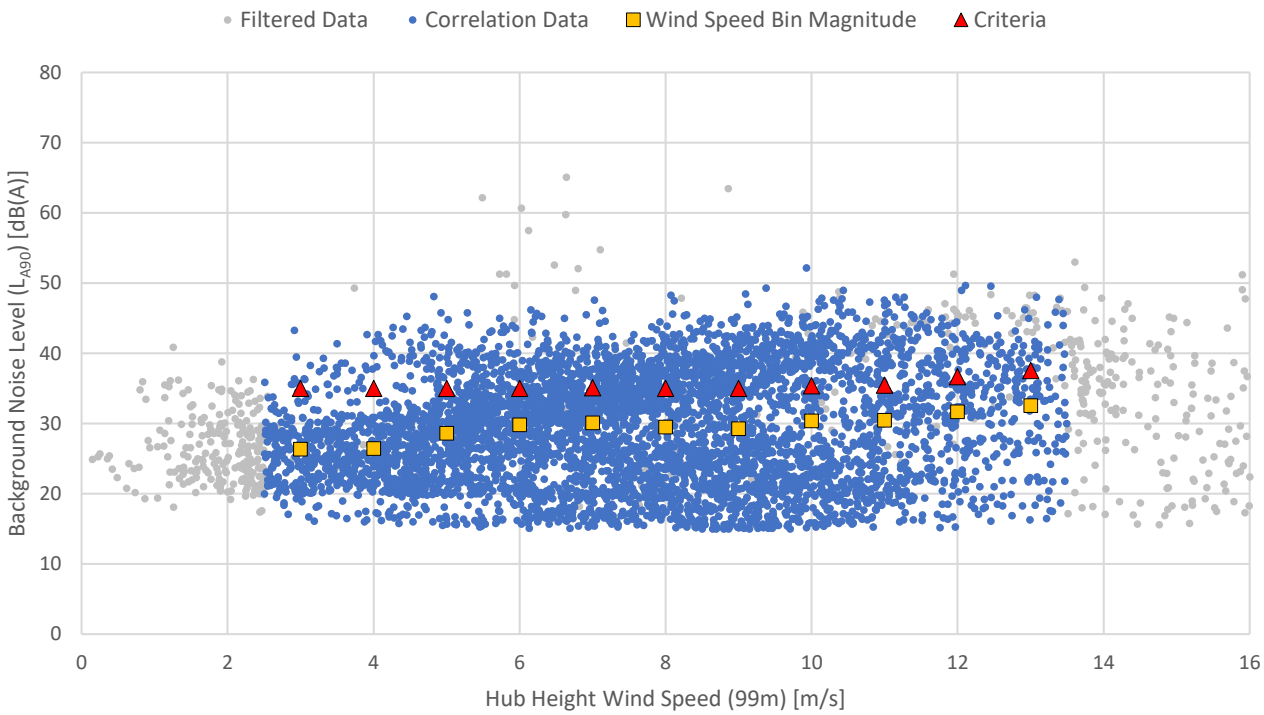
Appendix D.3: Dwelling R035a Correlation Graph



Appendix D.4: Dwelling R048 Correlation Graph



Appendix D.5: Dwelling R063 Correlation Graph



APPENDIX E: NOISE CRITERIA

ID Code	Receptor Status	Nearest Logging Location	Noise Criterion [dB(A)] at Integer Wind Speeds (m/s)										
			3	4	5	6	7	8	9	10	11	12	13
R006a	Host - Associated	R048	45	45	45	45	45	45	45	45	45	45	45
R006d	Host - Associated	R048	45	45	45	45	45	45	45	45	45	45	45
R013	Host - Associated	R063	45	45	45	45	45	45	45	45	45	45	45
R015	Host - Associated	R002	45	45	45	45	45	45	45	45	45	46	49
R016c	Host - Associated	R002	45	45	45	45	45	45	45	45	45	46	49
R021	Host - Associated	R063	45	45	45	45	45	45	45	45	45	45	45
R036	Host - Associated	R002	45	45	45	45	45	45	45	45	45	46	49
R044	Host - Associated	R063	45	45	45	45	45	45	45	45	45	45	45
R007b	Neighbour - Associated	R048	45	45	45	45	45	45	45	45	45	45	45
R018a	Neighbour - Associated	R018a	45	45	45	45	45	45	45	45	45	46	48
R020	Neighbour - Associated	R018a	45	45	45	45	45	45	45	45	45	46	48
R048	Neighbour - Associated	R048	45	45	45	45	45	45	45	45	45	45	45
R002	Non-Associated	R002	35	35	35	36	37	38	39	40	43	46	49
R016a	Non-Associated	R035a	35	35	35	35	35	35	35	36	36	37	38
R016b	Non-Associated	R035a	35	35	35	35	35	35	35	36	36	37	38
R026a	Non-Associated	R035a	35	35	35	35	35	35	35	36	36	37	38
R032a	Non-Associated	R018a	35	35	35	35	35	35	35	39	42	46	48
R032b	Non-Associated	R018a	35	35	35	35	35	35	35	39	42	46	48
R032c	Non-Associated	R018a	35	35	35	35	35	35	35	39	42	46	48
R032d	Non-Associated	R018a	35	35	35	35	35	35	35	39	42	46	48
R032e	Non-Associated	R018a	35	35	35	35	35	35	35	39	42	46	48
R035a	Non-Associated	R035a	35	35	35	35	35	35	35	36	36	37	38
R035b	Non-Associated	R035a	35	35	35	35	35	35	35	36	36	37	38
R037	Non-Associated	R035a	35	35	35	35	35	35	35	36	36	37	38
R038	Non-Associated	R035a	35	35	35	35	35	35	35	36	36	37	38
R039	Non-Associated	R035a	35	35	35	35	35	35	35	36	36	37	38

ID Code	Receptor Status	Nearest Logging Location	Noise Criterion [dB(A)] at Integer Wind Speeds (m/s)										
			3	4	5	6	7	8	9	10	11	12	13
R040a	Non-Associated	R048	35	35	35	35	35	35	35	37	40	42	43
R041	Non-Associated	R063	35	35	35	35	35	35	35	35	35	37	38
R042	Non-Associated	R063	35	35	35	35	35	35	35	35	35	37	38
R047	Non-Associated	R048	35	35	35	35	35	35	35	37	40	42	43
R053a	Non-Associated	R035a	35	35	35	35	35	35	35	36	36	37	38
R063	Non-Associated	R063	35	35	35	35	35	35	35	35	35	37	38
R064	Non-Associated	R048	35	35	35	35	35	35	35	37	40	42	43
R065	Non-Associated	R048	35	35	35	35	35	35	35	37	40	42	43
R066	Non-Associated	R048	35	35	35	35	35	35	35	37	40	42	43
R067	Non-Associated	R048	35	35	35	35	35	35	35	37	40	42	43
R068	Non-Associated	R063	35	35	35	35	35	35	35	35	35	37	38
R072	Non-Associated	R048	35	35	35	35	35	35	35	37	40	42	43
R076	Non-Associated	R002	35	35	35	36	37	38	39	40	43	46	49
R077	Non-Associated	R002	35	35	35	36	37	38	39	40	43	46	49
R078	Non-Associated	R002	35	35	35	36	37	38	39	40	43	46	49
R116	Non-Associated	R035a	35	35	35	35	35	35	35	36	36	37	38
R117	Non-Associated	R063	35	35	35	35	35	35	35	35	35	37	38
R118	Non-Associated	R048	35	35	35	35	35	35	35	37	40	42	43
R120	Non-Associated	R035a	35	35	35	35	35	35	35	36	36	37	38