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Bloomfield Colliery

Quarterly Noise Monitoring and Compliance Assessment

December 2016

Report Number Q64 630.01053

17 February 2017

Bloomfield Collieries

Four Mile Creek Road

Ashtonfield NSW 2323

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Quarterly Noise Monitoring and Compliance Assessment

December 2016

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1 INTRODUCTION

Bloomfield Collieries Pty Ltd (Bloomfield) has commissioned SLR Consulting Australia Pty Ltd (SLR) to conduct daytime, evening and night-time noise monitoring for the Bloomfield Colliery in accordance with the Project Approval requirements set by the Department of Planning and Infrastructure (DP&I). This noise monitoring has been conducted in conjunction with the December 2016 quarterly monitoring for Abel and Donaldson Coal Mines (refer SLR Report Q64 630.01053-R1).

The objectives of the noise monitoring survey for this quarter were as follows:

- Measure the ambient noise levels at five noise sensitive locations surrounding the colliery during the daytime, evening and night-time period. Noise surveys comprising of both unattended, continuous noise monitoring and operator attended monitoring were conducted.
- Qualify all sources of noise within each of the attended surveys, including estimated contribution or maximum level of the individual noise sources.
- Assess the noise emissions of Bloomfield Colliery and determine compliance with respect to the Consent Conditions contained in the Project Approval.

1.1 Acoustic Terminology

The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

2 PROJECT APPROVAL AND CONSENT CONDITIONS

Bloomfield Colliery Project Approval 07_0087

Project Approval was granted on 3 September 2009 for the Bloomfield Project (PA 07_0087). On 16 May 2011, the approval was granted for a modification to the Approval in accordance with Section 75W of the Environmental Planning and Assessment Act 1979.

Approved Operations

PA 07_0087 allows Bloomfield to:

- Extract up to 1.3 Million tonnes per annum (Mtpa) of run-of-mine (ROM) coal for 12 years.
- Transport this coal to the existing Bloomfield Coal Handling and Preparation Plant (CHPP).
- Progressively rehabilitate the site.

The 2011 modified approval subsequently allows Bloomfield to:

- Relocate the mine's power supply infrastructure.
- Establish a new haul road.
- Manage the mine's out-of-pit overburden emplacement requirements and improve on-site rehabilitation outcomes.

It is noted that the Bloomfield CHPP is consented under the Abel Coal Mine Project Approval.

Consent Conditions

The relevant conditions relating to noise from the PA 07_0087 are reproduced below.

Schedule 3 NOISE

Noise Impact Assessment Criteria

The Proponent shall ensure that the noise generated by the project does not exceed the noise impact assessment criteria in ***Table 1****.*

Table 1 Operator Noise Impact Assessment Criteria

Morning Shoulder	***Day***	***Evening***	***Night***		***Location and Locality***	
$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{A1(1min)}$		
40	35	35	35	45	E	Browns Road, Black Hill
42	35	35	35	45	F	Black Hill Road, Black Hill
43	39	42	37	45	G	Buchanan Road, Buchanan
35	35	35	35	45	H	Mt Vincent Road, Louth Park
35	35	35	35	45	L	Kilshanny Avenue, Ashtonfield
48	39	39	37	46	M	John Renshaw Drive, Buttai
43	42	42	35	46	N	Lings Road, Buttai

Notes

- *To interpret the locations in Table 1, see Appendix 2.*
- *The limits in Table 1 are to apply under meteorological conditions of up to 3 m/s at 10 m above ground level, excluding F and G class inversions as described in the NSW Industrial Noise Policy.*

However, if the Proponent has a written negotiated noise agreement with the landowner of any land, and a copy of this agreement has been forwarded to the Department and DECC, then the Proponent may exceed the noise limits in Table 1 on that land in accordance with the negotiated noise agreement.

Cumulative Noise Criteria

2. The Proponent shall take all reasonable and feasible measures to ensure that the noise generated by the project combined with the noise generated by other mines does not exceed the following amenity criteria at any residence on, or on more than 25 percent of, any privately owned land:

- *LAeq(11 hour) 50 dB(A) – Day;*
- *LAeq(4 hour) 45 dB(A) – Evening; and*
- *LAeq(9 hour) 40 dB(A) – Night.*

Continuous Improvement

3. The Proponent shall:

(a) implement all reasonable and feasible noise mitigation measures;

(b) investigate ways to reduce the noise generated by the project; and

(c) report on these investigations and the implementation and effectiveness of these measures in the AEMR, to the satisfaction of the Director-General.

Monitoring

4. The Proponent shall prepare and implement a Noise Monitoring Program for the project to the satisfaction of the Director-General.

The Program must:

(a) be prepared in consultation with DECC and be submitted to the Director-General for approval within 6 months of the date of this approval; and

(b) include:

- *a combination of unattended and attended monitoring measures; and*
- *a noise monitoring protocol for evaluating compliance with the noise impact assessment criteria in this approval.*

Statement of Commitments

11. Noise Management and Monitoring

A Noise Management Plan shall be prepared and implemented for the project. The Plan will include mitigation and monitoring requirements for the project.

3 NOISE MONITORING METHODOLOGY

3.1 General Requirements

The operational noise monitoring program was conducted with reference to PA 07_0087, and in accordance with SLR Report 630.01573-R3R1 dated 16 September 2011 (*Bloomfield Coal Project Noise Monitoring Program)* and AS 1055:1997 *Acoustics - Description and Measurement of Environmental Noise*.

3.2 Monitoring Locations

Significant noise modelling and monitoring has been conducted for the seven locations identified within **Table 1** of the consent conditions. With the experience of this previous work, five noise monitoring locations have been identified to represent the potentially most affected receivers of noise emissions from Bloomfield Colliery operations. The details of the monitoring locations are given in **Table 2**.

Table 2 Noise Monitoring Locations

Noise Monitoring Location	Description
F	Lot 684 Black Hill Road, Black Hill
G	156 Buchanan Road, Buchanan
L	Kilshanny Avenue, Ashtonfield
M	John Renshaw Drive, Buttai
N	Lings Road, Buttai

A site map identifying the assessment and noise monitoring locations is presented in **Appendix B**.

3.3 Unattended Continuous Noise Monitoring

An environmental noise logger was deployed for a minimum of a seven day period between 16 December 2016 and 23 December 2016 at each of the five nominated locations given in **Table 2**. All unattended monitoring equipment was programmed to continuously record statistical noise level indices in 15 minute intervals including the L_{Amax}, L_{A1}, L_{A10}, L_{A90}, L_{A99}, L_{Amin} and L_{Aeq}. The statistical noise exceedance levels (L_{AN}) are the levels exceeded for N% of the 15 minute interval. The L_{A90} represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level. The L_{A10} is the level exceeded for 10% of the time and is usually referred to as the average maximum noise level. The L_{Aeq} is the equivalent continuous sound pressure level and represents the steady sound level which is equal in energy to the fluctuating level over the interval period. The L_{Amax} is the maximum noise level recorded over the interval.

Instrument calibration was conducted before and after each measurement survey, with the variation in calibrated levels not exceeding ±0.5 dB.

3.4 Operator Attended Noise Monitoring

Operator attended noise surveys were conducted at each of the five noise monitoring locations during the day, evening and night-time periods to identify and quantify sources of noise that contributed to the overall ambient noise level. The measurements were conducted over a 15 minute period using an integrating sound level meter.

4 OPERATOR ATTENDED NOISE MONITORING

4.1 Equipment Location

The locations and details of the plant operating on the Bloomfield open cut mine during the operator attended noise monitoring period are shown in **Table 3** and **Figure 1**.

Table 3 Operations Log

Date	Plant		Work Location		
			Day Shift	Afternoon Shift	Night Shift
20/12/2016	Production	5500 (Digger)	SH14 EC111	SH14 EC111	-
		5700 (Digger)	EX02 C2	-	-
		SK75 (Drill)	EX02 C2	EX02 C2	EX02 C2
		SK50 (Drill)	SH14 DON	-	-
	Dump		SCUT	SCUT	-

Figure 1 Bloomfield Operating Locations

Source: Bloomfield Collieries Pty Ltd 2017

4.2 Results of Operator Attended Noise Monitoring

Operator attended noise measurements were conducted during the daytime, evening and night-time commencing during the day of Tuesday 20 December 2016 and completed during the night-time on Wednesday 21 December 2016. All operator attended noise surveys were conducted using a Brüel & Kjær 2270 Type 1, integrating sound level meter (s/n: 3003729).

The results of the operator attended noise measurements are given in **Table 4** to **Table 8**.

Ambient noise levels given in the tables include all noise sources such as traffic, insects, birds, and mine operations as well as any other industrial operations.

The tables provide the following information:

- Monitoring location.
- Date and start time.
- Wind velocity (m/s) and Temperature (ºC) at the measurement location.
- Typical maximum (L_{Amax}) and contributed noise levels.

Mine contributions listed in the tables are from Bloomfield Colliery and are stated only when a contribution could be quantified.

Table 4 Location F, Lot 684 Black Hill Road, Black Hill

Period[1]	Date/Start Time/ Weather	Primary Noise Descriptor (dBA re 20 μPa)					Description of Noise Emissions and Typical Maximum Noise Levels (LAmax - dBA)
		LAmax	LA1	LA10	LA90	LAeq	
Day	20/12/2016 14:42 34°C 2.9 m/s NW 3/8 Cloud Cover	83	73	60	52	61	John Renshaw Drive 59 to 65 Local road traffic 70 to 83 Wind in trees 40 to 48 Frogs/Insects 43 to 48 Bloomfield Colliery Inaudible
		Estimated Bloomfield Colliery Noise Contribution Inaudible					
Evening	20/12/2016 18:45 31°C 2.1 m/s NW 2/8 Cloud Cover	71	61	55	46	53	John Renshaw Drive 50 to 61 Local road traffic 68 to 71 Frogs/Insects 43 to 58 Bloomfield Colliery Inaudible
		Estimated Bloomfield Colliery Noise Contribution Inaudible					
Night	20/12/2016 22:51 26°C 0.7 m/s W 1/8 Cloud Cover	68	58	53	45	50	John Renshaw Drive 55 to 60 Local road traffic up to 68 Frogs/Insects 47 to 53 Bloomfield Colliery Inaudible
		Estimated Bloomfield Colliery Noise Contribution Inaudible					

Note 1: EPA periods used for the INP are defined as Daytime - 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday; Evening - 6.00 pm 10.00 pm; Night - 10.00 pm to 7.00 am pm Monday to Saturday, 10.00 pm to 8.00 am Sunday.

Table 5 Location G, Buchanan Road, Buchanan

Period[1]	Date/Start Time/ Weather	Primary Noise Descriptor (dBA re 20 μPa)					Description of Noise Emissions and Typical Maximum Noise Levels (LAmax - dBA)
		LAmax	LA1	LA10	LA90	LAeq	
Day	20/12/2016 15:47 34°C 1.8 m/s W 3/8 Cloud Cover	69	65	63	55	60	Road traffic 42 to 46 Wind in trees 50 to 52 Birdsong up to 52 Insects 58 to 69 Bloomfield Colliery Inaudible
		Estimated Bloomfield Colliery Noise Contribution Inaudible					
Evening	20/12/2016 19:49 29°C 1.2 m/s NW 2/8 Cloud Cover	78	77	76	64	72	Road traffic up to 45 Insects 71 to 78 Helicopter 56 to 61 Bloomfield Colliery Inaudible
		Estimated Bloomfield Colliery Noise Contribution Inaudible					
Night	21/12/2016 00:02 25°C 0.5 m/s W 1/8 Cloud Cover	57	54	50	44	48	Road traffic 43 to 57 Insects 48 to 53 Bloomfield Colliery Inaudible
		Estimated Bloomfield Colliery Noise Contribution Inaudible					

Note 1: EPA periods used for the INP are defined as Daytime - 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday; Evening - 6.00 pm 10.00 pm; Night - 10.00 pm to 7.00 am pm Monday to Saturday, 10.00 pm to 8.00 am Sunday.

Table 6 Location L, 17 Kilshanny Ave, Ashtonfield

Period[1]	Date/Start Time/ Weather	Primary Noise Descriptor (dBA re 20 μPa)					Description of Noise Emissions and Typical Maximum Noise Levels (LAmax - dBA)
		LAmax	LA1	LA10	LA90	LAeq	
Day	20/12/2016 16:15 34°C 1.9m/s WNW 2/8 Cloud Cover	71	65	50	38	51	Distant road traffic 35 to 40 Local road traffic 62 to 71 Pedestrians up to 54 Wind in trees 38 to 42 Birdsong 49 up to 55 Dog barking up to 47 Insects 31 to 34 Air conditioner up to 37 Aeroplane up to 40 Bloomfield Colliery Inaudible
		Estimated Bloomfield Colliery Noise Contribution Inaudible					
Evening	20/12/2016 20:18 29°C 0.7 m/s WNW 2/8 Cloud Cover	75	65	48	36	51	Distant road traffic 32 to 36 Local road traffic 72 to 75 Insects 32 to 34 Resident (shed) 41 to 52 Bloomfield Colliery Inaudible
		Estimated Bloomfield Colliery Noise Contribution Inaudible					
Night	20/12/2016 00:31 25°C Calm 1/8 Cloud Cover	48	45	45	34	42	Dog barking 45 to 48 Insects 33 to 46 Road traffic 30 to 35 Bloomfield Colliery Inaudible
		Estimated Bloomfield Colliery Noise Contribution Inaudible					

Note 1: EPA periods used for the INP are defined as Daytime - 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday; Evening - 6.00 pm 10.00 pm; Night - 10.00 pm to 7.00 am pm Monday to Saturday, 10.00 pm to 8.00 am Sunday.

Table 7 Location M, John Renshaw Drive, Buttai

Period[1]	Date/Start Time/ Weather	Primary Noise Descriptor (dBA re 20 μPa)					Description of Noise Emissions and Typical Maximum Noise Levels (LAmax - dBA)
		LAmax	LA1	LA10	LA90	LAeq	
Day	20/12/2016 15:02 34°C 3.0m/s W 3/8 Cloud Cover	65	59	56	49	54	Road traffic 58 to 65 Wind gusts up to 58 Insects 40 to 46 Bloomfield Colliery Inaudible
		Estimated Bloomfield Colliery Noise Contribution Inaudible					
Evening	20/12/2016 19:05 31°C 2.1 m/s W 2/8 Cloud Cover	63	58	54	44	51	Road traffic 53 to 63 Birdsong up to 55 Insects 48 to 51 Bloomfield Colliery Inaudible
		Estimated Bloomfield Colliery Noise Contribution Inaudible					
Night	20/12/2016 23:14 25°C 0.5 m/s W 1/8 Cloud Cover	59	57	53	45	50	Road traffic 50 to 59 Insects 46 to 51 Bloomfield Colliery Inaudible
		Estimated Bloomfield Colliery Noise Contribution Inaudible					

Note 1: EPA periods used for the INP are defined as Daytime - 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday; Evening - 6.00 pm 10.00 pm; Night - 10.00 pm to 7.00 am pm Monday to Saturday, 10.00 pm to 8.00 am Sunday.

Table 8 Location N, Lings Road, Buttai

Period[1]	Date/Start Time/ Weather	Primary Noise Descriptor (dBA re 20 μPa)					Description of Noise Emissions and Typical Maximum Noise Levels (LAmax - dBA)
		LAmax	LA1	LA10	LA90	LAeq	
Day	20/12/2016 15:02 34°C 3.6m/s WNW 3/8 Cloud Cover	81	77	70	53	67	Road traffic 72 to 81 Wind gusts up to 57 Birdsong up to 65 Insects up to 45 Bloomfield Colliery Inaudible
		Estimated Bloomfield Colliery Noise Contribution Inaudible					
Evening	20/12/2016 19:25 29°C 1.2 m/s NW 2/8 Cloud Cover	80	75	67	44	63	Road traffic 72 to 80 Insects up to 44 Bloomfield Colliery Inaudible
		Estimated Bloomfield Colliery Noise Contribution Inaudible					
Night	20/12/2016 23:36 25°C 0.5 m/s W 1/8 Cloud Cover	82	76	63	49	62	Road traffic 62 to 82 Insects/frogs 46 to 55 Bloomfield Colliery Inaudible
		Estimated Bloomfield Colliery Noise Contribution Inaudible					

Note 1: EPA periods used for the INP are defined as Daytime - 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday; Evening - 6.00 pm 10.00 pm; Night - 10.00 pm to 7.00 am pm Monday to Saturday, 10.00 pm to 8.00 am Sunday.

4.3 Operator Attended Noise Monitoring Summary

4.3.1 Location F – Black Hill Road, Black Hill

Noise levels at Location F, were dominated by local traffic on Black Hill Road and distant traffic on John Renshaw Drive. Insect noise and birdsong was also a contributor at this location.

Bloomfield Colliery operations remained inaudible during all operator attended noise measurements.

4.3.2 Location G – Buchanan Road, Buchanan

Birds, insect noise and distant road traffic on Buchanan Road and John Renshaw Drive contributed to the overall ambient noise environment during the evening and night-time operator attended noise surveys.

Bloomfield Colliery operations remained inaudible during all operator attended noise measurements.

4.3.3 Location L – Killshanny Avenue, Ashtonfield

Noise levels at Location L were dominated by intermittent road traffic, suburban noise as well as insects and birds.

Bloomfield Colliery operations remained inaudible during all operator attended noise measurements.

4.3.4 Location M – John Renshaw Drive, Buttai

Noise levels at Location M, were dominated by distant traffic on John Renshaw Drive as well as insects and birds.

Bloomfield Colliery operations remained inaudible during all operator attended noise measurements.

4.3.5 Location N – Lings Road, Buttai

Noise levels at location N were dominated by traffic noise from John Renshaw Drive and insects.

Bloomfield Colliery operations remained inaudible during all operator attended noise measurements.

4.4 Compliance Assessment and Discussion of Results

4.4.1 Operations

Results of the operational noise compliance assessment are given in **Table 9**.

Table 9 Compliance Noise Assessment - Operations

Location	Estimated Bloomfield $L_{Aeq(15minute)}$ Contribution			Consent Conditions $L_{Aeq(15minute)}$			Compliance		
	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night
F – Black Hill Road, Black Hill	Inaudible at all times			35	35	35	Yes[1]	Yes[1]	Yes[1]
G – Buchanan Road, Buchanan	Inaudible at all times			39	42	37	Yes	Yes	Yes
L – Kilshanny Ave, Ashtonfield	Inaudible at all times			35	35	35	Yes	Yes	Yes
M – John Renshaw Drive, Buttai	Inaudible at all times			39	39	37	Yes	Yes	Yes
N – Lings Road, Buttai	Inaudible at all times			42	42	35	Yes	Yes	Yes

1 – Mine owned Property

Results presented in **Table 9** indicate that compliance with the consent conditions was achieved at all attended noise monitoring locations during all periods.

4.4.2 Sleep Disturbance

Results of the sleep disturbance compliance assessment are given in **Table 10**.

Table 10 Compliance Noise Assessment – Sleep Disturbance

Location	Estimated Bloomfield LA1(1minute) Contribution	Consent Conditions LA1(1minute)	Compliance
F – Black Hill Road, Black Hill	Inaudible	45	Yes[1]
G – Buchanan Road, Buchanan	Inaudible	45	Yes
L – Kilshanny Ave, Ashtonfield	Inaudible	45	Yes
M – John Renshaw Drive, Buttai	Inaudible	46	Yes
N – Lings Road, Buttai	Inaudible	46	Yes

1 – Mine owned Property

Results presented in **Table 10** indicate that compliance with the sleep disturbance consent conditions was achieved at all locations during the night-time noise surveys.

5 UNATTENDED CONTINUOUS NOISE MONITORING

5.1 Results of Unattended Continuous Monitoring

Unattended continuous noise monitoring was conducted between 16 December 2016 and 23 December 2016 at each of the five nominated locations given in **Table 2**. Details of the noise loggers used for the unattended continuous noise monitoring are given in **Table 11**.

As Location N is predominately dominated by road traffic along John Renshaw Drive, an alternate noise logger location was selected closer to Bloomfield operations. The alternative logger location allows a Bloomfield noise contribution to be measured at this location and a Bloomfield contribution to be calculated at Location N.

Table 11 Noise Logger and Noise Monitoring Locations

Location	Noise Logger Serial Number	Date of Logging
F – Black Hill Road, Black Hill	ARL EL- 316 16-203-530	16/12/2016-23/12/2016
G – Buchanan Road, Buchanan	B&K 2250L - 3004635	16/12/2016-23/12/2016
L – Kilshanny Ave, Kilshanny	SVAN 957 - 20674	16/12/2016-23/12/2016
M – John Renshaw Drive, Buttai	SVAN 957 - 21425	16/12/2016-23/12/2016
N – Alternative Logger Location 669 John Renshaw Drive, Buttai	SVAN 957 - 20668	16/12/2016-23/12/2016

The unattended ambient noise logger data from each monitoring location have been presented graphically on a daily basis and are attached as Appendix C1 to C5. A summary of the results of the unattended continuous noise monitoring is given in **Table 12**.

The ambient noise level data quantifies the overall noise level at a given location independent of its source or character.

The measured ambient noise levels were divided into three periods representing day, evening and night as designated in the NSW Industrial Noise Policy (INP).

Precautions were taken to minimise influences from extraneous noise sources (eg optimum placement of the loggers away from creeks, trees, houses, etc), however, not all these sources or their effects can be eliminated. This is particularly the case during the warmer times of year when noise from insects, frogs, birds and other animals can become quite prevalent.

Weather data for the subject area during the noise monitoring period was obtained from the weather station located on the Bloomfield project site. Noise data during periods of any rainfall and/or wind speeds in excess of 5 m/s (approximately 9 knots) were discarded in accordance with INP weather affected data exclusion methodology.

Table 12 Unattended Continuous Monitoring Ambient Noise Levels (dBA Re 20 µPa)

Location	Period	LA1	LA10	LA90	LAeq
F - Lot 684 Black Hill Road, Black Hill	Daytime	72	59	48	61
	Evening	65	57	43	61
	Night	61	57	42	57
G -156 Buchanan Road, Buchanan	Daytime	66	63	43	64
	Evening	52	48	38	62
	Night	47	43	33	50
L – Kilshanny Avenue, Ashtonfield	Daytime	60	49	35	59
	Evening	60	51	35	55
	Night	57	50	31	48
M - John Renshaw Drive, Buttai	Daytime	58	55	47	62
	Evening	58	54	44	52
	Night	56	51	39	50
N – Alternative Logger Location 669 John Renshaw Drive	Daytime	61	57	44	55
	Evening	57	52	38	58
	Night	47	44	31	45

Note: EPA periods used for the INP are defined as Daytime - 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday; Evening - 6.00 pm 10.00 pm; Night - 10.00 pm to 7.00 am pm Monday to Saturday, 10.00 pm to 8.00 am Sunday.

5.2 Discussion

As discussed in **Section 4**, Bloomfield Colliery operations remained inaudible during all operator attended surveys.

Given observations made during the operator attended noise surveys, it is likely that noise levels at Locations F were dominated by road traffic noise from John Renshaw Drive and Black Hill Road as well as crickets, insects and bird noise during all periods.

Noise levels at Location G were dominated by road traffic during the daytime, while at Location L noise levels were dominated by insects, local traffic and residential noise.

A review of data from the noise logger at the alternative logger location N reveals that noise levels at this location are heavily influenced by natural noise sources, as such it is likely that Bloomfield operations were compliant with the consent conditions at location N during the noise monitoring period.

6 CONCLUSION

SLR was engaged by Bloomfield Collieries Pty Ltd to conduct operator attended and unattended noise monitoring for Bloomfield Colliery in accordance with the Project Approval requirements set by the DP&I.

Results of noise monitoring have indicated compliance with the consent conditions at all monitoring locations during the December 2016 monitoring period.

1 Sound Level or Noise Level

The terms "sound" and "noise" are almost interchangeable, except that in common usage "noise" is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or L_P are commonly used to represent Sound Pressure Level. The symbol L_A represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2E-5 Pa.

2 "A" Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an "A-weighting" filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120 110	Heavy rock concert Grinding on steel	Extremely noisy
100 90	Loud car horn at 3 m Construction site with pneumatic hammering	Very noisy
80 70	Kerbside of busy street Loud radio or television	Loud
60 50	Department store General Office	Moderate to quiet
40 30	Inside private office Inside bedroom	Quiet to very quiet
20	Unoccupied recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as "linear", and the units are expressed as dB(Z) or dB.

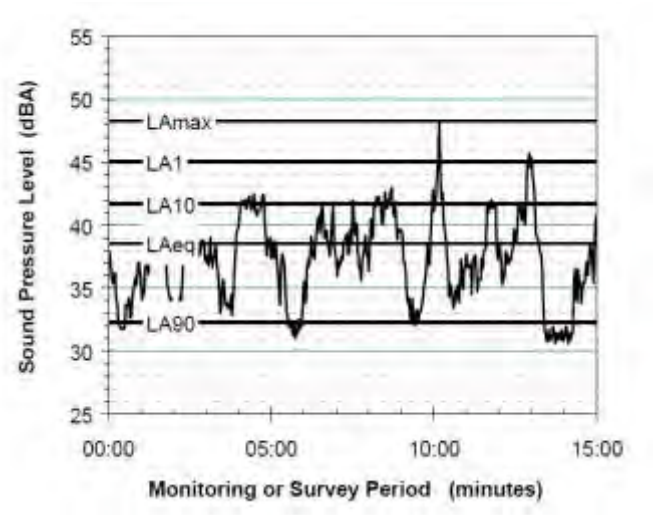
3 Sound Power Level

The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 1E-12 W.
The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

L_{A1} The noise level exceeded for 1% of the 15 minute interval.

L_{A10} The noise level exceed for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

L_{A90} The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

L_{Aeq} The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the "repeatable minimum" L_{A90} noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or "average" levels representative of the other descriptors (L_{Aeq}, L_{A10}, etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than "broad band" noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

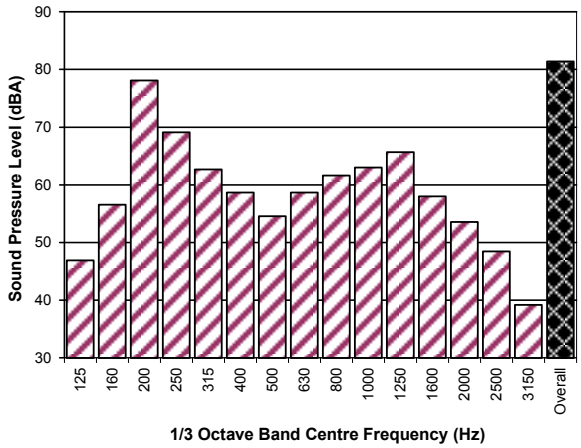
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of "peak" velocity or "rms" velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as "peak particle velocity", or PPV. The latter incorporates "root mean squared" averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/V_o), where V_o is the reference level (1E-6 mm/s). Care is required in this regard, as other reference levels are used by some organizations.

9 Human Perception of Vibration

People are able to "feel" vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

10 Over-Pressure

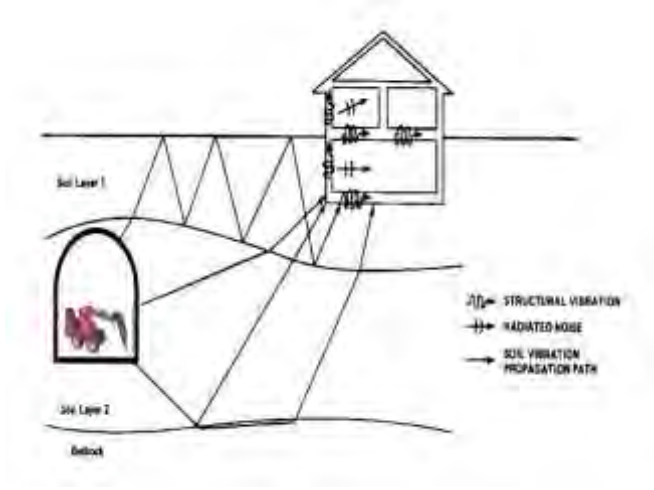
The term "over-pressure" is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11 Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed "regenerated noise", "structure-borne noise", or sometimes "ground-borne noise". Regenerated noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of regenerated noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and regenerated noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term "regenerated noise" is also used to describe other types of noise that are emitted from the primary source as a different form of energy. One example would be a fan with a silencer, where the fan is the energy source and primary noise source. The silencer may effectively reduce the fan noise, but some additional noise may be created by the aerodynamic effect of the silencer in the airstream. This "secondary" noise may be referred to as regenerated noise

Appendix B

Noise Monitoring Location Map

SLR
10 KINGS ROAD
NEW LAMBTON
NEW SOUTH WALES 2305
AUSTRALIA
T: 61 2 4037 3200
F: 61 2 4037 3201
www.slrconsulting.com

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Project No:	630.01053
Date:	28/01/2015
Drawn by:	NT
Scale:	1:45,000
Sheet Size:	A4
Projection:	GDA 1994 MGA Zone 56

LEGEND

Noise Monitoring Locations

N
W
E
S
0 500 1,000 1,500 2,000 m

Donaldson Coal

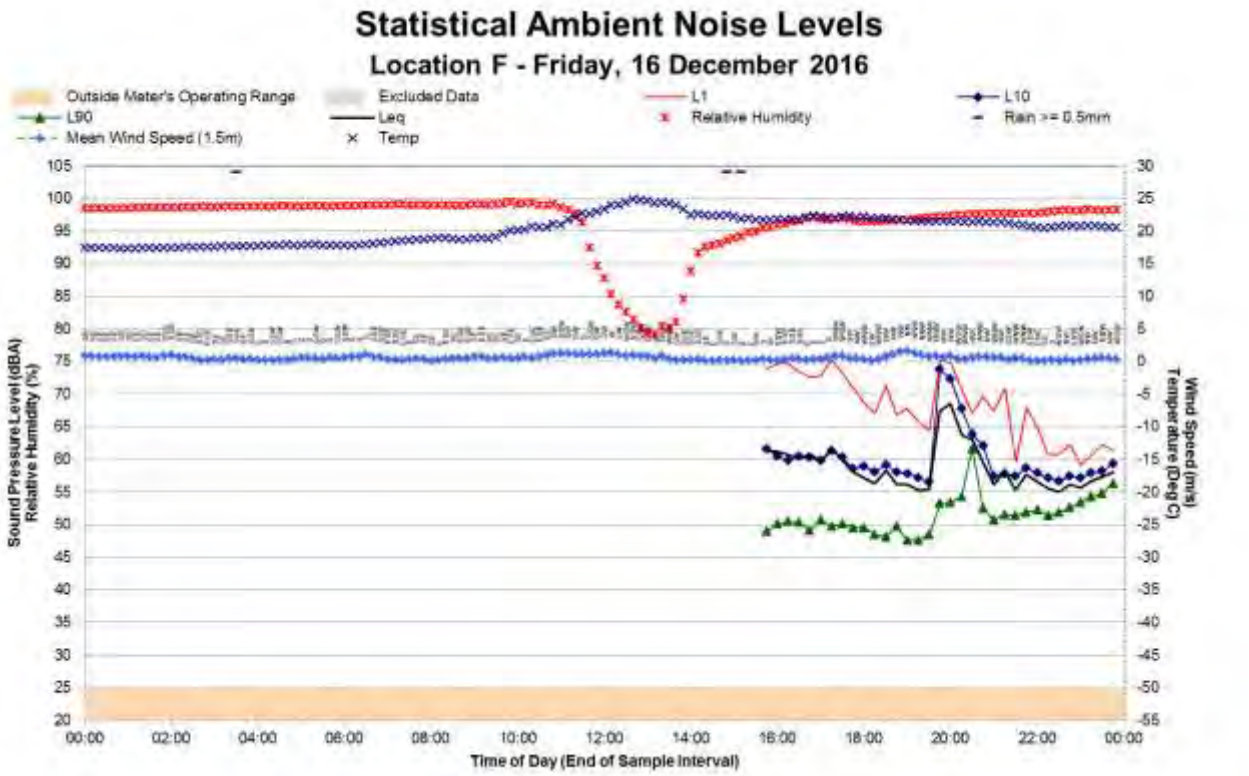
Noise Monitoring

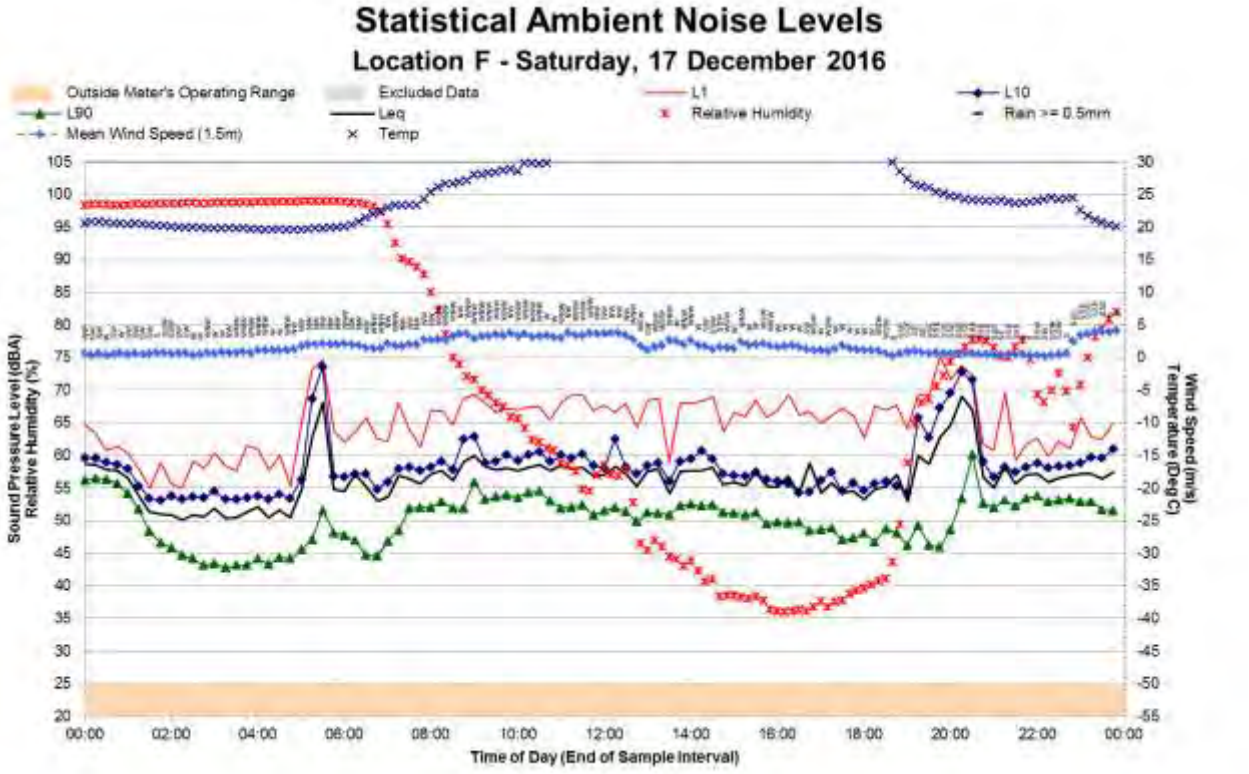
Noise Monitoring Locations

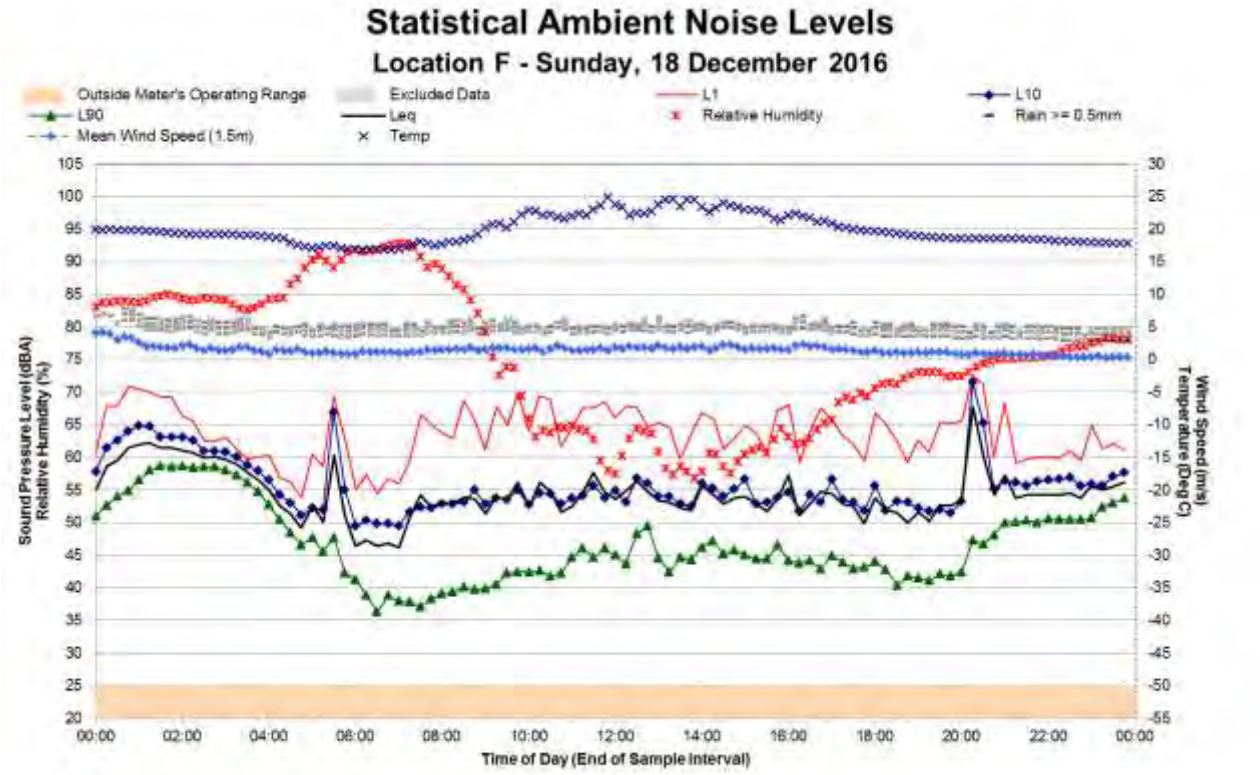
APPENDIX A

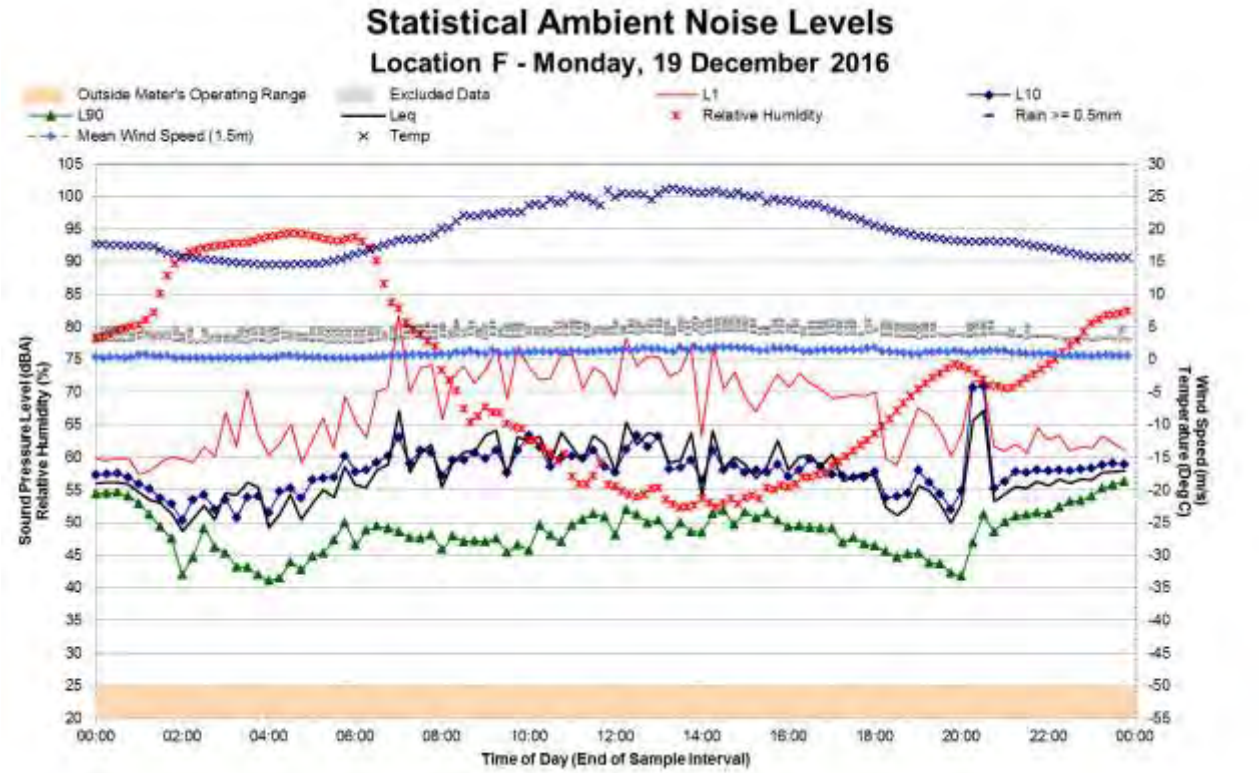
Appendix C1

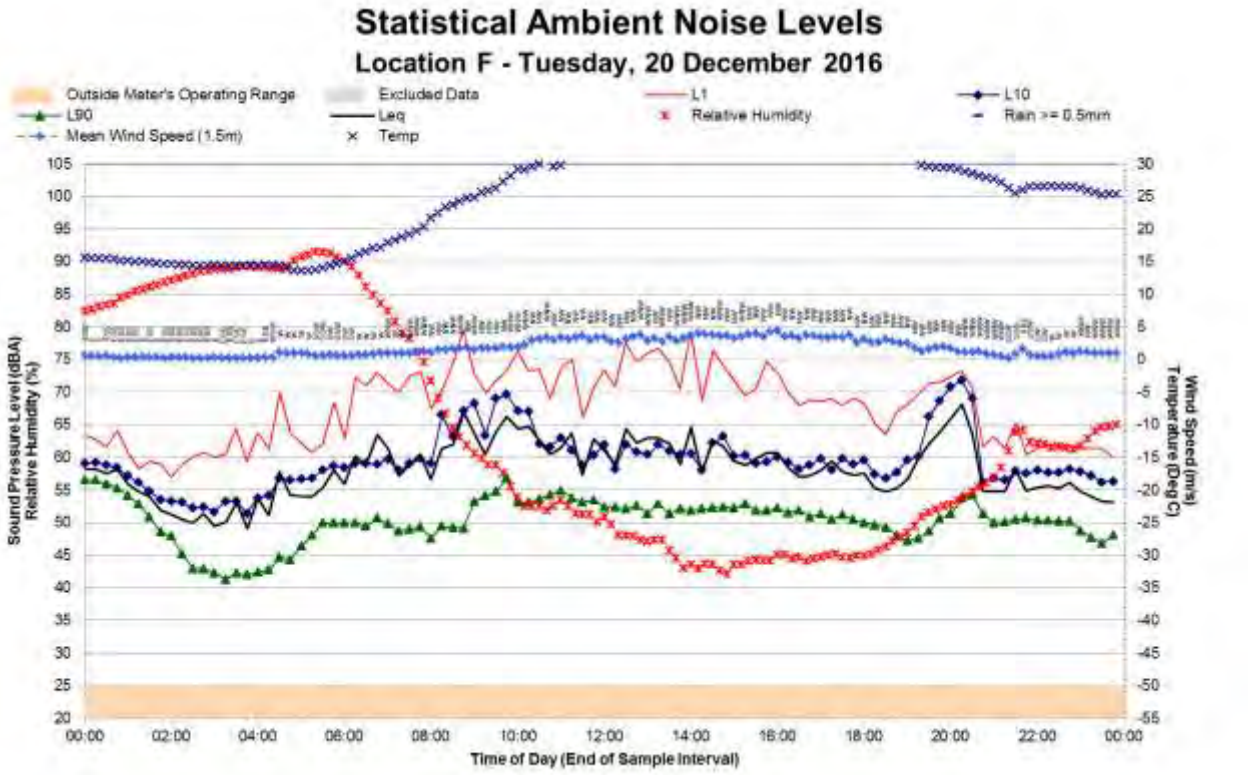
Statistical Ambient Noise Levels – Location F

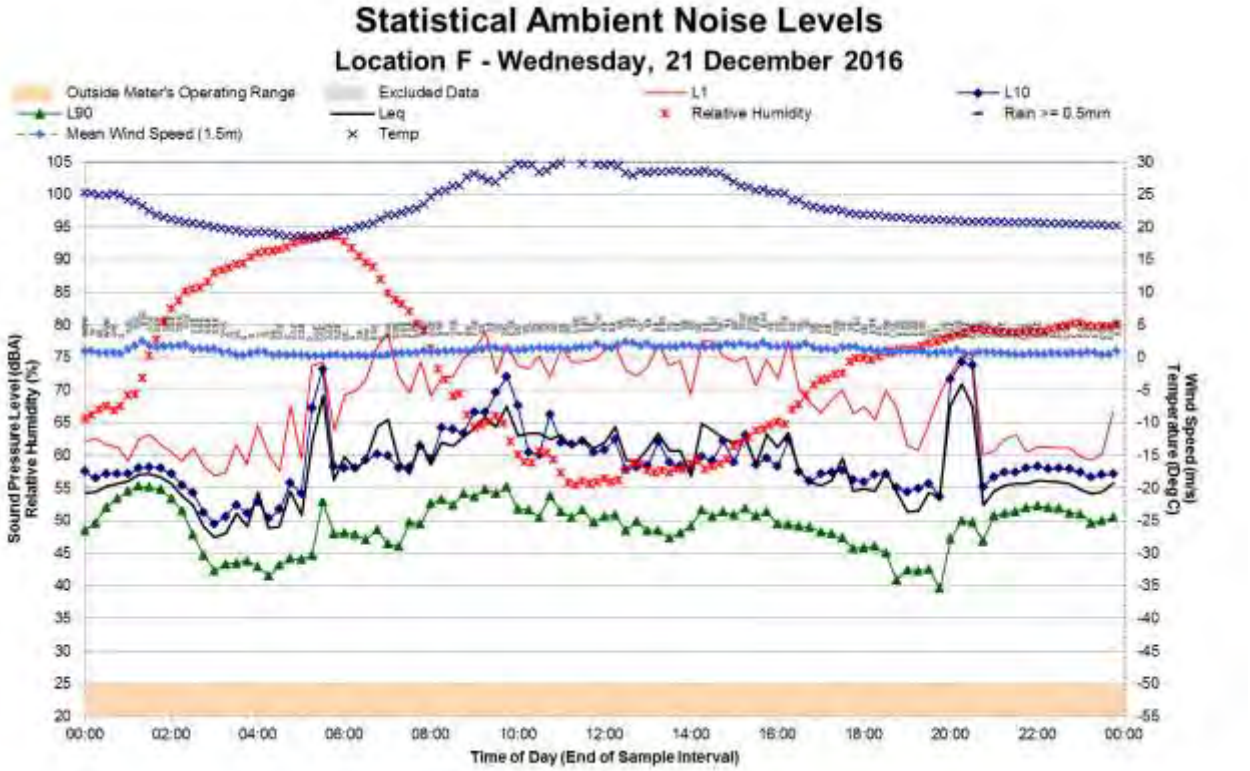


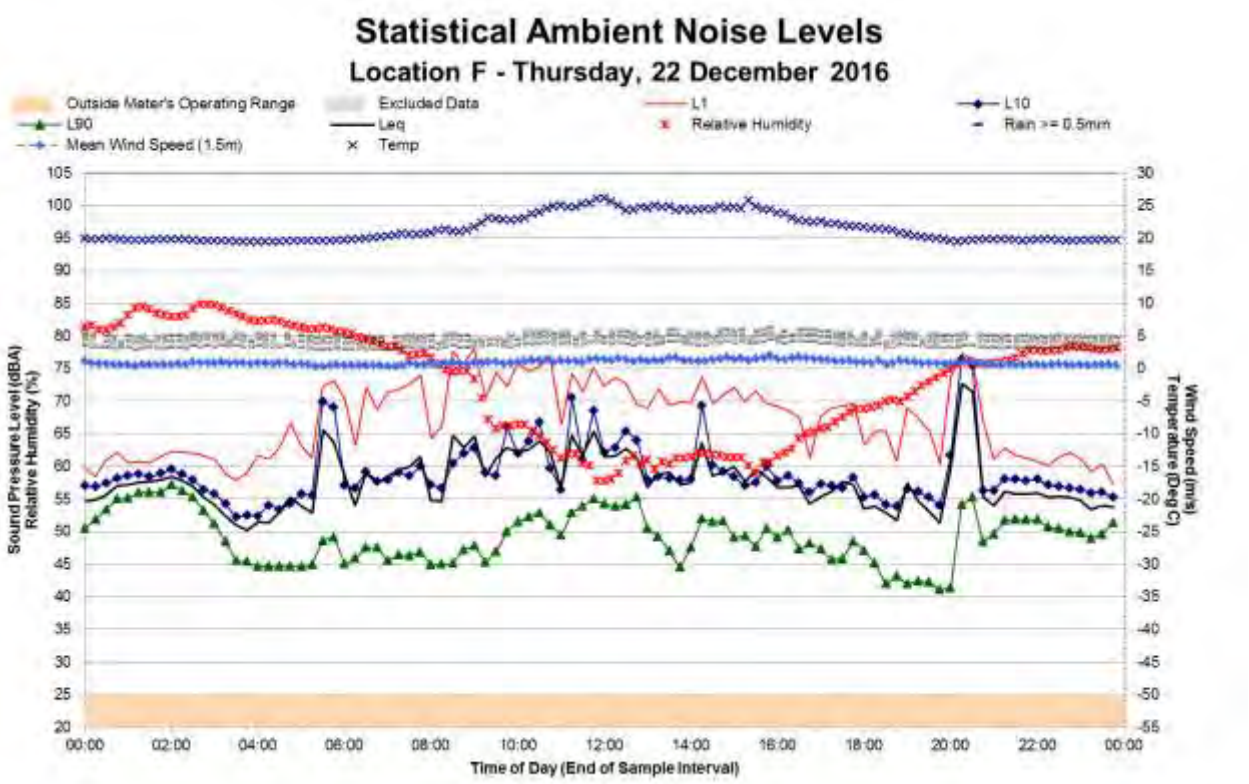


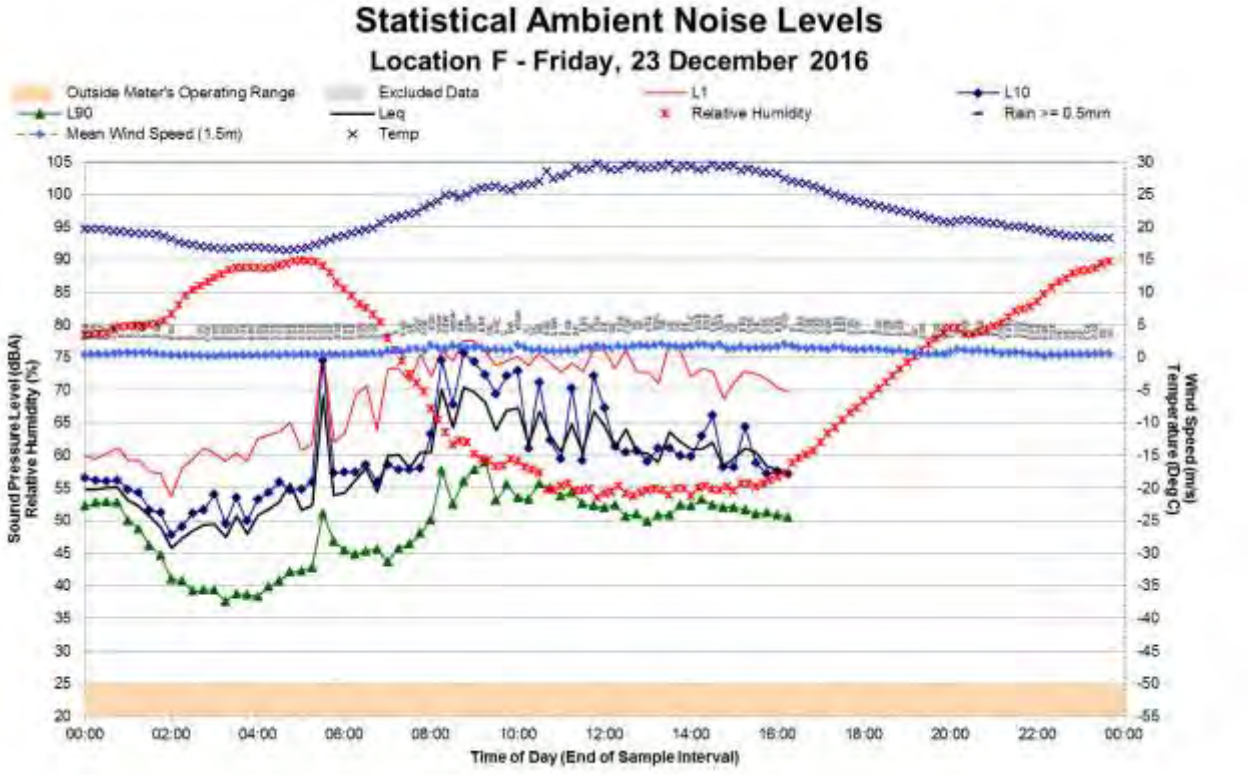

Statistical Ambient Noise Levels
Location F - Sunday, 18 December 2016
Outside Mater's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location F - Monday, 19 December 2016
Outside Mater's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location F - Tuesday, 20 December 2016
Outside Mater's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

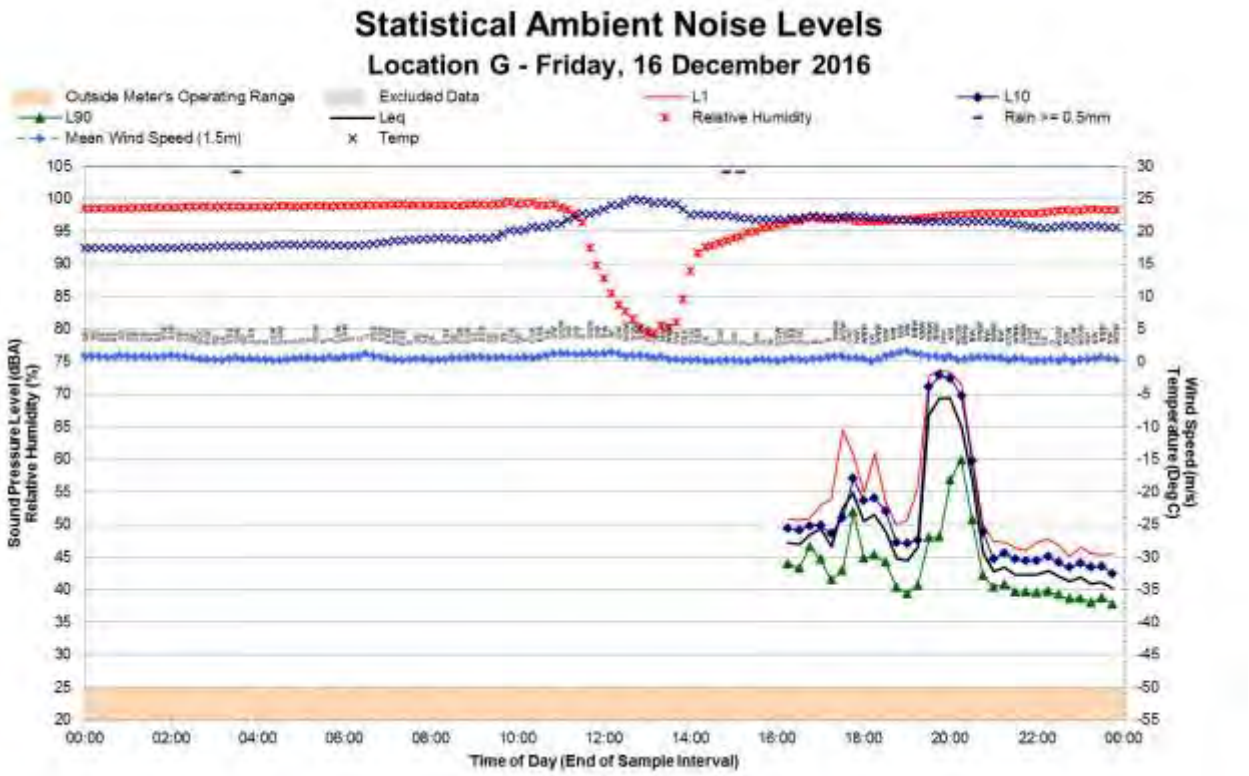

Statistical Ambient Noise Levels
Location F - Wednesday, 21 December 2016
Outside Mater's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

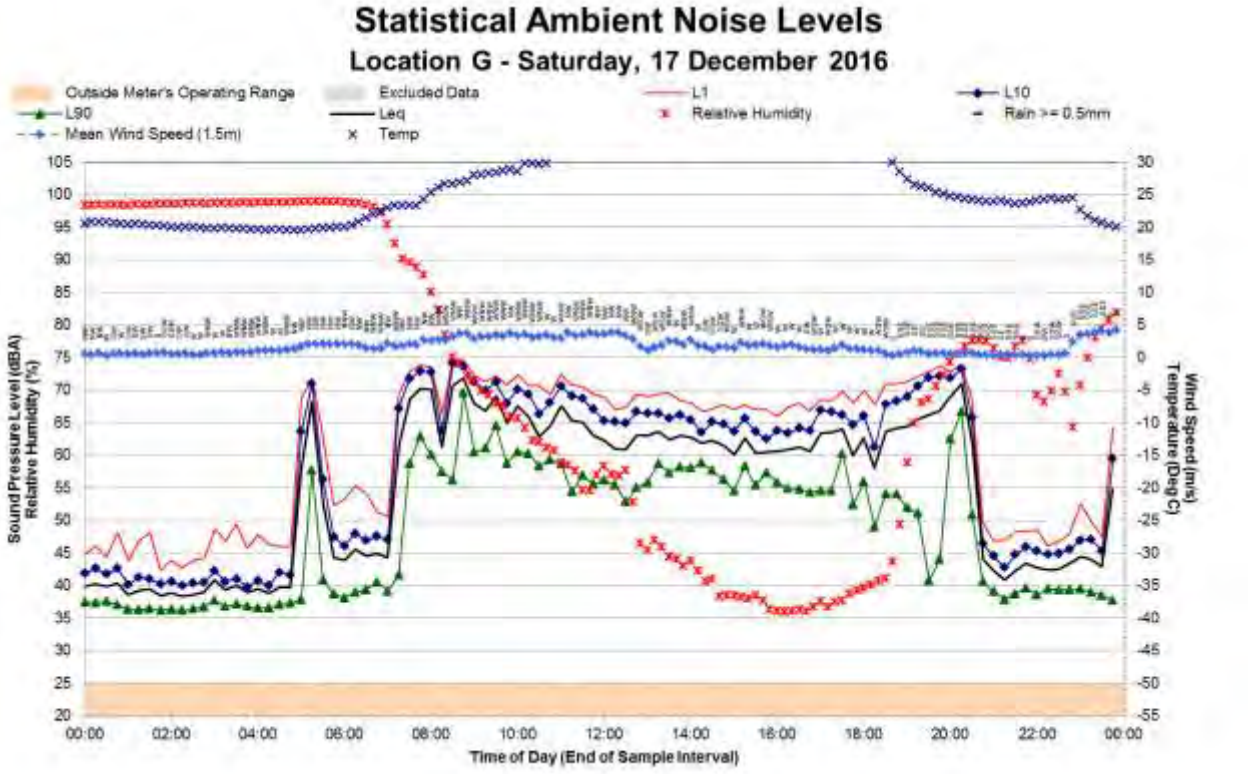

Statistical Ambient Noise Levels
Location F - Thursday, 22 December 2016
Outside Mater's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

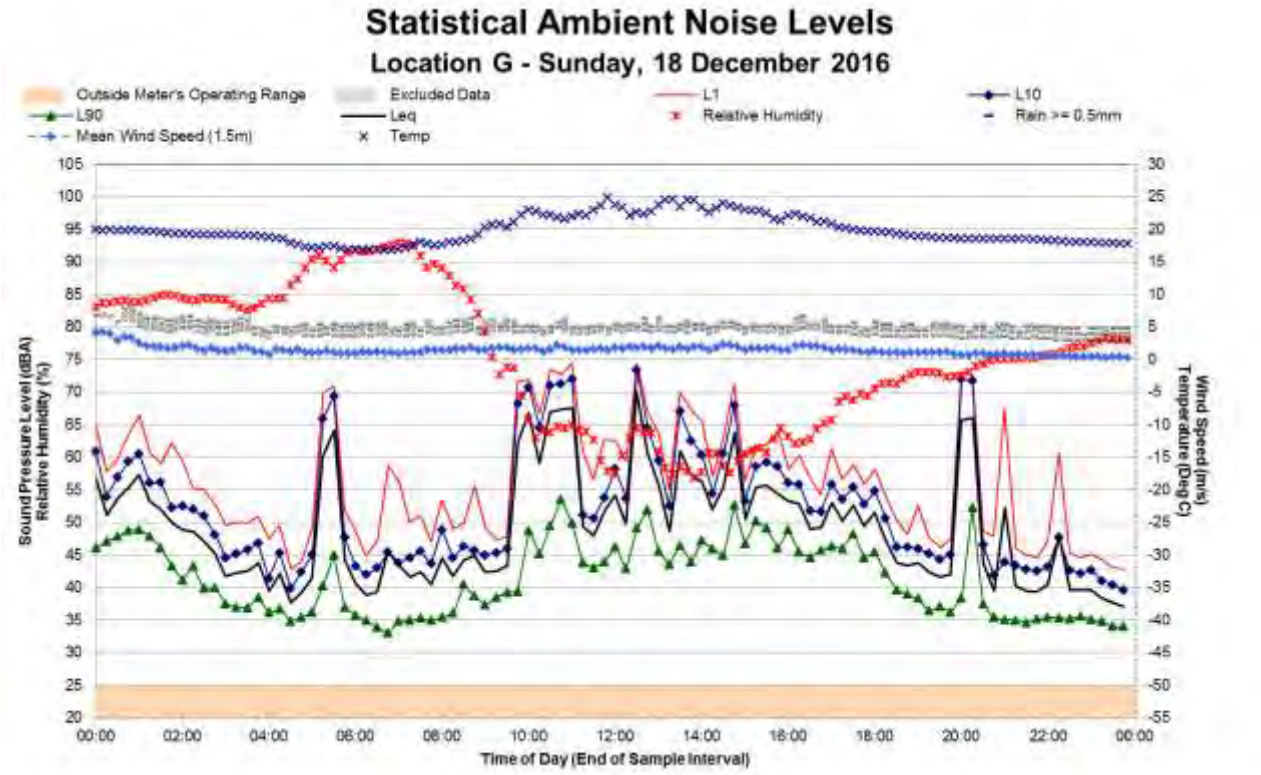

Statistical Ambient Noise Levels
Location F - Friday, 23 December 2016
Outside Mater's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

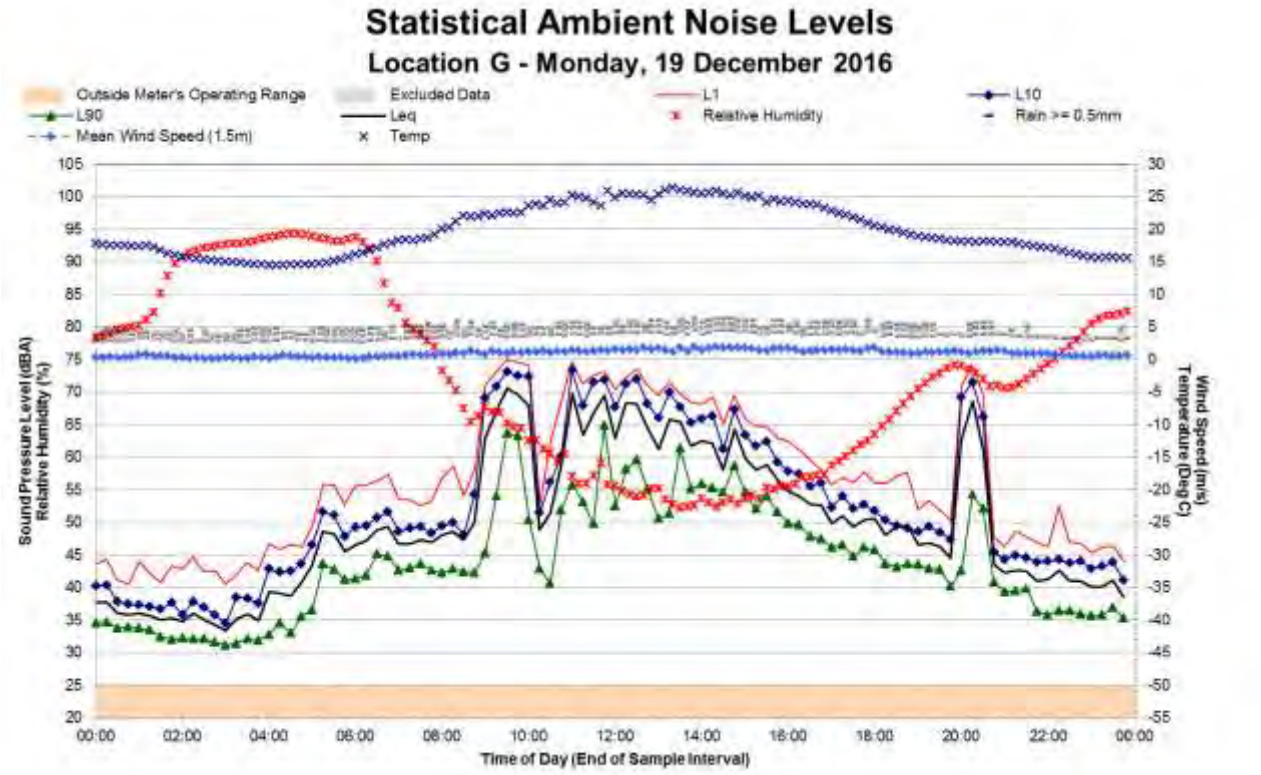
Appendix C2

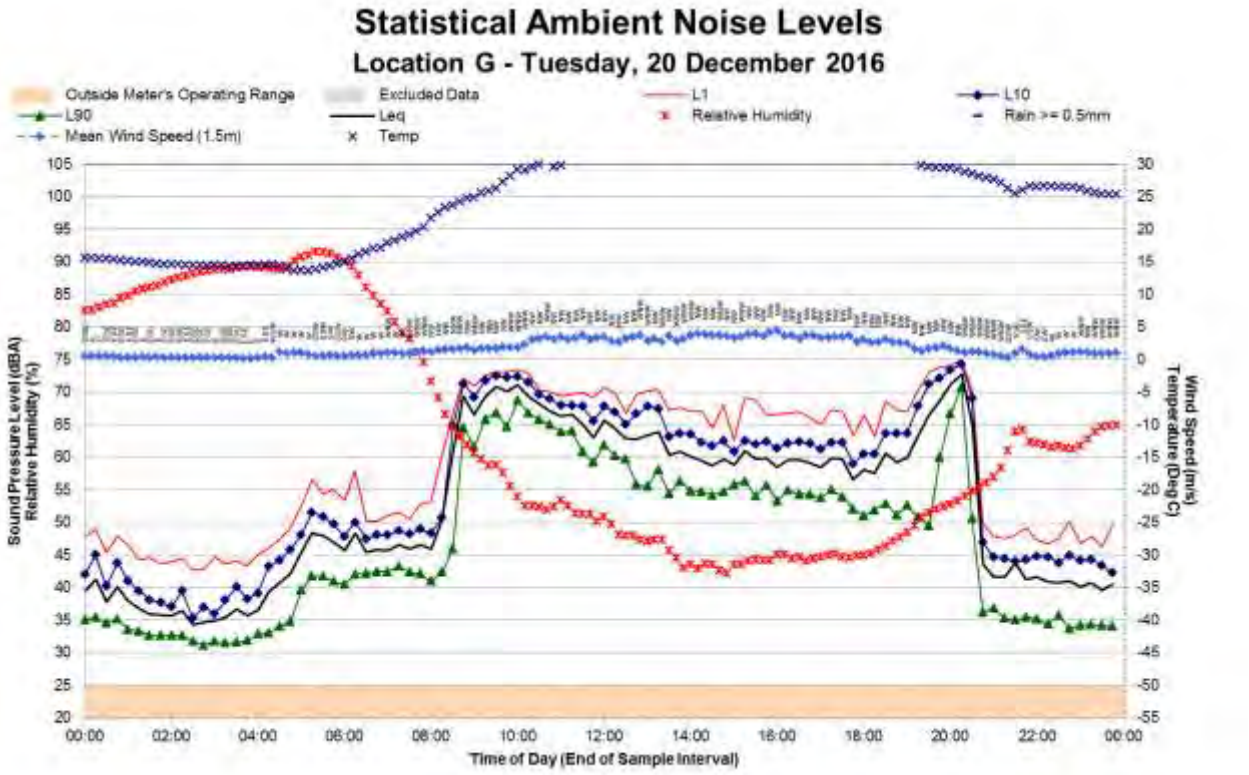
Statistical Ambient Noise Levels – Location G

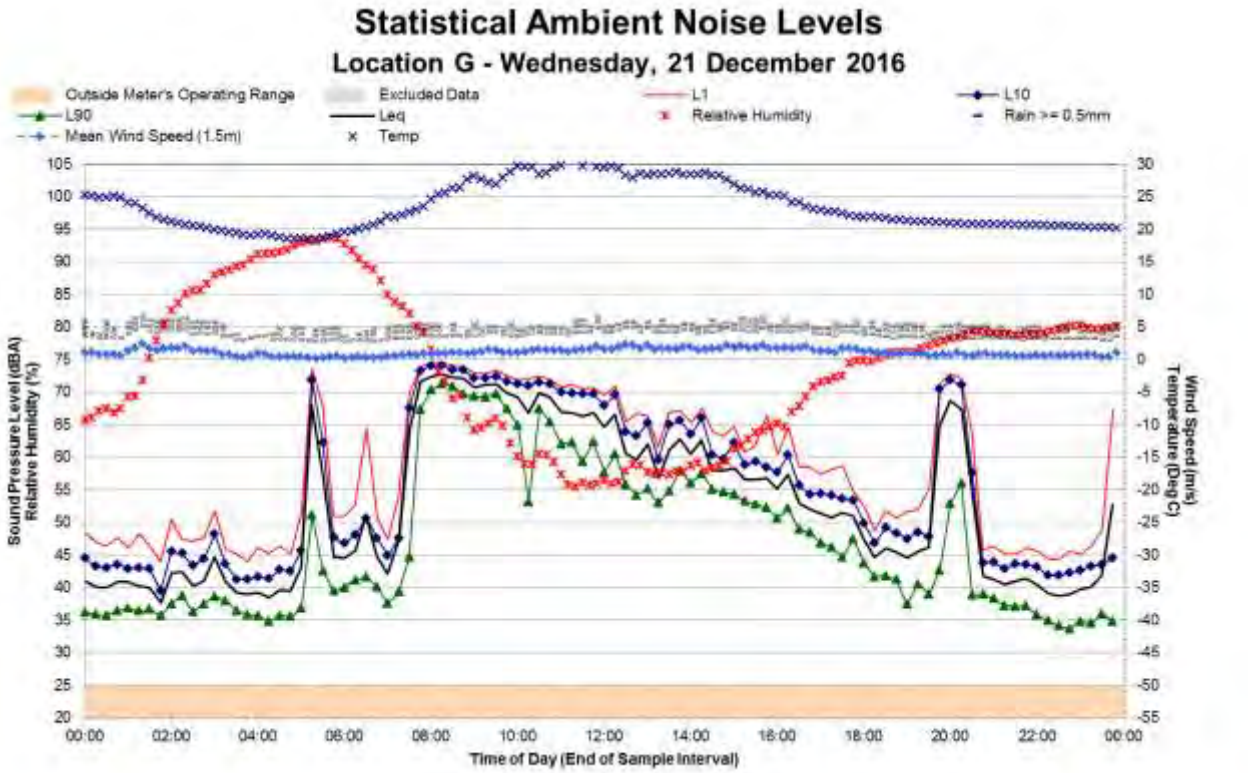





Statistical Ambient Noise Levels
Location G - Sunday, 18 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

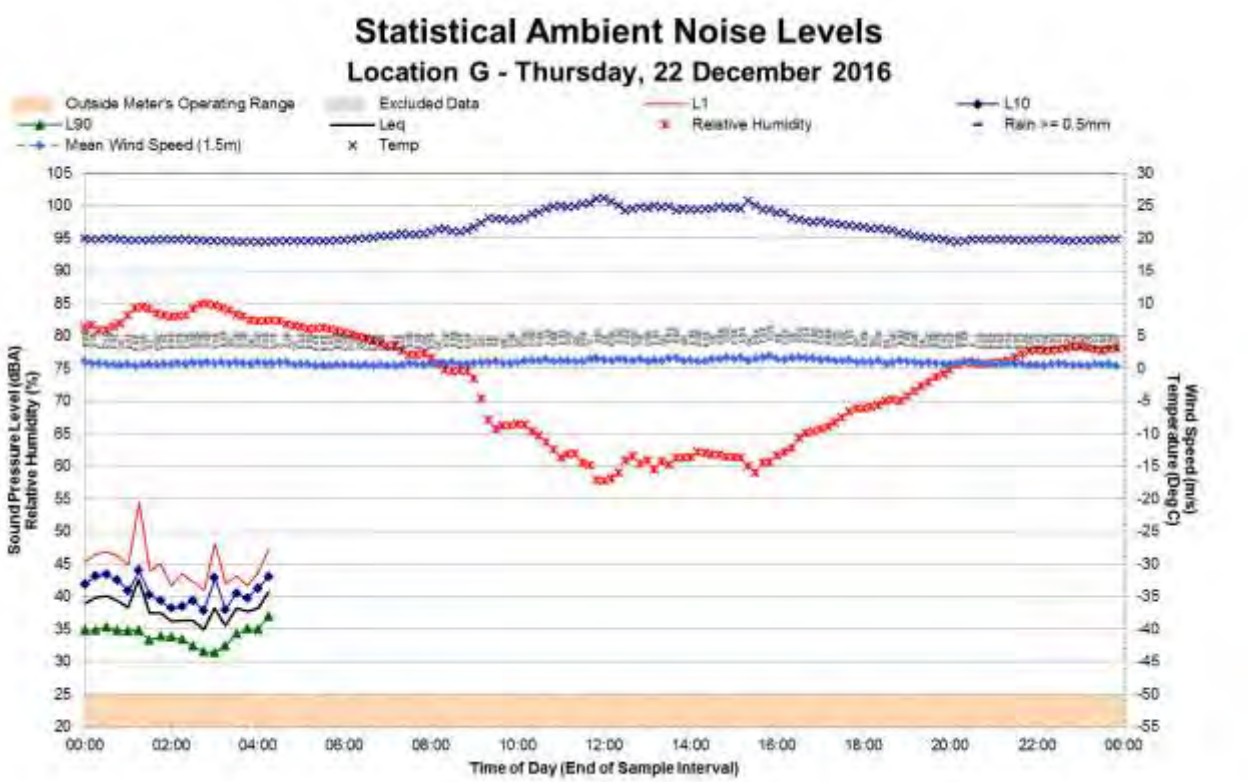

Statistical Ambient Noise Levels
Location G - Monday, 19 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location G - Tuesday, 20 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location G - Wednesday, 21 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

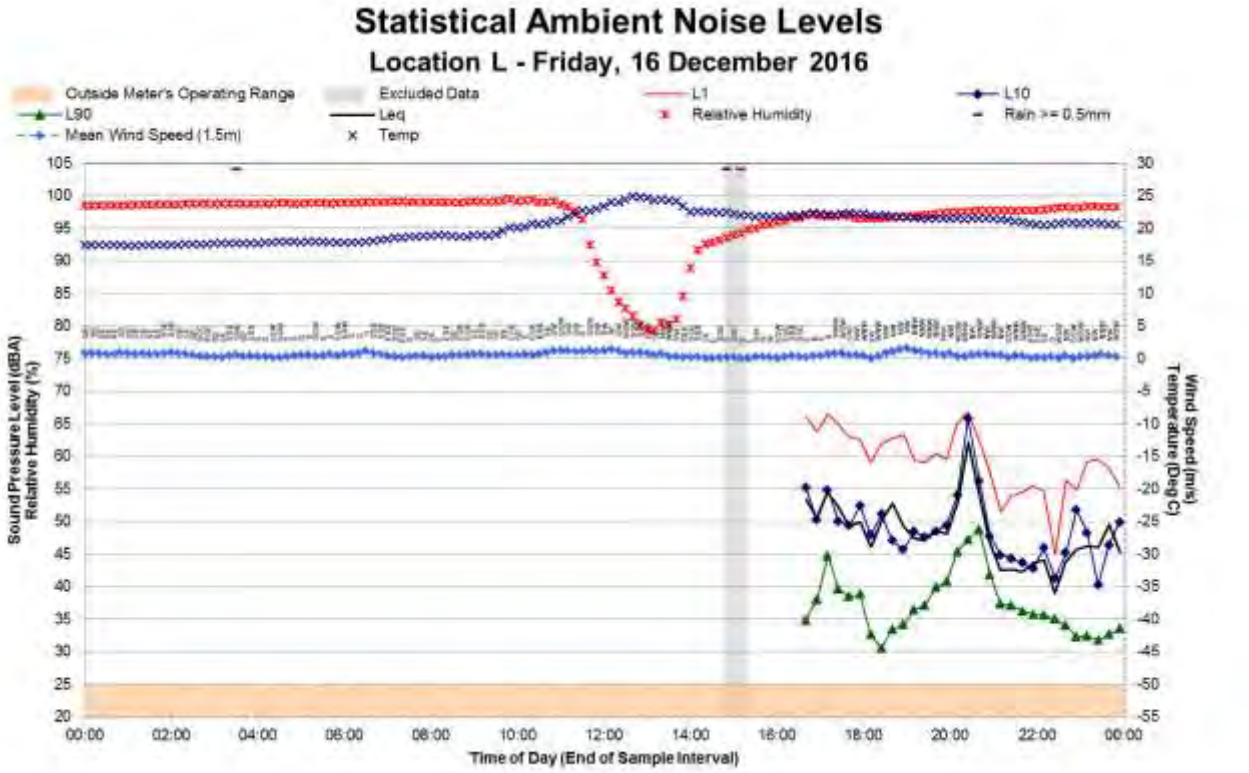
Appendix C2

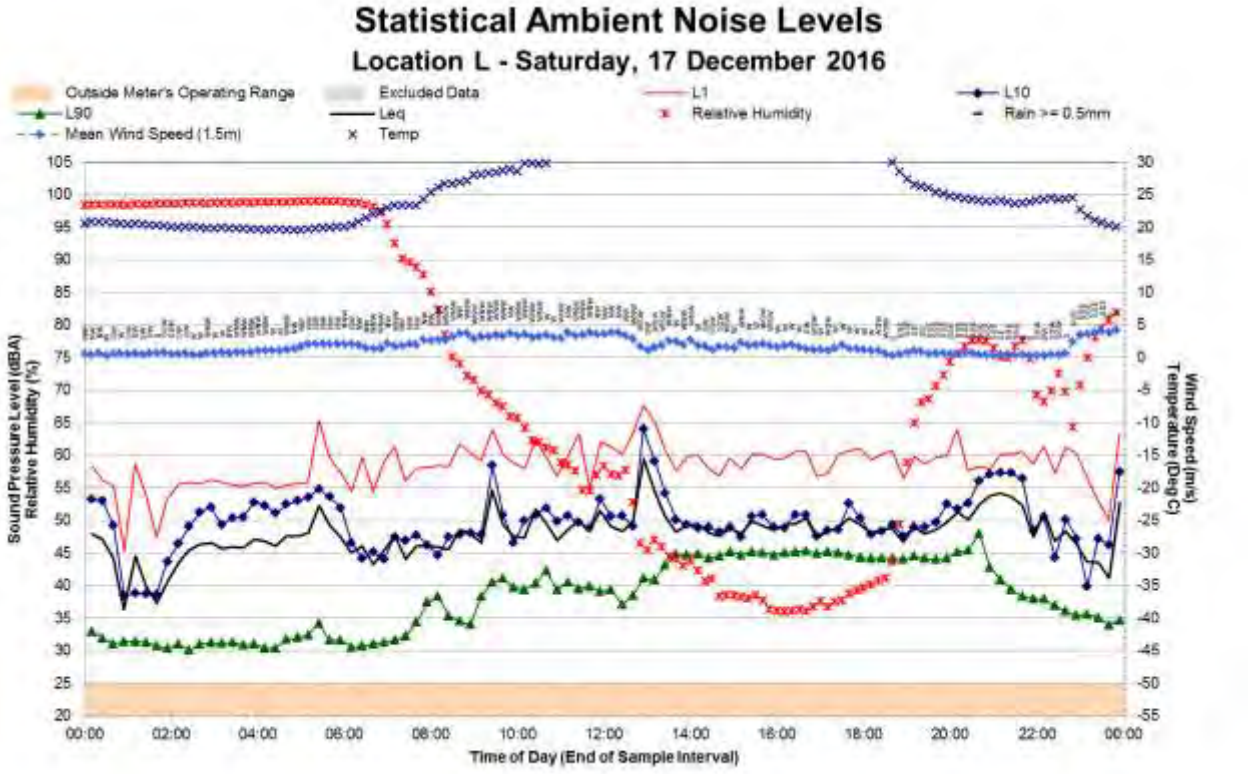
Statistical Ambient Noise Levels – Location G

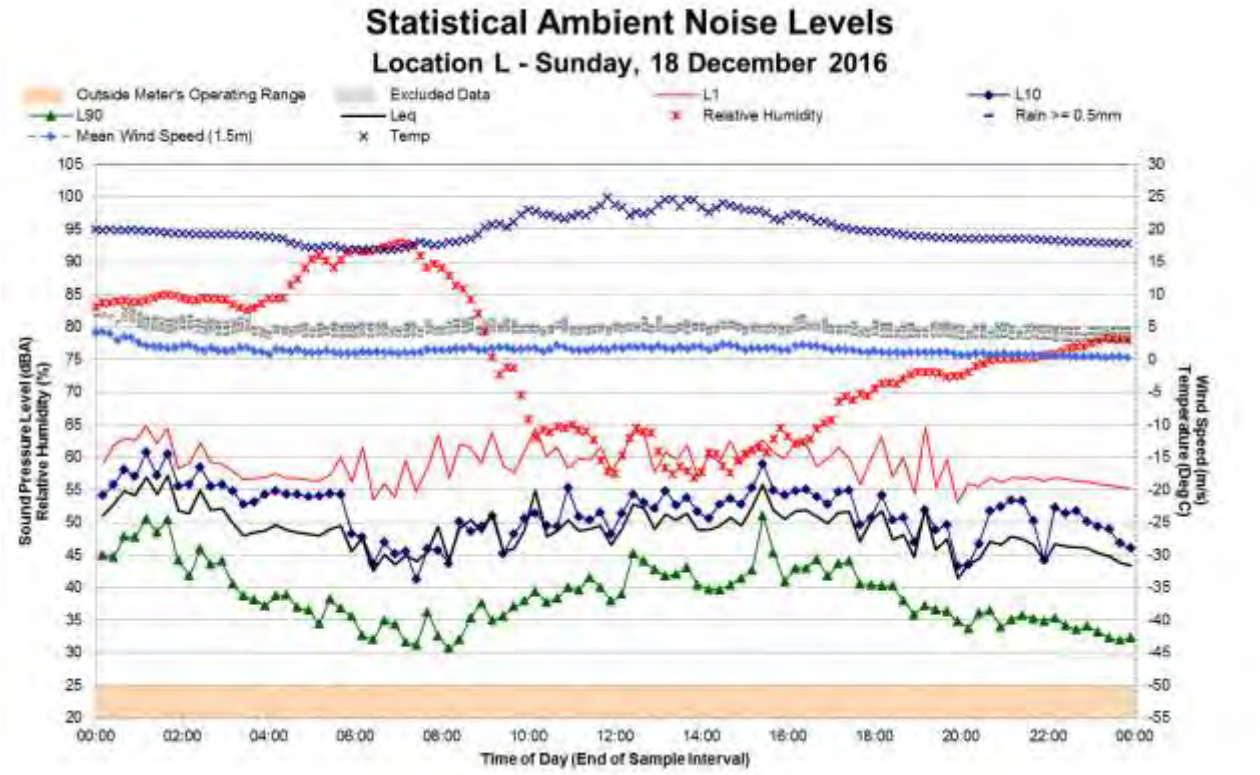


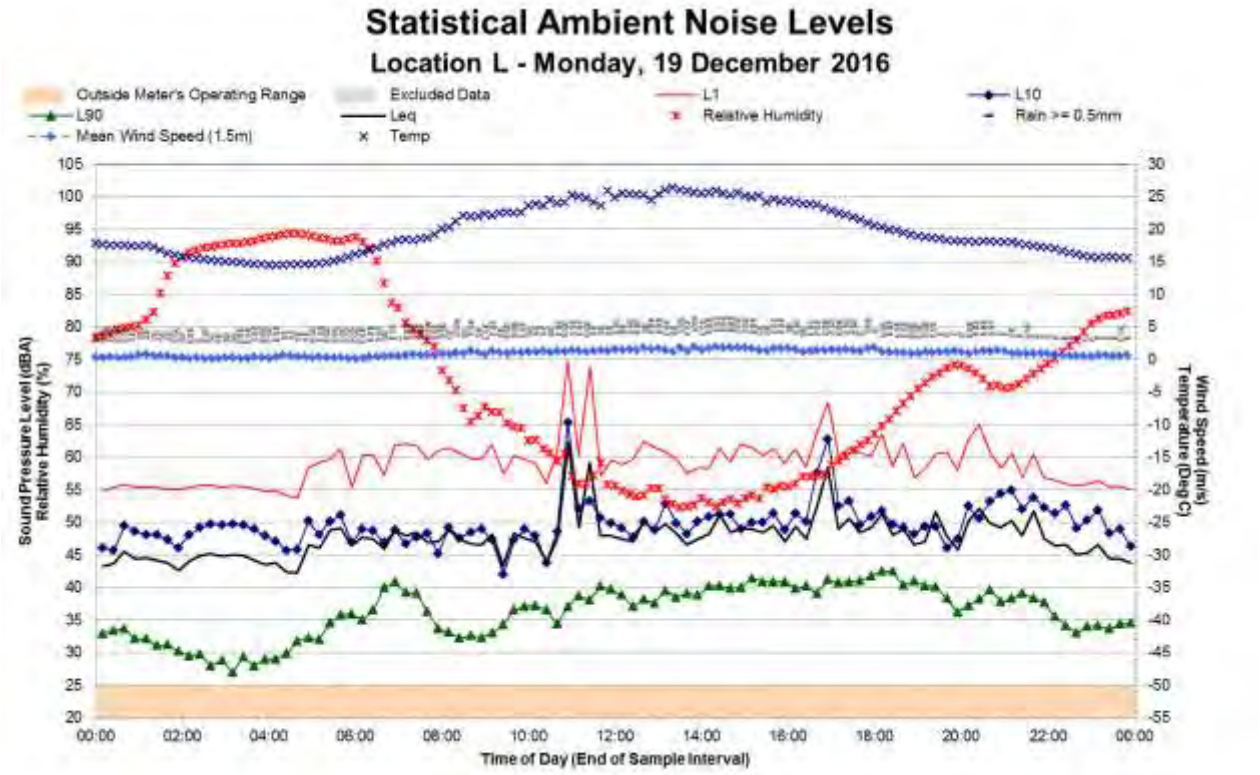
Appendix C3

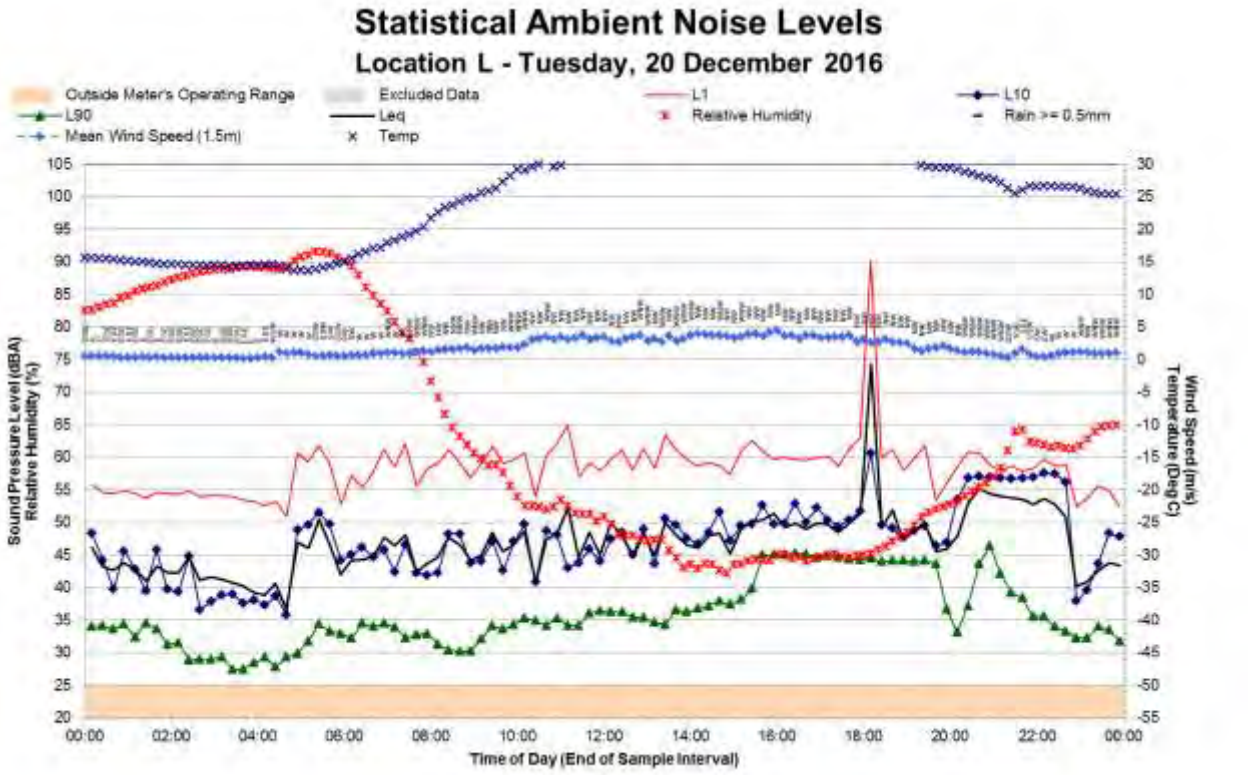
Statistical Ambient Noise Levels – Location L

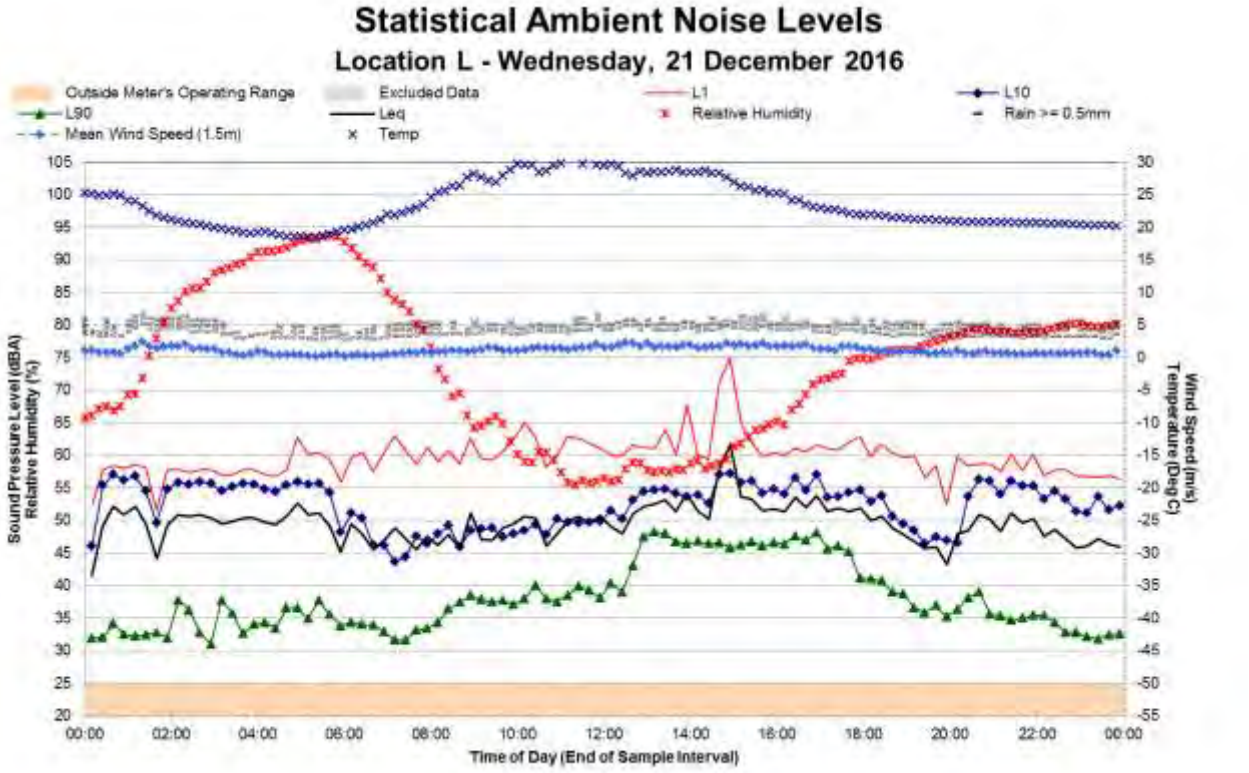


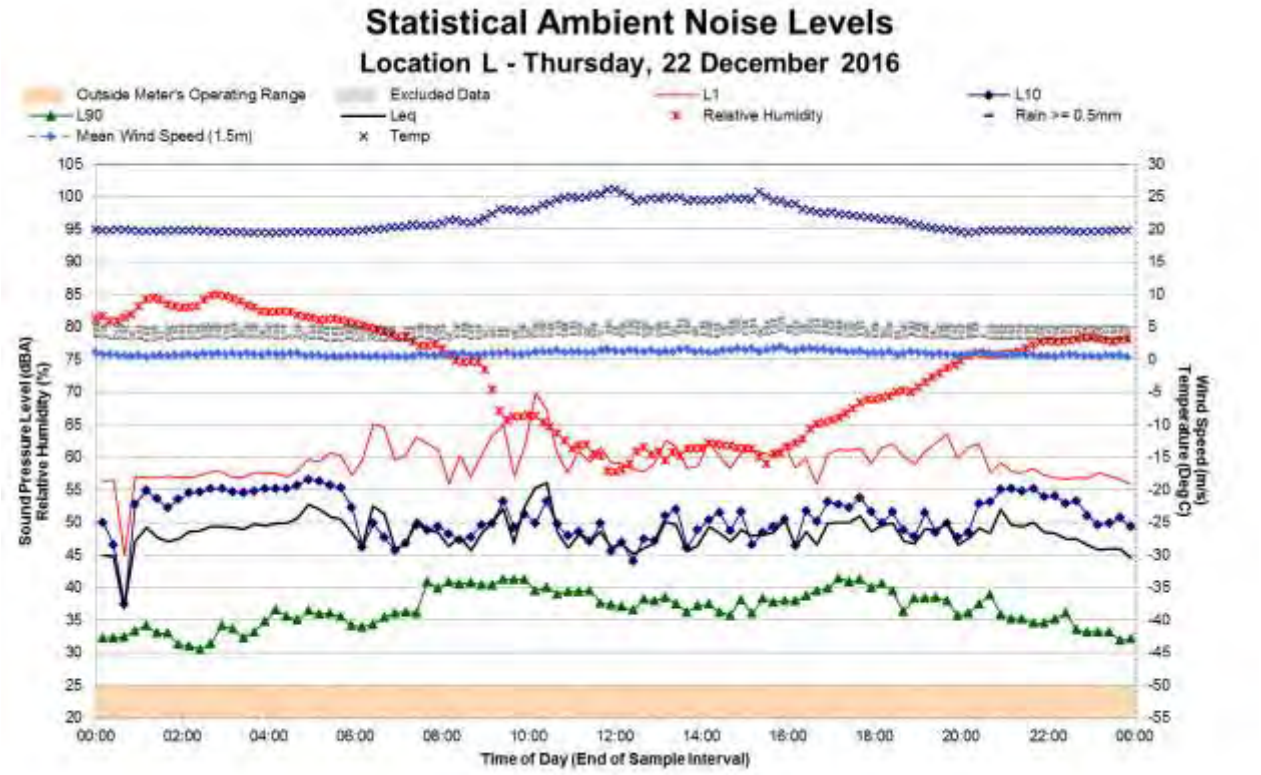


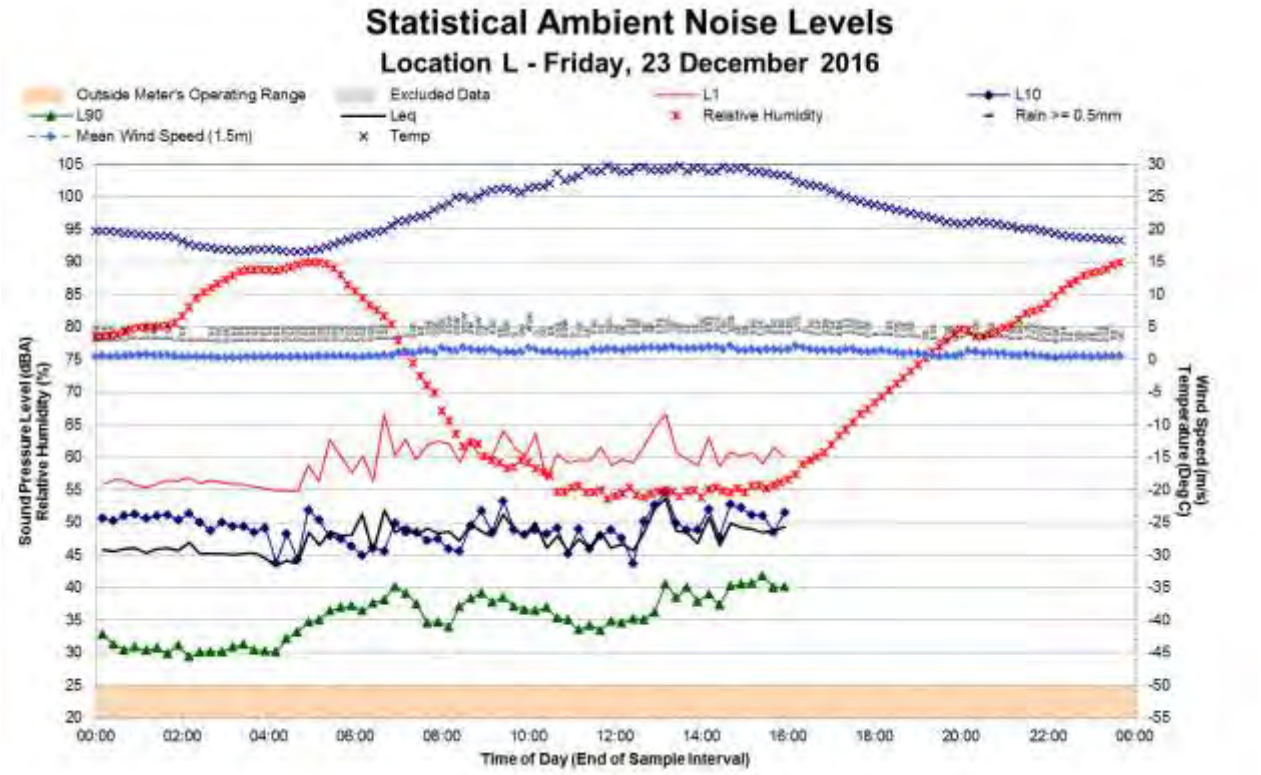

Statistical Ambient Noise Levels
Location L - Sunday, 18 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location L - Monday, 19 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location L - Tuesday, 20 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

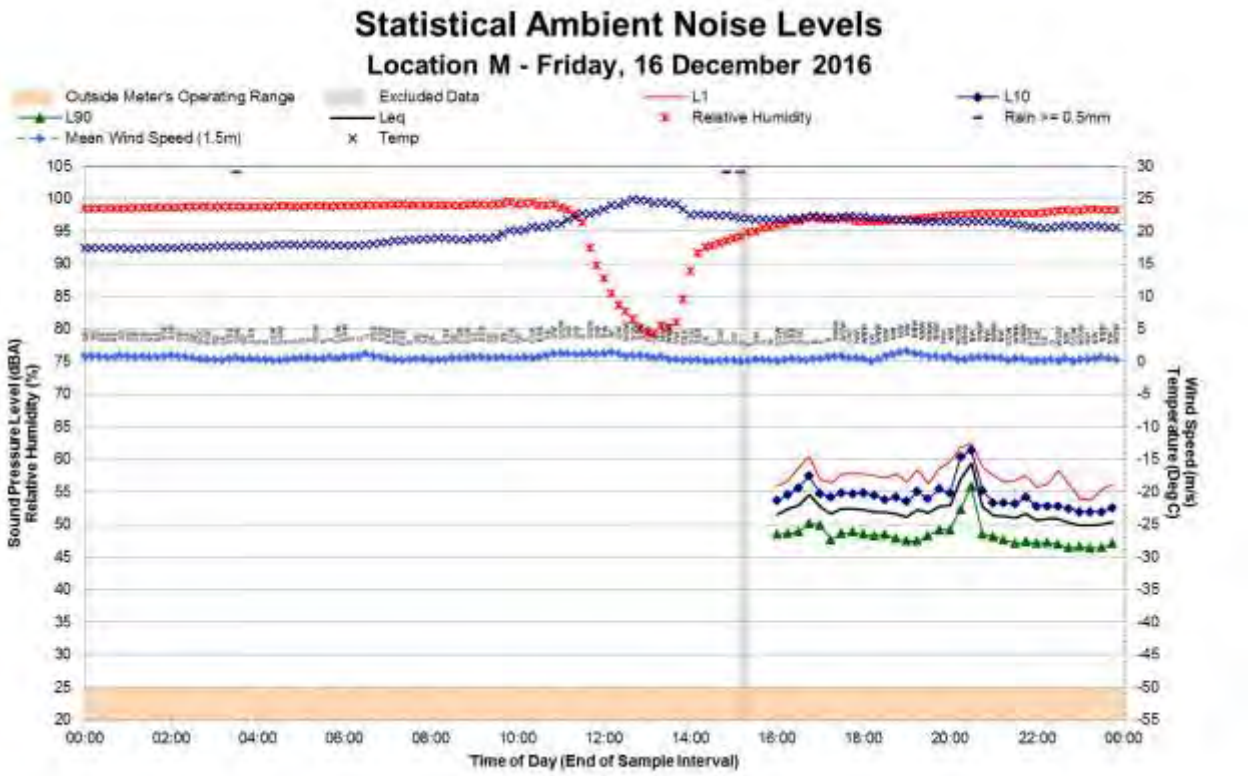

Statistical Ambient Noise Levels
Location L - Wednesday, 21 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

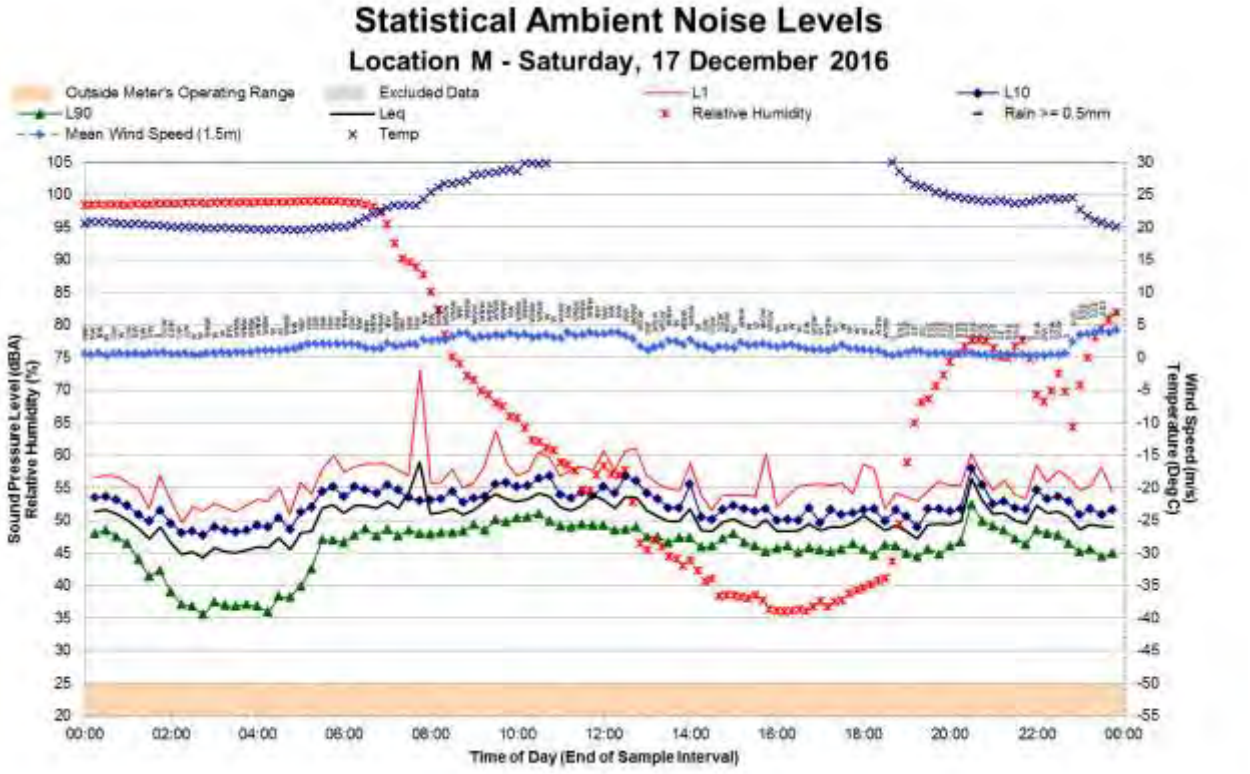

Statistical Ambient Noise Levels
Location L - Thursday, 22 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

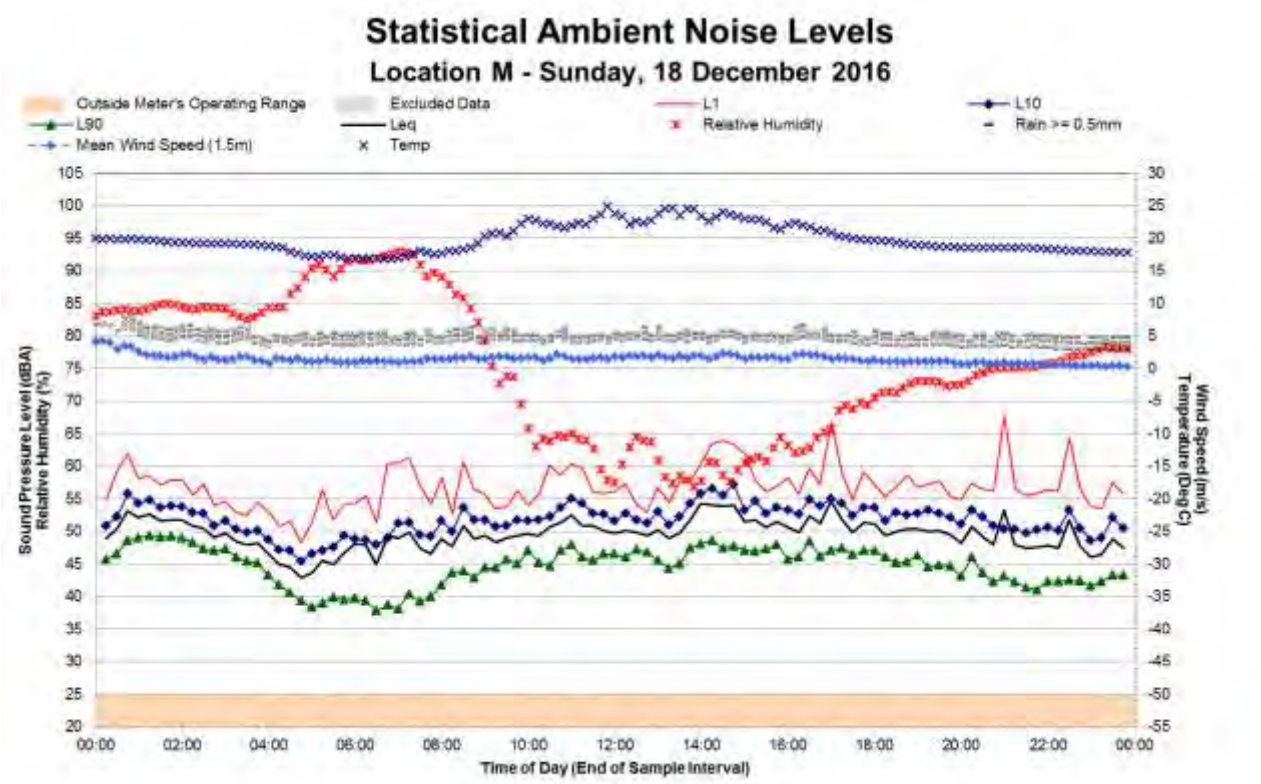

Statistical Ambient Noise Levels
Location L - Friday, 23 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

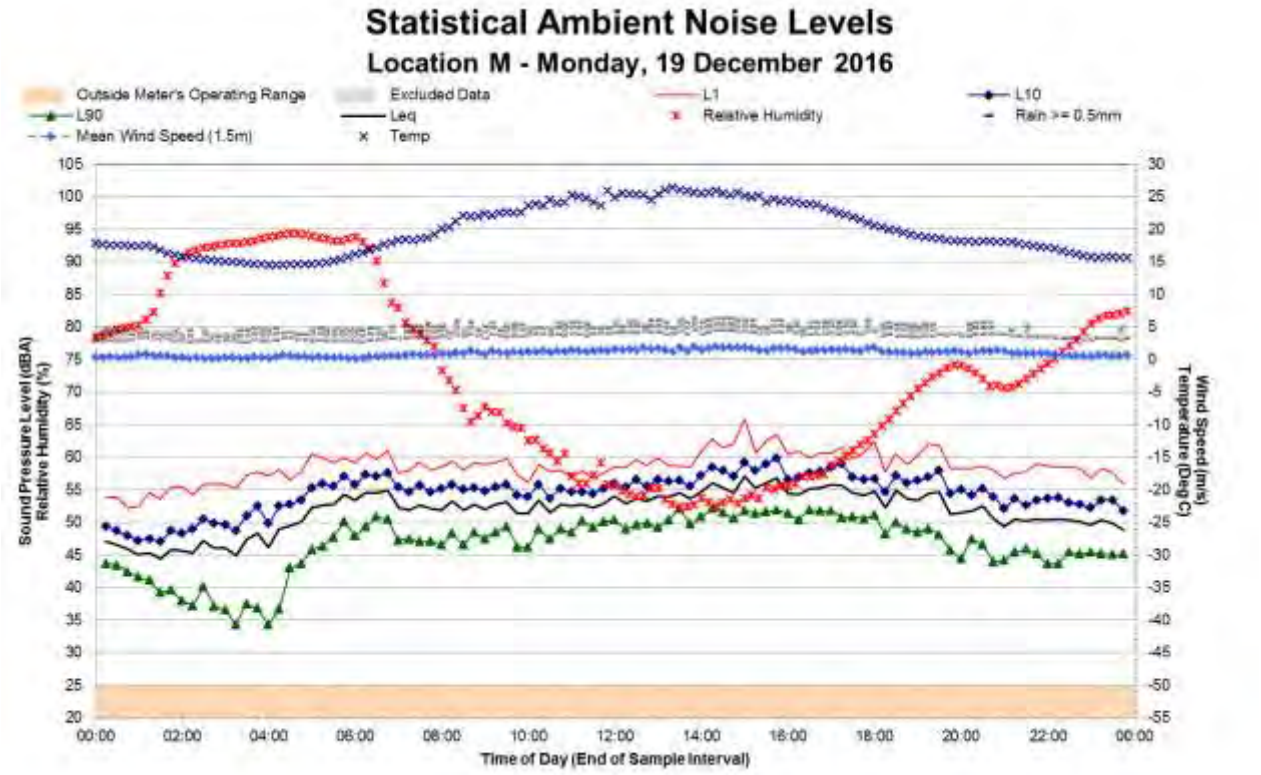
Appendix C4

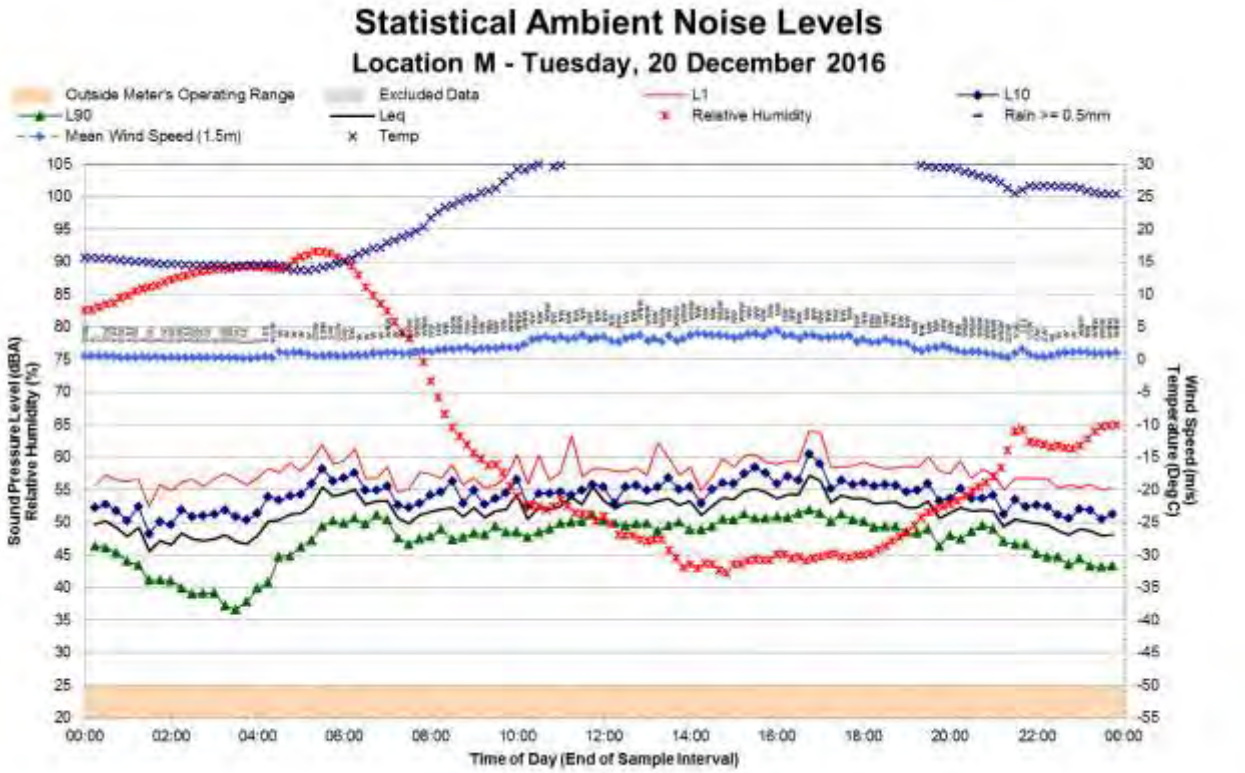
Statistical Ambient Noise Levels – Location M

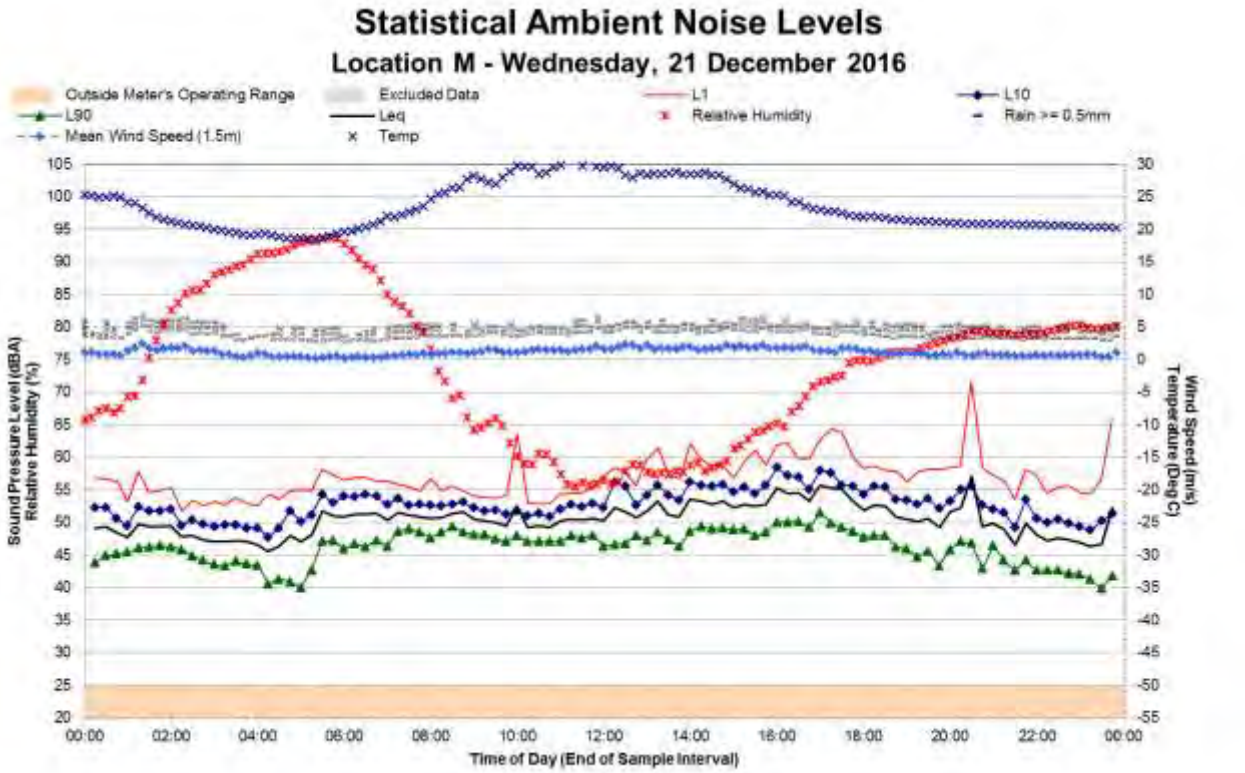


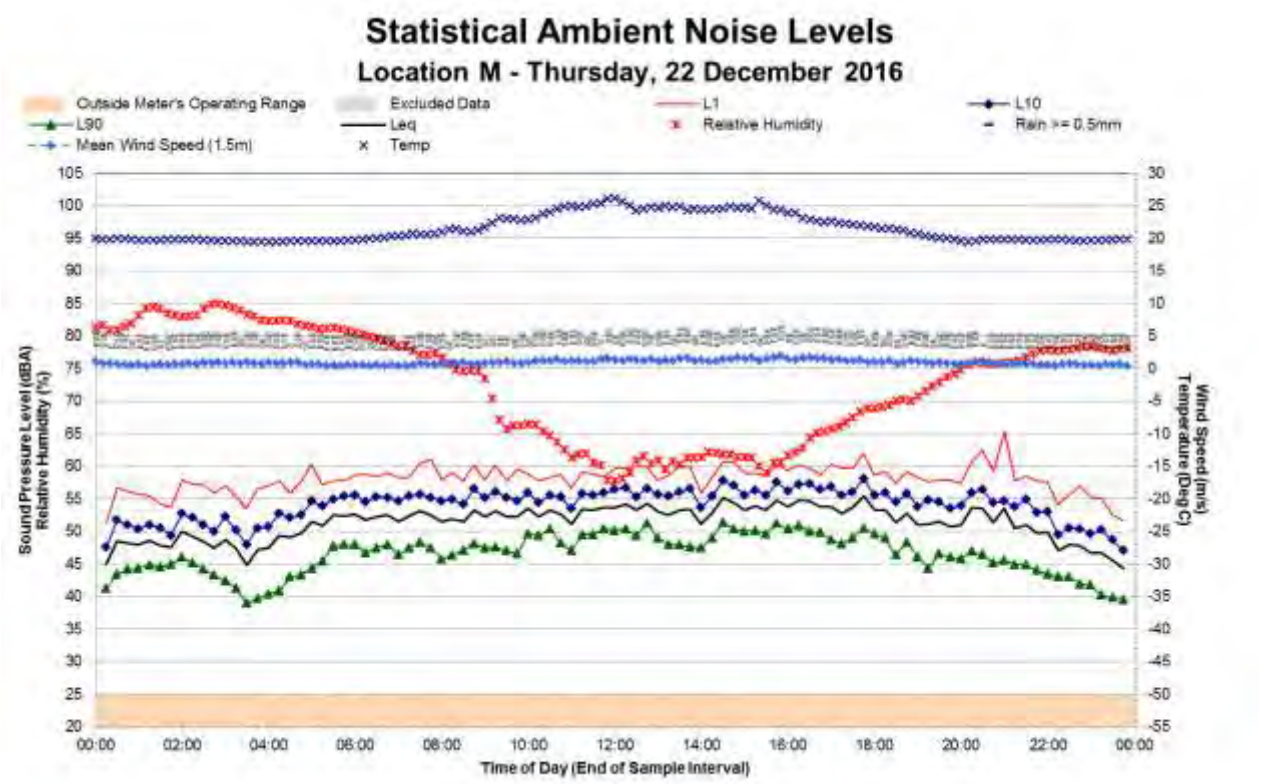


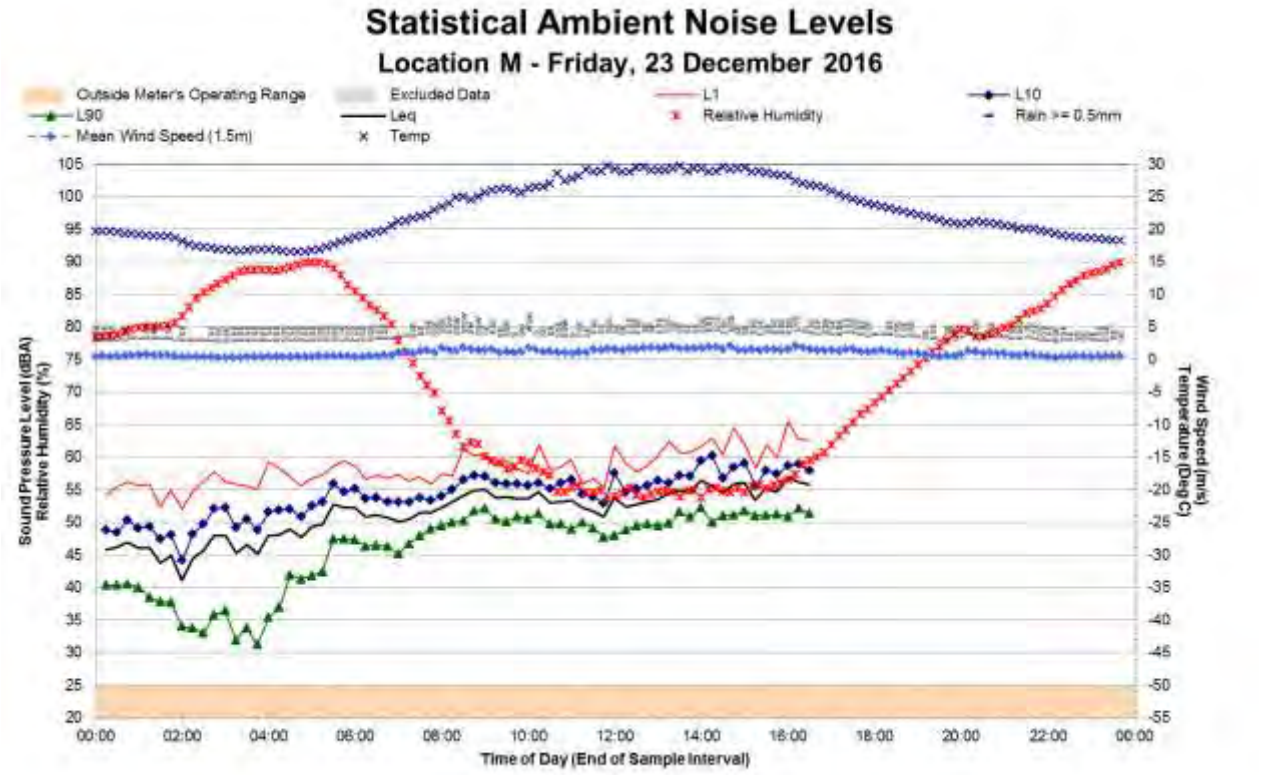

Statistical Ambient Noise Levels
Location M - Sunday, 18 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location M - Monday, 19 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location M - Tuesday, 20 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

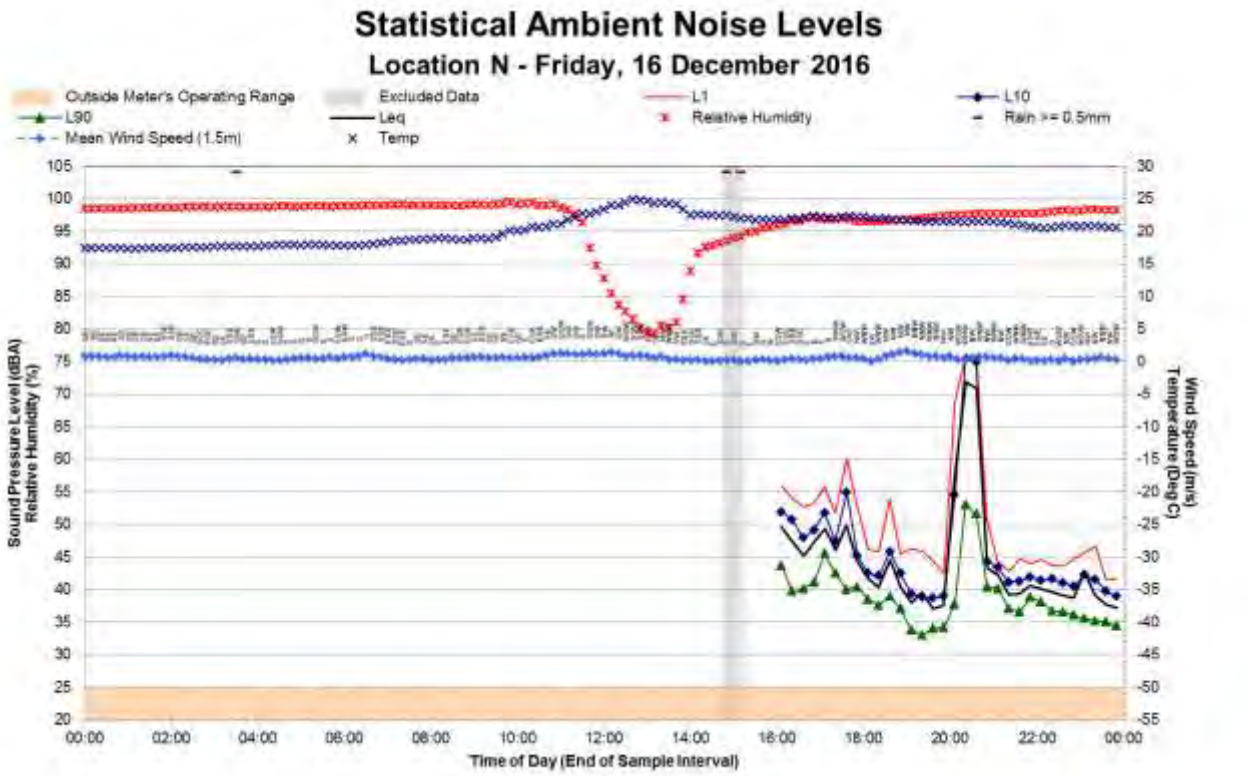

Statistical Ambient Noise Levels
Location M - Wednesday, 21 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

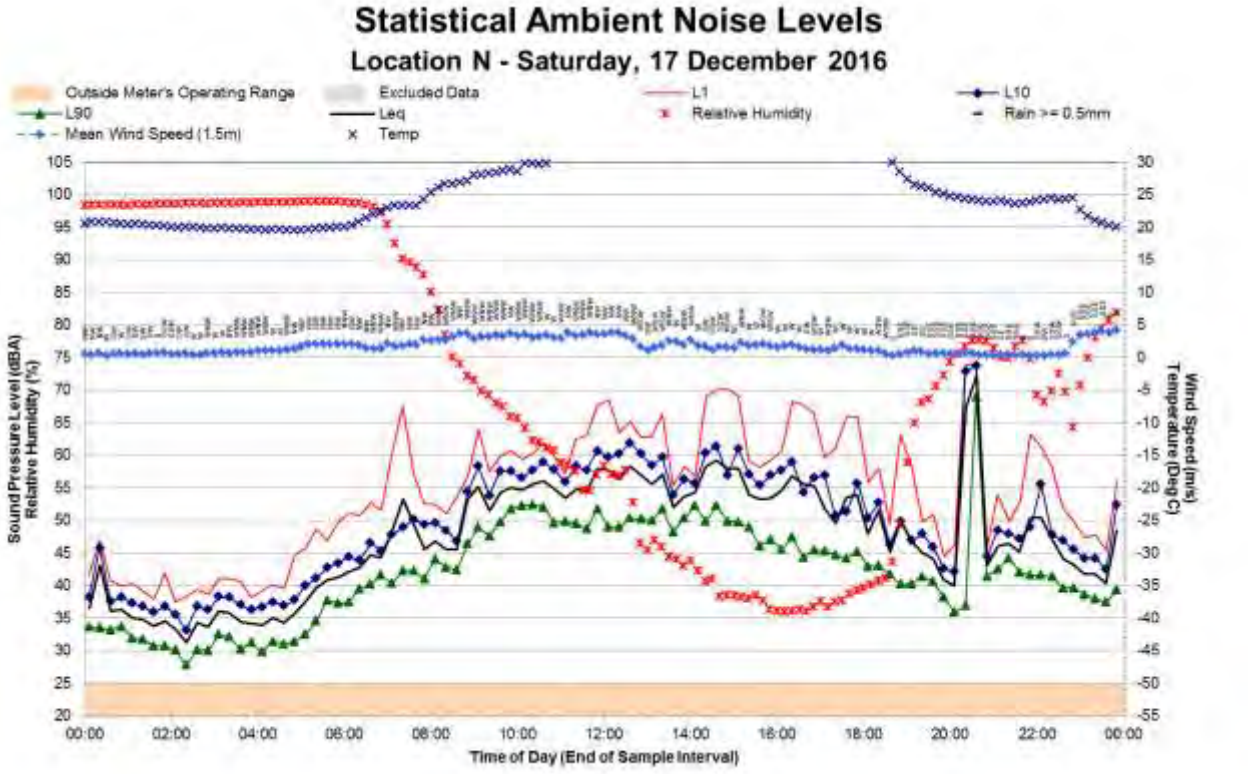

Statistical Ambient Noise Levels
Location M - Thursday, 22 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location M - Friday, 23 December 2016
Outside Meter's Operating Range
Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Temp
Sound Pressure Level (dBA)
Relative Humidity (%)
Wind Speed (m/s)
Temperature (Deg C)
Time of Day (End of Sample Interval)

Appendix C5

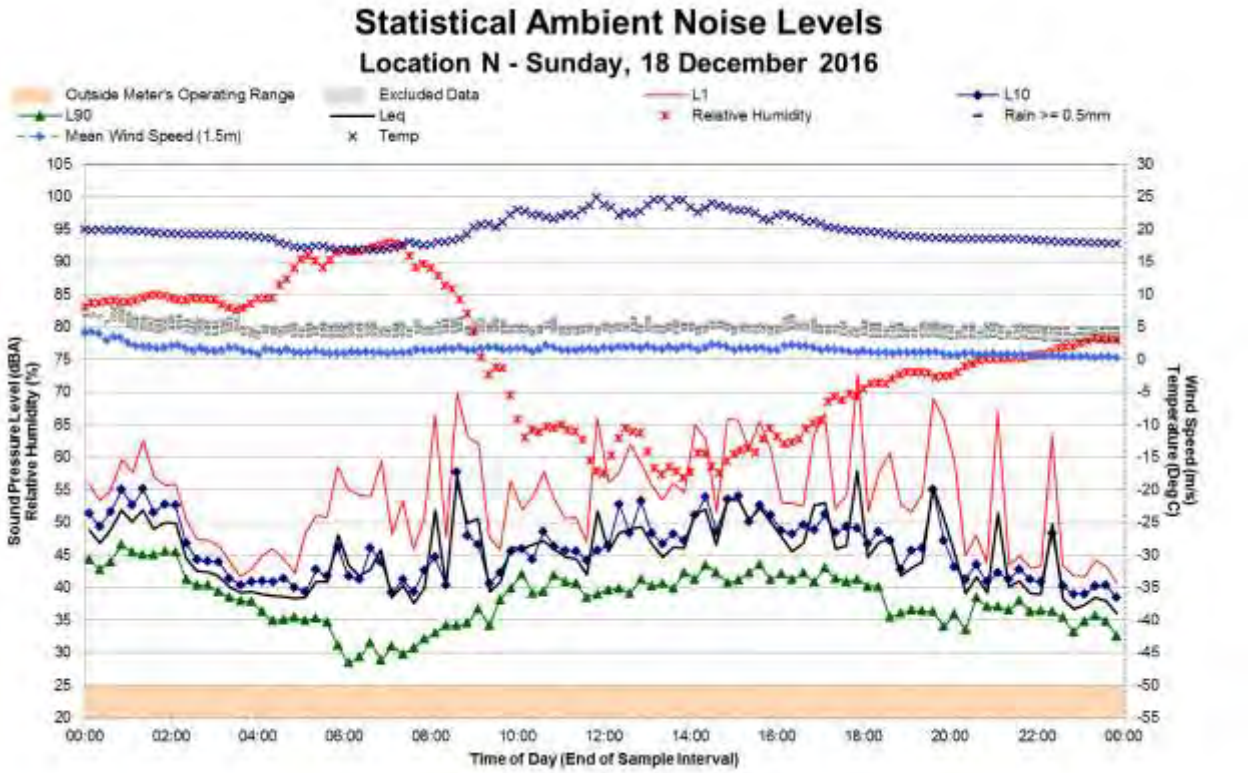
Statistical Ambient Noise Levels – Location N

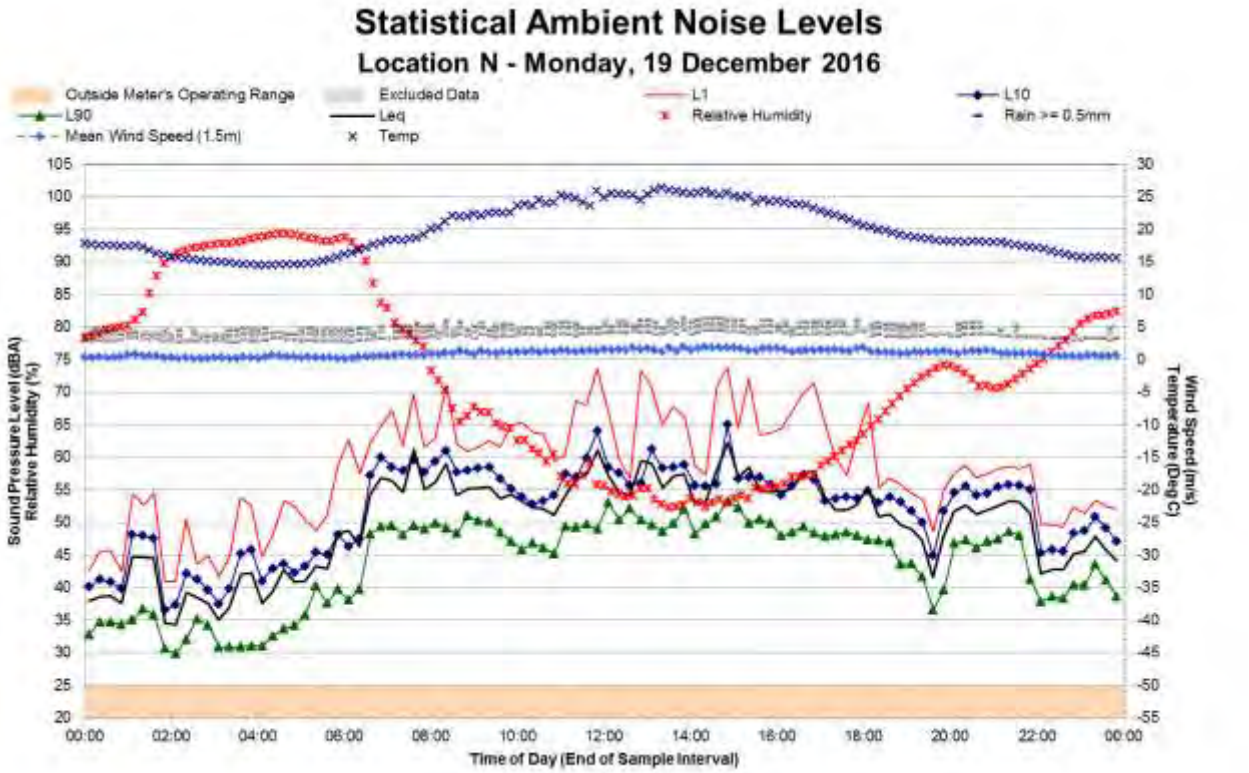




Appendix C5

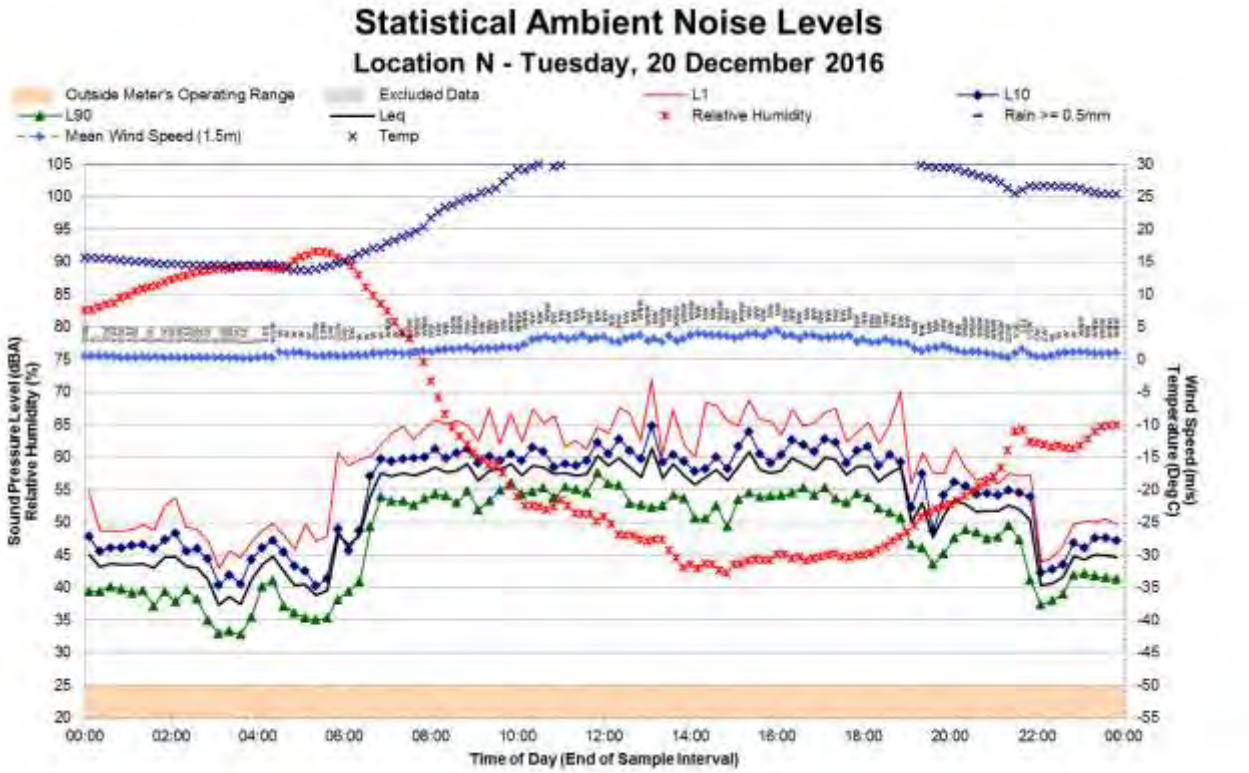
Statistical Ambient Noise Levels – Location N

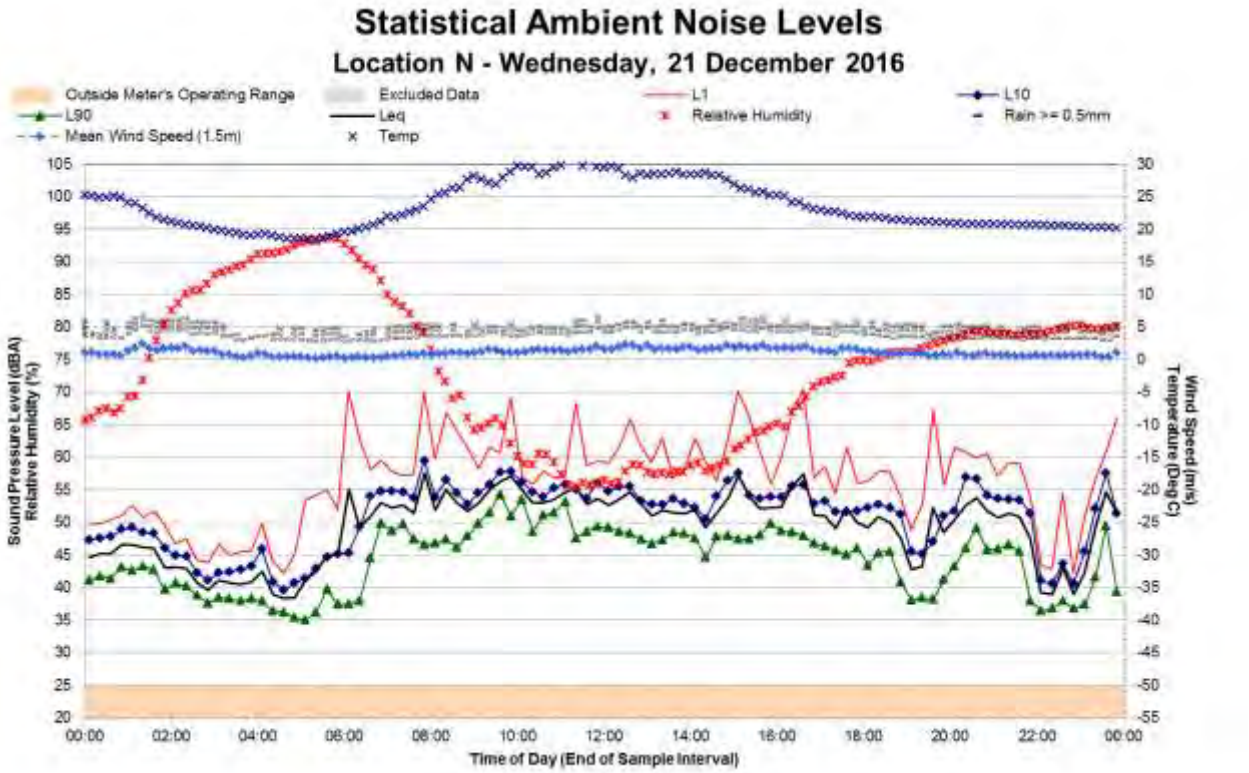




Appendix C5

Statistical Ambient Noise Levels – Location N





Appendix C5

Statistical Ambient Noise Levels – Location N