NOISE AND VIBRATION IMPACT ASSESSMENT
FOR
TALLAWARRA-B POWER STATION MODIFICATION

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EXECUTIVE SUMMARY

Benbow Environmental has been commissioned by EnergyAustralia to undertake a noise impact assessment (NIA) to support EnergyAustralia's modification request to Project Approval 07_0124. The proposed modification "modified project" is the second modification (Mod-2) that relates to the Tallawarra Stage B Gas Turbine Power Station Project. This NIA assesses the potential noise impacts associated with the use of one new F Class Open Cycle Gas Turbine (OCGT) (280 – 400 MW) that will replace the two proposed E Class OCGTs with a nominal capacity of 300 – 450 MW. The F Class OCGT is a more efficient machine than the E Class OCGT.

This noise impact assessment includes:

- Consideration of surrounding land uses;
- Consideration of current legislation and guidelines including Noise Policy for Industry (2017);
- Background noise monitoring, when Tallawarra - A was not operating (during maintenance);
- Establishing criteria in accordance with the Noise Policy for Industry (2017);
- Modelling of Tallawarra - A noise calibrated from on-site measurements;
- Modelling of proposed 1 x F class OCGT noise;
- Comparison of the noise emissions from 1 x F-class OCGT to 2 x E-class OCGTs against the noise limits;
- Assessment of low frequency noise;
- Assessment of start up noise – calibrated from on-site measurements of Tallawarra A - start up;
- Construction noise impact assessment undertaken in accordance with the NSW Interim Construction Noise Guidelines;
- Road noise impact assessment undertaken in accordance with the Road Noise Policy 2011 (RNP)
- Discussion of noise and vibration impacts associated with construction, operation and road traffic associated with the modified Project;
- Recommendations of mitigation measures; and
- A statement of predicted compliance.

The predicted results for the proposed F Class OCGT plant noise levels show slightly lower noise emissions compared to the currently approved 2xE Class OCGT plant. All scenarios are predicted to comply with the relevant criteria derived from the NSW Noise Policy for Industry.

Sleep disturbance is predicted to comply with the sleep disturbance criteria.

Construction noise impacts are predicted to comply with the NSW Interim Construction Noise Criteria at all receivers.

Vibration impacts are expected to be negligible. The vibration goals in accordance with the existing project approval are the: vibration limits set out in the Assessing Vibration: A Technical Guideline (Department of Environment and Climate Change, 2006) for human exposure. The vibration impacts are expected to comply with this requirement. A detailed vibration assessment is not considered warranted.

Road noise impacts have been assessed and readily achieve compliance with the RNP.

Although not required to achieve compliance mitigation and management practices are outlined in Section 10.

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1. INTRODUCTION

Benbow Environmental has been commissioned by EnergyAustralia to undertake a noise impact assessment (NIA) to support EnergyAustralia's modification request to Project Approval 07_0124. The proposed modification "modified project" is the second modification (Mod-2) that relates to the Tallawarra Stage B Gas Turbine Power Station Project. This NIA assesses the potential noise impacts associated with the use of one new F Class Open Cycle Gas Turbine (OCGT) (280 – 400 MW) that will replace the two proposed E Class OCGTs with a nominal capacity of 300 – 450 MW.

1.1 Scope of Works

This noise impact assessment includes the following:

- Consideration of surrounding land uses;
- Consideration of current legislation and guidelines including Noise Policy for Industry (2017);
- Background noise monitoring, when Tallawarra - A was not operating (during maintenance);
- Establishing criteria in accordance with the Noise Policy for Industry (2017);
- Modelling of Tallawarra - A noise calibrated from on-site measurements;
- Modelling of proposed 1 x F class OCGT noise;
- Comparison of the noise emissions from 1 x F-class OCGT to 2 x E-class OCGTs against the noise limits;
- Assessment of low frequency noise;
- Assessment of start up noise – calibrated from on-site measurements of Tallawarra A - start up;
- Construction noise impact assessment undertaken in accordance with the NSW Interim Construction Noise Guidelines;
- Road noise impact assessment undertaken in accordance with the Road Noise Policy 2011 (RNP)
- Discussion of noise and vibration impacts associated with construction, operation and road traffic associated with the modified Project;
- Recommendations of mitigation measures; and
- A statement of predicted compliance.

2. PROJECT AND SITE DESCRIPTION

2.1 APPROVED PROJECT

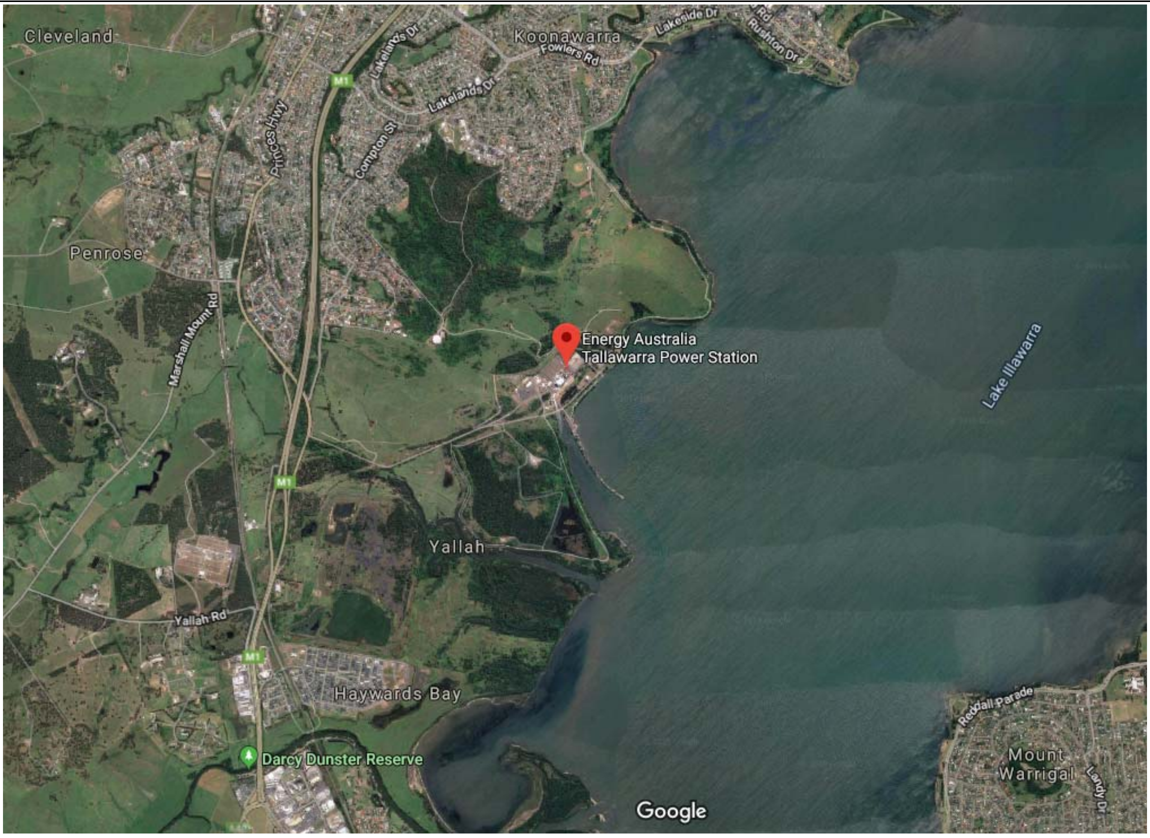
The Tallawarra Power Station contains an existing 420 MW combined cycle gas fired power station (Tallawarra A) which has been operating since 2009.

In 2010 the Department of Planning's Major Projects approved 2 or 3 'E Class Gas Turbines' (Tallawarra B). EnergyAustralia is seeking to modify this application to 1 'F Class Gas Turbine' which is to operate at 280 MW to 400 MW.

2.1.1 Site Location

The site location is shown in Figure 2-1.

Figure 2-1: Site Location



Source: Google Earth 2019

↑N		Benbow Environmental 25-27 Sherwood Street, Northmead NSW 2152

2.1.2 Hours of Operations

The plant will generally operate intermittently. However, occasionally, the plant may operate for 24 hours. Therefore this study is based on Tallawarra site operating 24 hours, 7 days a week as a conservative approach.

2.2 MODIFIED PROJECT DESCRIPTION

The current approval allows for the construction and operation of a two- or three-unit E-Class gas turbines. The modified project involves the construction and operation of one F-class single open cycle gas turbine (OCGT) unit.

2.3 DESCRIPTION OF THE SURROUNDING AREA

The site is located on the western bank of Lake Illawarra surrounded by vacant grassed areas. The closest existing residential area is located approximately 1 km to the north of the site. There are plans to redevelop some of the surrounding vacant area as shown in Figure 2-2. The future uses include, residential, commercial/industrial, business parks and potential aged care and schooling facilities. The closest future residential area is located approximately 710 m to the north of the site.

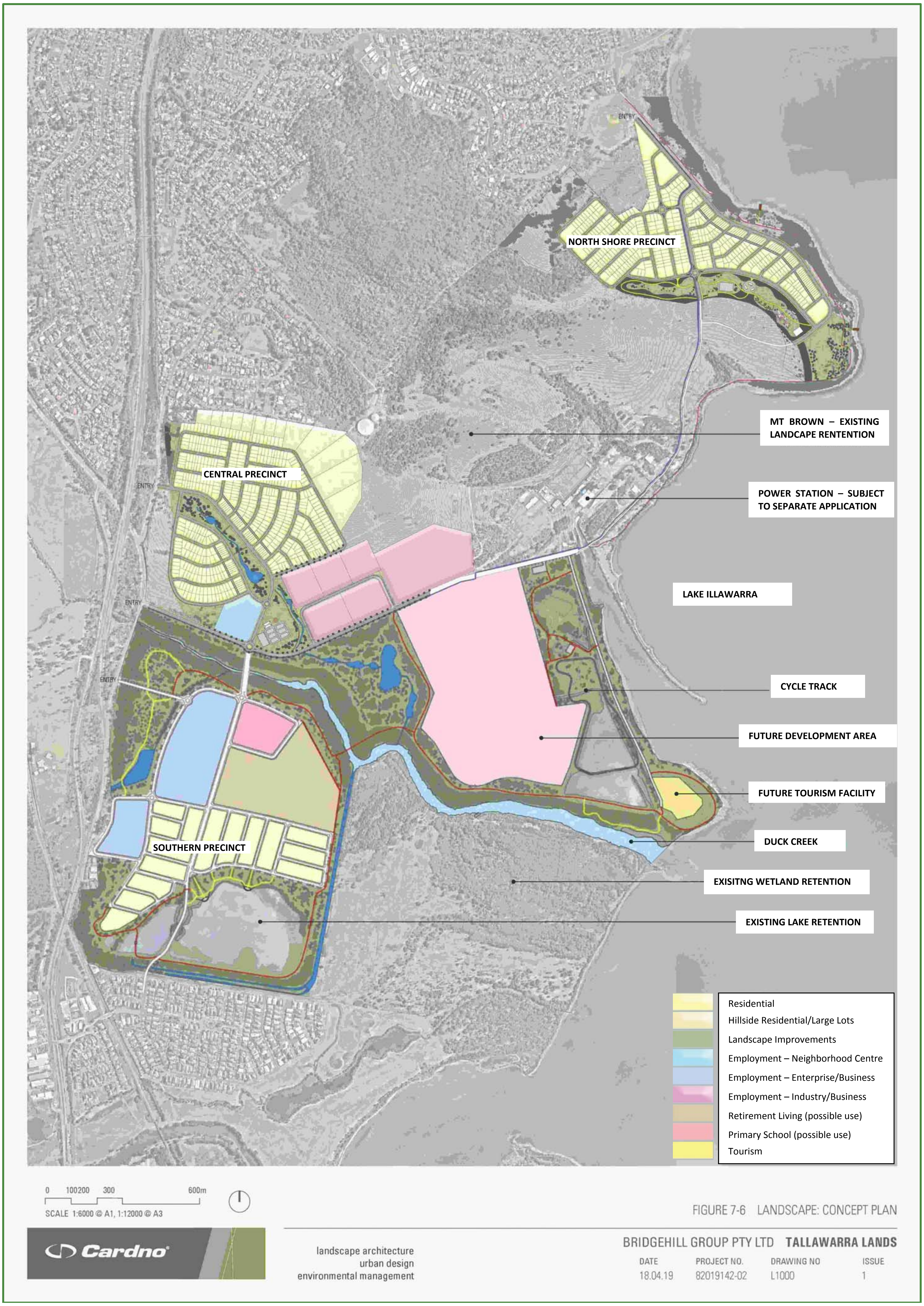
2.3.1 Land Use Changes

Since the original approval the residential area in Haywards Bay south west of the site has been constructed and occupied. Furthermore areas of Tallawarra Lands have been designated and approved for future use including residential use, within closer proximity to the site than the current surrounding receivers. Noise is a priority issue in the vicinity due to the complexity of noise sources and the potential land use conflict with the Tallawarra Lands development. Further, a current modification application for Tallawarra Lands, if approved, will mean a significant increase in housing density in the proximity of the power stations. Therefore future receivers have been included in the assessment. These are shown in Figure 2-2 and represented by receivers 12 to 32 in Table 2-1, Figure 2-3 and Figure 2-4. Tallawarra Lands was considered and anticipated by the original EIS, even though approval had not been finalised at the time.

2.4 NEAREST SENSITIVE RECEIVERS

Table 2-1 lists the representative locations of potentially affected existing and future receivers that are considered in this assessment. The locations are shown on the most recent layout in the following figures.

Figure 2-2: Future Use Concept Plan



Source: Cardno Landscape Concept Plan 2019

Table 2-1: Nearest Receivers

Receiver ID	Project Approval ID	Address	Direction from Site	Lot and DP	Approximate distance to site (m)	Easting	Northing	Type of receiver
R1	T2	54 Carlyle Close Dapto	NW	Lot 819 DP876973	1,150	297722.26	6177950.65	Residential
R2	T2	44 Coronet Place Dapto	NW	Lot 11 DP703747	1,120	297790.30	6178228.53	Residential
R3	T4	17 Malonga Place Koonawarra	N	Lot 169 DP262210	1,060	298541.81	6178767.46	Residential
R4	T4	83 Wyndarra Way Koonawarra	N	Lot 239 DP262630	1,240	298723.14	6178982.11	Residential
R5	-	68 Gilba Road Koonawarra	N	Lot 220 DP242860	1,450	298875.86	6179230.15	Residential
R6	ML#9	57 The Boulevarde Oak Flats	S	Lot 200 DP13638	3,500	299687.96	6174255.44	Residential
R7	ML#9	23 Park Crescent Oak Flats	S	Lot 421 DP15987	3,800	298913.91	6173834.90	Residential
R8	ML#10	295 Reddall Parade Mount Warrigal	SE	Lot 261DP223828	3,650	301667.93	6175420.38	Residential
R9	ML#11	82 Haywards Bay Drive Haywards Bay	SW	Lot 523 DP1194029	2,370	297736.81	6175681.13	Residential
R10	ML#11	116 Haywards Bay Drive Haywards Bay	SW	Lot 226 DP1112514	2,470	297360.16	6175753.86	Residential
R11	ML#11	142a Haywards Bay Drive Haywards Bay	SW	Lot 381 DP1137139	2,720	297094.94	6175789.77	Residential
Tallawarra Lands Future Receivers								
R12	Most affected residence – proposed south-western residential area	Southern Precinct	SW	Lot 2 DP792664	1,840	297772.00	6176344.10	Residential
R13		Southern Precinct	SW	Lot 151 DP628980	1,960	297504.86	6176416.91	Residential

Table 2-1: Nearest Receivers

Receiver ID	Project Approval ID	Address	Direction from Site	Lot and DP	Approximate distance to site (m)	Easting	Northing	Type of receiver
R14	Most affected residence – proposed central residential area	Central Precinct	W	Lot 15 DP DP1050255	1,100	297828.31	6177479.52	Residential
R15		Central Precinct	W	Lot 15 DP DP1050255	1,000	297885.37	6177673.22	Residential
R16		Central Precinct	W	Lot 1 DP551658	1,000	297884.38	6177776.82	Residential
R17		Central Precinct	NW	Lot 102 DP716727	1,010	297874.24	6177843.85	Residential
R18	Most affected residence – proposed northern residential area	Northern Precinct	N	Lot 30 DP1175058	870	298713.53	6178645.77	Residential
R19		Northern Precinct	N	Lot 30 DP1175058	820	298767.19	6178592.09	Residential
R20		Northern Precinct	N	Lot 30 DP1175058	750	298820.85	6178537.22	Residential
R21		Northern Precinct	N	Lot 30 DP1175058	710	298875.70	6178497.85	Residential
R22		Northern Precinct	NE	Lot 30 DP1175058	750	299024.79	6178521.67	Residential
R23		Northern Precinct	NE	Lot 30 DP1175058	800	299146.45	6178534.76	Residential
R24		Northern Precinct	NE	Lot 30 DP1175058	890	299302.70	6178559.77	Residential
R25		Northern Precinct	NE	Lot 30 DP1175058	850	299444.62	6178533.50	Residential
R26		Northern Precinct	NE	Lot 30 DP1175058	990	299556.72	6178471.46	Residential
R27		Northern Precinct	NE	Lot 30 DP1175058	990	299655.69	6178362.90	Residential

Table 2-1: Nearest Receivers

Receiver ID	Project Approval ID	Address	Direction from Site	Lot and DP	Approximate distance to site (m)	Easting	Northing	Type of receiver
R28	Most affected residence – proposed south-western residential area	Southern Precinct	SW	Lot 11 DP552933	1,580	297668.70	6176757.99	Aged Care (residential)
R29	-	Central Precinct	W	Lot 31 DP1175058	600	298323.28	6177514.00	Commercial
R30	-	Central Precinct	W	Lot 15 DP DP1050255	1,000	297930.88	6177478.31	Commercial
R31 R31B	-	Future Development Area (Potential Primary School)	SW	Lot 31 DP1175058	580 970	298492.60 298385.18	6177360.11 6176960.58	School
R32	-	Future Tourism Facility	S	Lot 31 DP1175058	1,250	299082.31	6176563.39	Commercial (Potential Holiday Accommodation)

Source: Benbow Environmental, SixMaps, Tallawarra Master Plan 2020

Figure 2-3: Nearest Sensitive Receivers

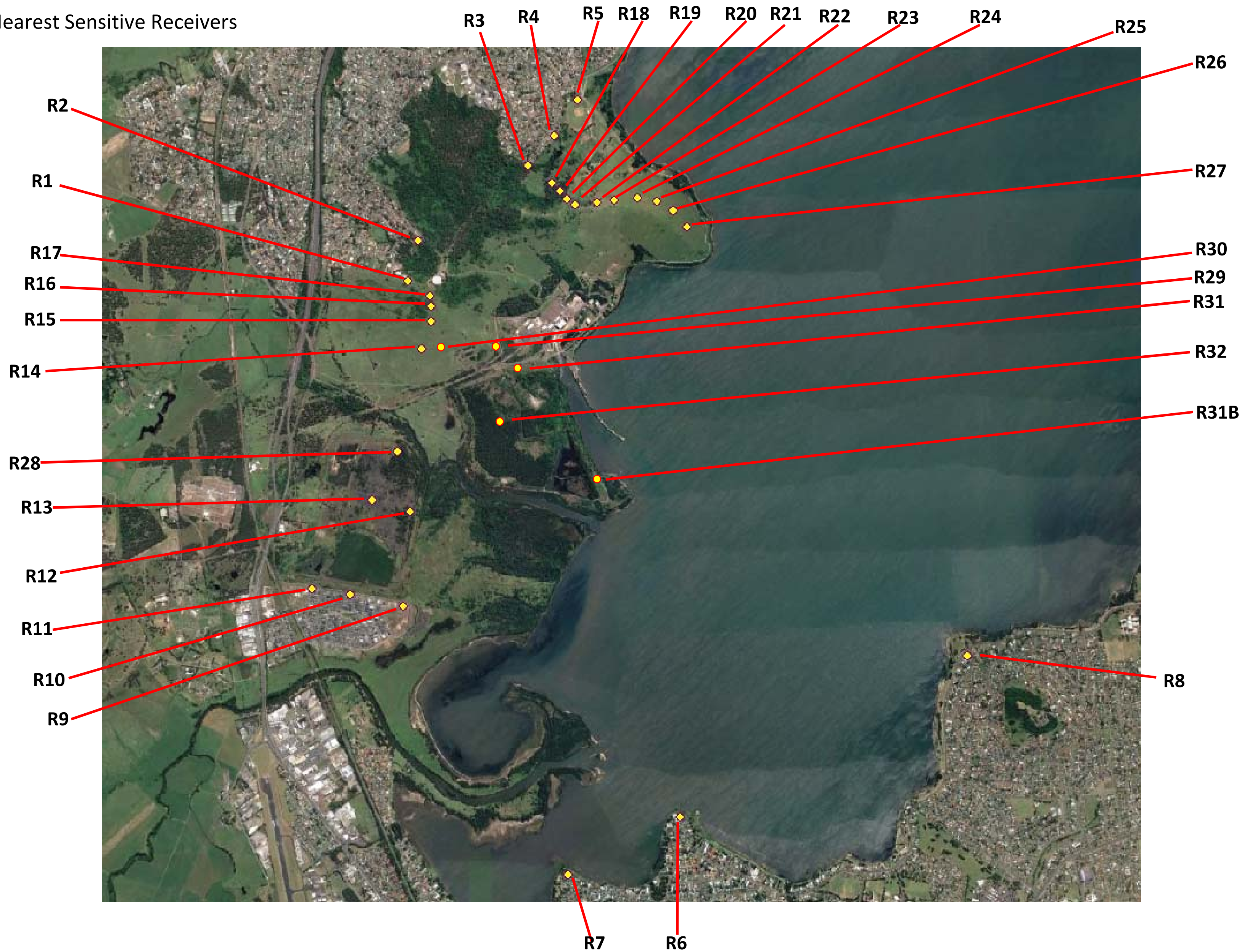
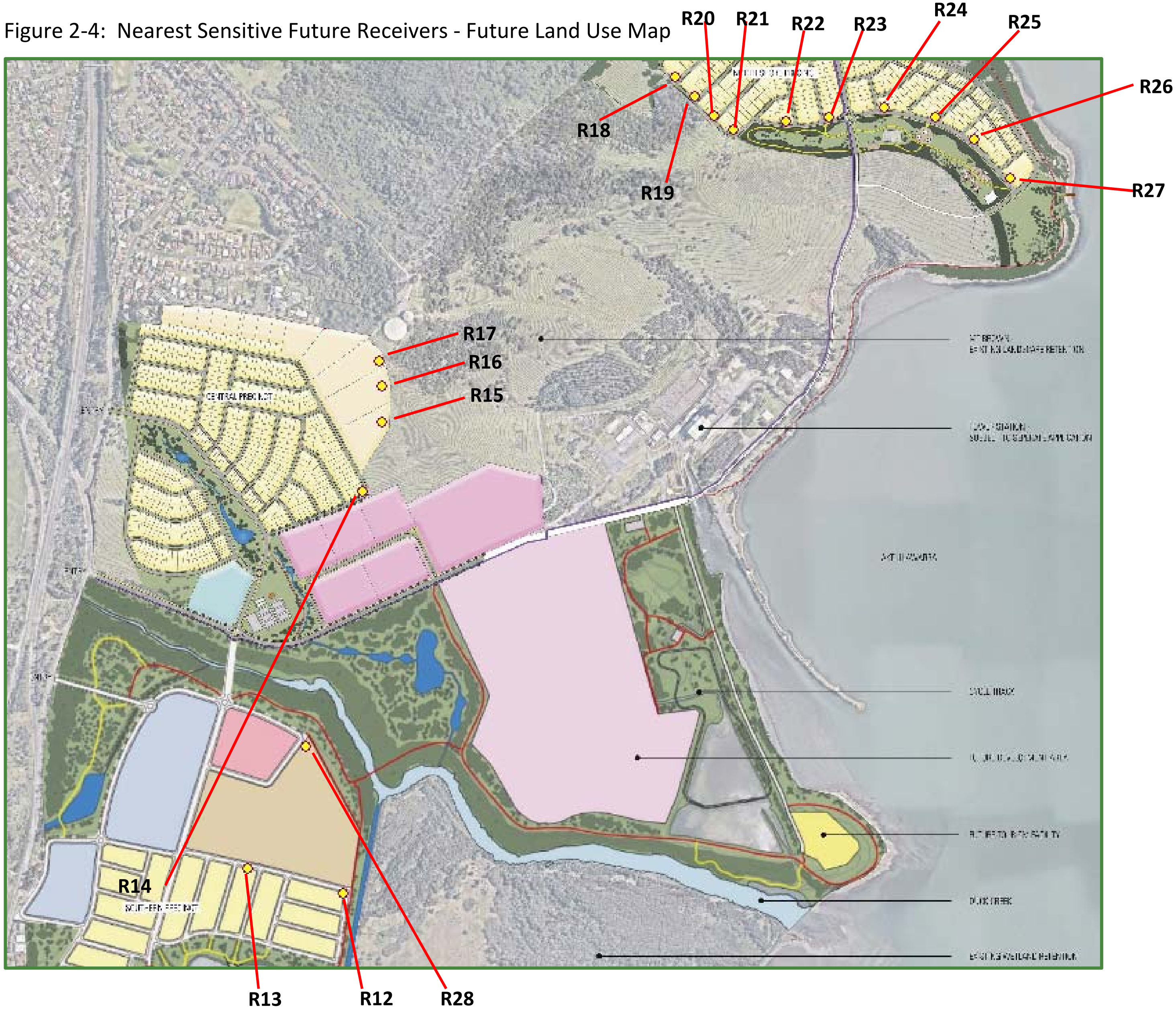


Figure 2-4: Nearest Sensitive Future Receivers - Future Land Use Map



3. EXISTING ACOUSTIC ENVIRONMENT

The level of background noise varies over the course of any 24-hour period, typically from a minimum at 3.00am, to a maximum during morning and afternoon traffic peak hours. Therefore the NSW EPA Noise Policy for Industry (2017) requires that the level of background and ambient noise be assessed separately for daytime, evening and night time periods. The Noise Policy for Industry defines these periods as follows:

- **Day** – the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays;
- **Evening** – the period from 6pm to 10pm; and
- **Night** – the remaining periods.

3.1 NOISE MONITORING EQUIPMENT AND METHODOLOGY

Background noise level measurements were carried out using a Svantek SVAN 957 Precision Sound Level Meter (attended noise monitoring) and five (5) Acoustic Research Laboratories statistical Environmental Noise Loggers, type EL-215 and NGARA (unattended noise monitoring). The instrument sets were calibrated by a NATA accredited laboratory within two years of the measurement period. Calibration certificates have been included in Attachment 2.

To ensure accuracy and reliability in the results, field reference checks were applied both before and after the measurement period with an acoustic calibrator. There were no excessive variances observed in the reference signal between the pre-measurement and post-measurement calibration. The instruments were set on A-weighted Fast response and noise levels were measured over 15-minute statistical intervals. QA/QC procedures applied for the measurement and analysis of noise levels have been presented in Attachment 3. The microphones were fitted with windsocks and were positioned between 1.2 metres and 1.5 metres above ground level.

For the loggers located on EnergyAustralia lands (Logger A and D), a small wire fence was installed around the loggers to protect them from inquisitive cattle and horses. These can be seen in photographs presented in Figure 12-1 and Figure 12-4.

3.2 MEASUREMENT LOCATION

Unattended long-term noise monitoring was undertaken from 7/8th May 2019 to 28th May 2019, at five locations shown in Figure 3-1.

Attended noise monitoring was undertaken at the Logger locations on the 7th and 28th of May 2019. Photographs of the locations are presented in Attachment 4. Noise Logger Charts are presented in Attachment 5.

3.3 MEASURED BACKGROUND NOISE LEVELS

All background noise monitoring was undertaken when the existing plant was not operating as it was undergoing maintenance during this time.

3.3.1 Long-Term Unattended Noise Monitoring Results

The data was analysed to determine a single assessment background level (ABL) for each day, evening and night time period, in accordance with the NSW EPA Noise Policy for Industry. That is, the ABL is established by determining the lowest tenth-percentile level of the L_{A90} noise data over each period of interest. The background noise level or rating background level (RBL) representing the day, evening and night assessment periods is based on the median of individual ABL's determined over the entire monitoring period.

A summary of the results of the long-term unattended noise monitoring is displayed in Table 3-1. Detailed tables and daily noise logger graphs have been included in Attachment 5.

The logger locations were specifically chosen as they were considered representative of the existing and future nearest sensitive residential receivers.

Figure 3-1: Map of Unattended Loggers

Source: Google Earth 2019

↑N Not to scale			Benbow Environmental 25-27 Sherwood Street, Northmead NSW 2152

Table 3-1: Unattended Logger Results *

Logger Location	Address	RBL (L_{A90})			L_{Aeq}		
		Day	Evening	Night	Day	Evening	Night
Logger A	Yallah Bay Road, Yallah	38	41	31	54	48	50
Logger B	54 Carlyle Close, Dapto	36	42	34	53	48	47
Logger C	13 Malonga Place, Koonawarra	36	34	30	54	48	47
Logger D	Yallah Bay Road, Yallah	33	34	31	49	45	43
Logger E	108 Haywards Bay Drive, Haywards Bay	35	42	34	55	51	49

* Measurements from 7th May – 28th May 2019

3.3.2 Short-Term Attended Noise Monitoring Results

Given that the results of the unattended noise monitoring are affected by all ambient noise sources such as local fauna, road traffic and industrial sources, it is not possible to determine with precision the exact existing industrial noise contribution based on unattended monitoring alone. Therefore, the attended noise monitoring allows for a more detailed understanding of the existing ambient noise characteristics and a more meaningful final analysis to be undertaken. The results of the short-term attended noise monitoring are displayed in Table 3-2.

Table 3-2: Attended Noise Monitoring Results, dB(A)

Location / Time	Noise Descriptor				Comments
	L_{Aeq}	L_{A90}	L_{A10}	L_{A1}	
Logger A 13:50 7/5/19	50	46	52	57	***Plane Overhead ≤65 dB(A)*** ***Louder Vehicle on the Highway ≤ 55 dB(A)*** ***Wind Gust ≤ 52 dB(A)*** ***Nearby Bird ≤ 51 dB(A)*** ***Insect Noise ≤ 50 dB(A)*** ***Distant Construction Noise ≤ 50 dB(A)*** ***Distant Road Traffic from Highway ≤ 48 dB(A)***
Logger B 11:15 28/5/19	52	48	54	60	***Dog Barking ≤ 64 dB(A)*** ***Wind Gust ≤ 64 dB(A)*** ***Plane Overhead ≤ 61 dB(A)*** ***Helicopter Overhead ≤ 60 dB(A)*** ***Distant Road Traffic ≤ 56 dB(A)***
Logger C 10:32 28/5/19	51	40	49	58	***Motorcycle Passing By ≤ 76 dB(A)*** ***Nearby birds ≤ 61 dB(A)*** ***Doors Shutting ≤ 56 dB(A)*** ***Wind Gust ≤ 54 dB(A)*** ***Plane Overhead ≤ 50 dB(A)*** ***Dog Barking ≤ 50 dB(A)*** ***Distant Car ≤ 50 dB(A)*** ***Distant Road Traffic from Highway ≤ 44 dB(A)***

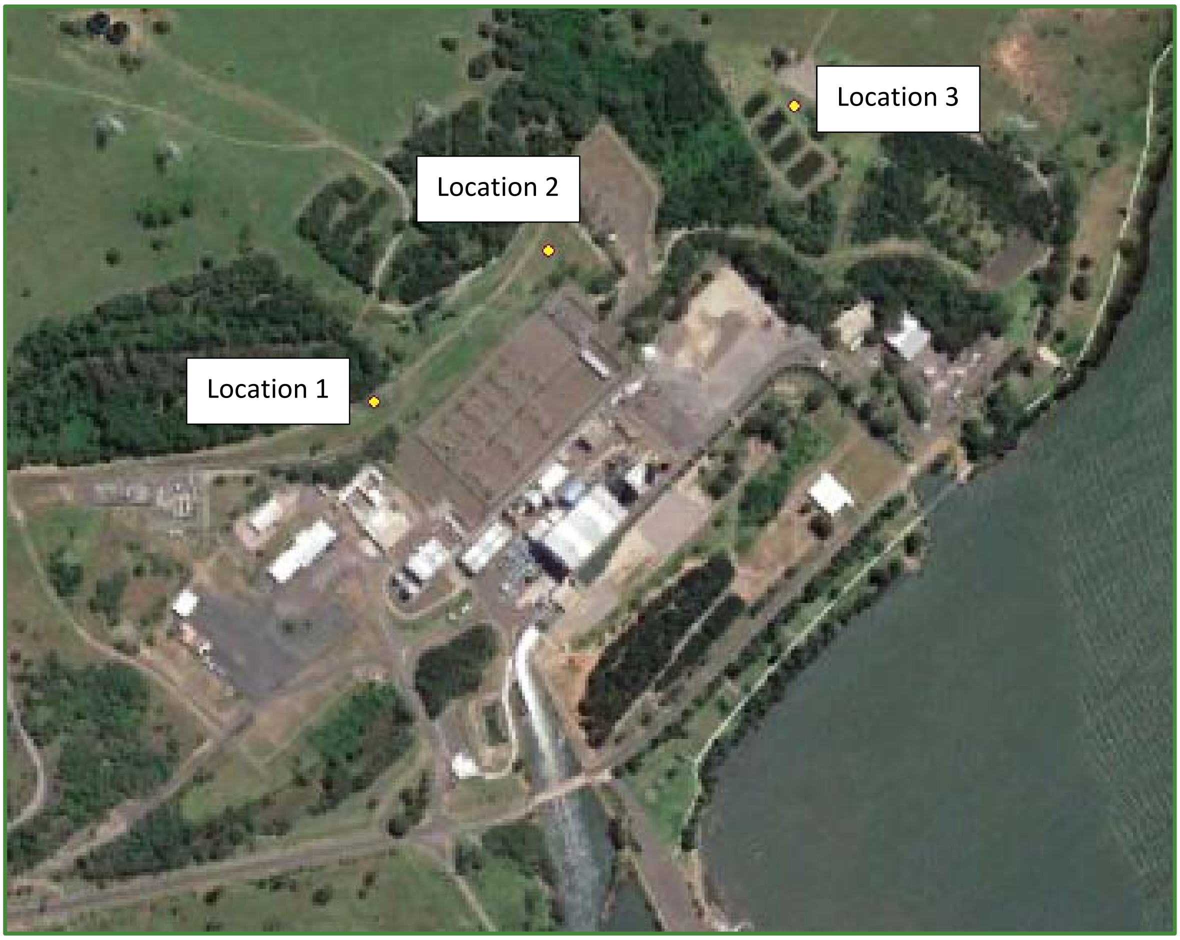
Table 3-2: Attended Noise Monitoring Results, dB(A)

Location / Time	Noise Descriptor				Comments
	L_{Aeq}	L_{A90}	L_{A10}	L_{A1}	
Logger D 16:39 7/5/19	41	36	42	50	***Nearby Bird ≤ 54 dB(A)*** ***Horse Neighing ≤ 54 dB(A)*** ***Dog Barking ≤ 48 dB(A)*** ***People Shouting ≤ 47 dB(A)*** ***Plane Overhead ≤ 47 dB(A)*** ***Horse Galloping ≤ 45 dB(A)*** ***Background Noise ≤ 40 dB(A)***
Logger E 11:45 28/5/19	52	46	53	62	***Car Passing By ≤ 70 dB(A)*** ***Car Door ≤ 70dB(A)*** ***Construction Noise ≤ 60 dB(A)*** ***Wind Gust ≤ 53 dB(A)*** ***Talking Nearby ≤ 51 dB(A)*** ***Distant Road Traffic Noise from Highway ≤ 50 dB(A)*** ***Dog Barking ≤ 50 dB(A)*** ***Nearby Birds ≤ 46 dB(A)***

3.4 MEASURED EXISTING PLANT NOISE LEVELS

Noise loggers were placed at location 1, 2 and 3 as shown in the following figure when Tallawarra A was operational. The loggers recorded high resolution 48 kHz (HD Audio: 48,000 samples per second) audio from 19/06/2019-27/06/2019. These results were post processed for frequency analysis; overall A-weighted levels are graphed and presented in Attachments 6.

Figure 3-2: Existing Plant Noise Measurement Locations



3.4.1 Continuous Max Load Noise Levels

Unattended results from 19-20/06/2019 were assessed during Tallawarra A's continuous operation. Results of worst case 15 minutes during standard continuous operations occurred at 9.00AM on the 20/06/2019 when the plant was at close to full capacity. Graphed results are presented in Attachment 6.

The results of the noise monitoring are as follows:

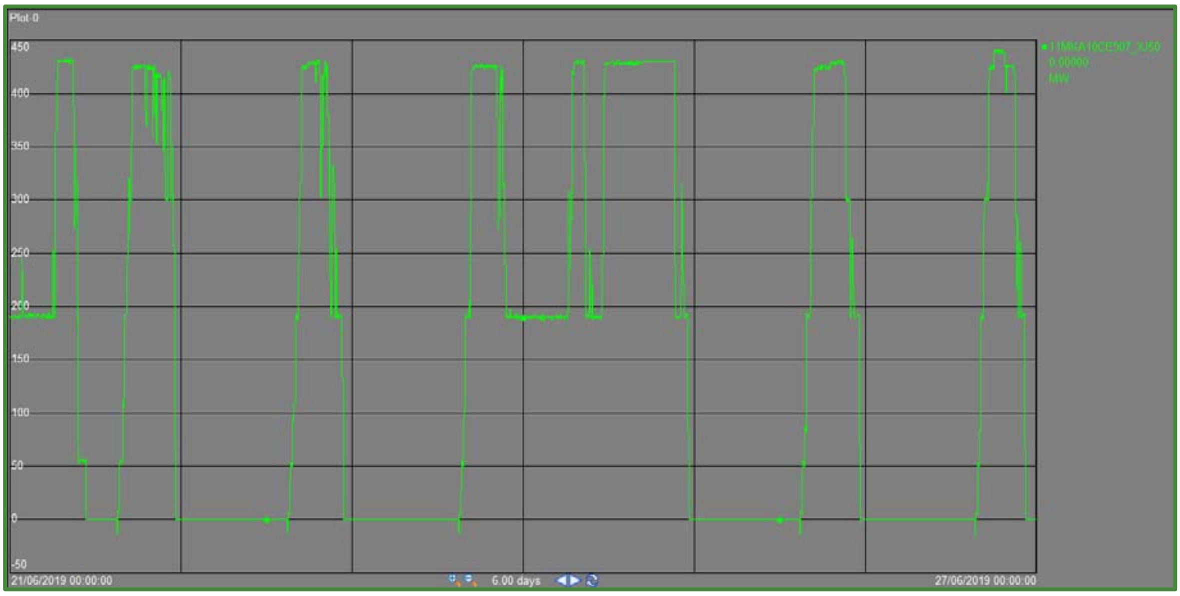
Table 3-3: Existing Plant Noise Levels

	Maximum LAeq,15min dB(A)				Maximum LCeq,15min dB(C)			
Location 1	54 dB(A)				72 dB(C)			
Location 2	54 dB(A)				69 dB(C)			
Location 3	50 dB(A)				61 dB(C)			
Low Frequency Noise 1/3 Octave LAeq,15min dB(Z)								
	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz
Location 1	67	65	69	67	64	63	62	58	52
Location 2	65	60	66	63	63	59	58	53	49
Location 3	57	55	59	57	54	55	54	51	52

3.4.2 Start-up/Shutdown Noise Levels

The data from the 3 noise loggers was compared to the Tallawarra Generation Profile (Figure 3-3) to identify when the power station was entering the start-up or shutdown. The analysis found that on most days, the power plant would start-up around 2:30pm and shutdown around 12am. For the time period of 21/6/19 to 26/6/19, each start-up and shutdown was considered and the relevant levels are presented in Table 3-4. Graphed results are presented in Attachment 7.

Figure 3-3: Tallawarra Generation Profile



Source: Tallawarra Power Station 2019

Table 3-4: Noise Level for Start-up/Shutdown (15 minutes)

Start-up (SU) / Shutdown (SD)	Date	Time	Location 1				Location 2				Location 3				Weather (hourly average of wind speed and direction)
			LAEQ	LA90	LCEQ	LC90	LAEQ	LA90	LCEQ	LC90	LAEQ	LA90	LCEQ	LC90	
SD	21/06/19	12:30	57	55	68	60	58	56	73	61	58	55	65	58	6.7 m/s at 210°
SU		14:45	60	52	73	67	64	53	76	66	54	50	66	61	6.8 m/s at 200°
SD	22/06/19	0:30	51	49	68	57	52	50	65	56	52	50	63	55	6.9 m/s at 215°
SU		14:15	58	54	68	60	60	56	73	63	59	56	68	59	7.2 m/s at 218°
SD		23:45	58	57	60	59	58	57	60	58	58	57	60	58	6.3 m/s at 198°
SU	23/06/19	14:15	58	54	63	59	59	56	67	60	59	56	62	58	6.8 m/s at 211°
SD	25/06/19	0:15	57	56	61	59	58	58	62	61	60	58	62	61	2 m/s at 233°
SU		14:30	60	58	67	64	**62**	57	67	63	57	55	62	59	4.1 m/s at 160°
SD	26/06/19	0:15	**60**	59	62	61	**60**	59	62	61	**61**	59	62	61	2 m/s at 234°
SU		15:00	**61**	59	65	62	59	57	63	59	**58**	56	64	60	4 m/s at 162°
SD		23:15	59	57	61	60	57	56	61	59	57	56	60	59	2.5 m/s at 253°

An analysis of the data revealed:

Noise measurement with A-weighting showed that the power station was at its loudest during start-up/shutdown periods where the noise would then quieten afterwards.

- Wind on the 21st, 22nd and 23rd caused elevated Leq levels.
- On the 25th and 26th the wind was below 5 m/s during start-up and shutdown and the Leq levels were approximately 1-2 dB greater than the L90. These values are considered representative.
- Under steady state conditions the difference between LA90 and LAeq was 1-2 dB(A).
- Maximum LAeq noise levels during start-up and shut down was 58-62 dB(A) at loggers 1-3. This is considerably higher than the continuous levels presented in Table 3-3. Note: Values affected by high wind noise have not been taken into consideration.
- When the power generation would increase or decrease by approximately 235 MW, the A-weighted noise change was negligible (< 1.5 dB(A)).
- By assessing the difference between LAeq and LCeq when wind was less than 5 m/s the difference was well below 15, therefore low frequency noise is not considered a feature during start-up and shutdown. Note: Values affected by high wind noise have not been taken into consideration.

3.4.3 Attended Measurements

Attended spot measurements were undertaken around the site, these were 34 in total. 1/3 octave noise levels are presented in Attachment 8.

Locations and results are presented in Figure 3-4 and Table 3-5.

Figure 3-4: Attended Measurement Location

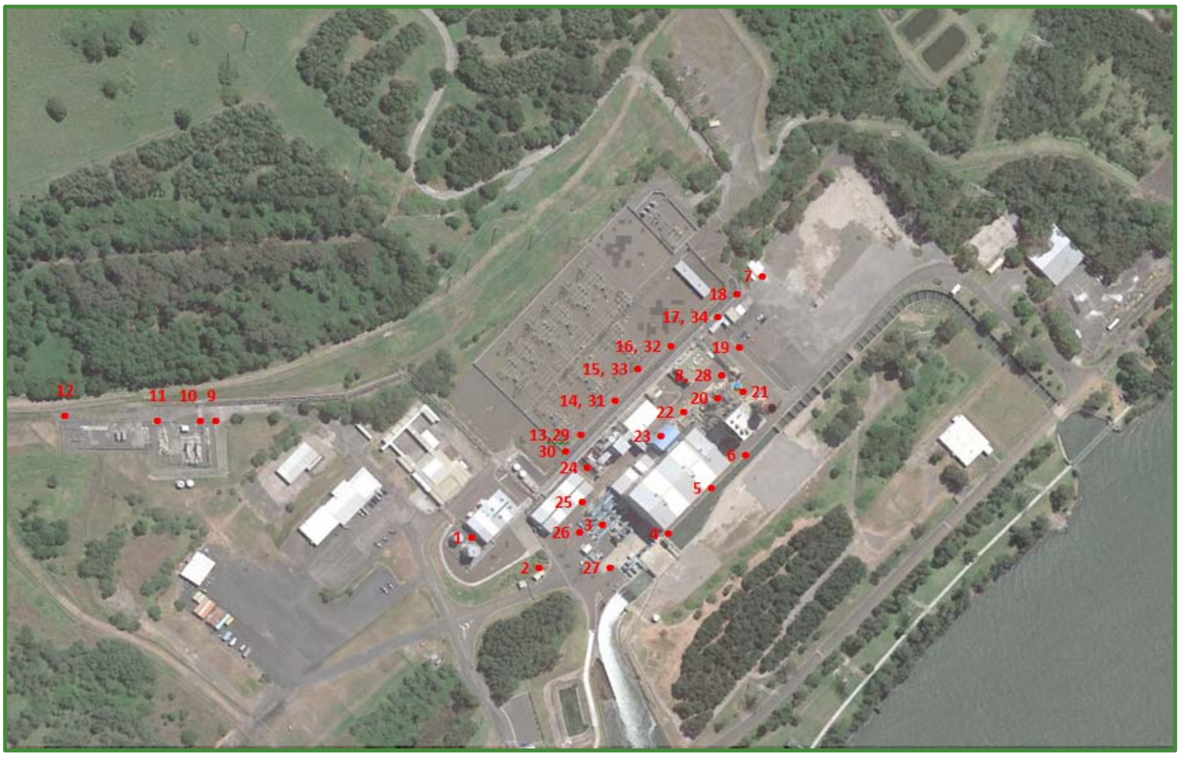


Table 3-5: Attended Measurement Results

Spot ID	Overall LAeq, dB(A)	Spot ID	Overall LAeq, dB(A)	Spot ID	Overall LAeq, dB(A)
1	75	12	50	23	75
2	60	13	59	24	73
3	75	14	62	25	73
4	68	15	64	26	60
5	75	16	63	27	68
6	75	17	67	29	68
7	90	18	66	30	68
8	82	19	69	31	71
9	65	20	82	32	71
10	71	21	79	33	70
11	64	22	76	34	75

4. METEOROLOGICAL FACTORS

Wind and temperature inversions may affect the noise emissions from the site and are to be incorporated in the assessment when considered to be a feature of the area.

In this section, an analysis of the 2018 weather data has been conducted to establish whether significant winds are characteristic of the area.

4.1 WIND EFFECTS

Wind is considered to be a feature where source-to-receiver wind speeds (at 10 m height) of 3 m/s or below occur for 30% or more of the time in any assessment period in any season.

4.2 WIND ROSE PLOTS

Wind rose plots show the direction that the wind is coming from, with triangles known as "petals". The petals of the plots in the figures summarise wind direction data into 8 compass directions i.e. north, north-east, east, south-east, etc. The length of the triangles, or "petals", indicates the frequency that the wind blows from that direction. Longer petals for a given direction indicate a higher frequency of wind from that direction. Each petal is divided into segments, with each segment representing one of the six wind speed classes.

Thus, the segments of a petal show what proportion of wind for a given direction falls into each class. The proportion of time for which wind speed is less than 0.5 m/s, when speed is negligible, is referred to as calm hours or "calms". Calms are not shown on a wind rose as they have no direction, but the proportion of time consisting of the period under consideration is noted under each wind rose.

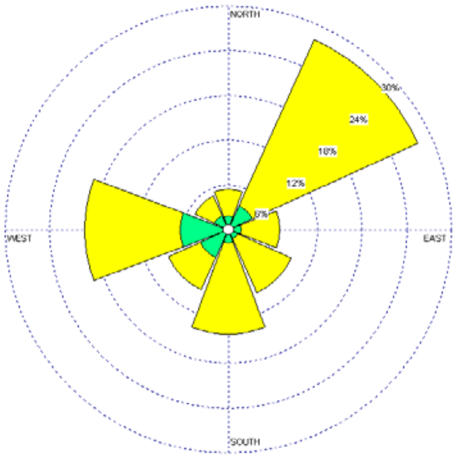
The concentric circles in each wind rose are the axis, which denote frequencies. In comparing the plots it should be noted that the axis varies between wind roses, although all wind roses are similar in size. The frequencies denoted on the axes are indicated beneath each wind rose.

4.3 LOCAL WIND TRENDS

Seasonal wind rose plots for this site utilising Albion Park (Wollongong Airport) AWS data have been included in Figure 4-1, Figure 4-2 and Figure 4-3 for day, evening and night periods respectively.

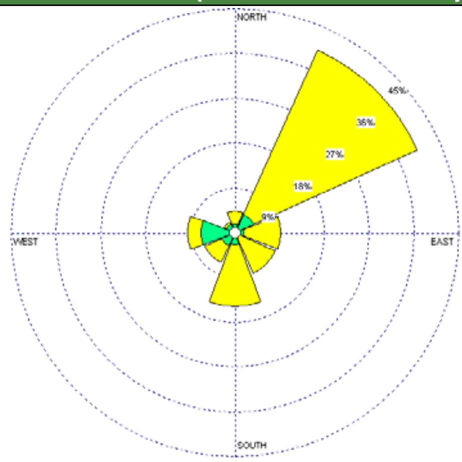
Figure 4-1: Wind Rose Plots– Bureau of Meteorology Albion Park (Wollongong Airport) 2018 Daytime (7:00-18:00)

All Seasons



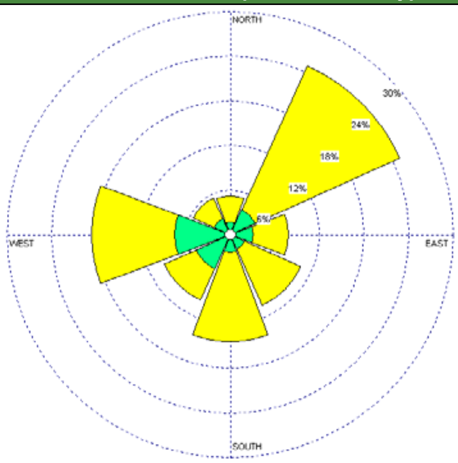
Average Wind Speed: 4.75 m/s
Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Summer Season (December – February)



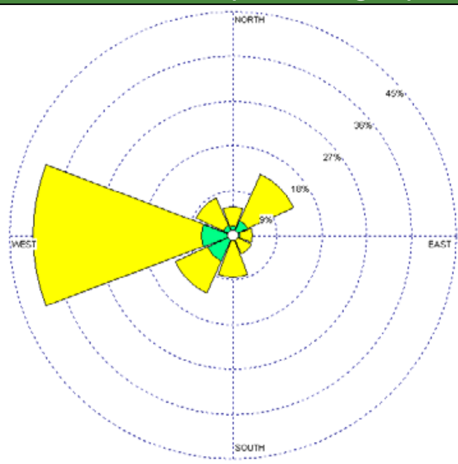
Average Wind Speed: 4.56 m/s
Axis Frequencies: 9%, 18%, 27%, 36%, 45%

Autumn Season (March – May)



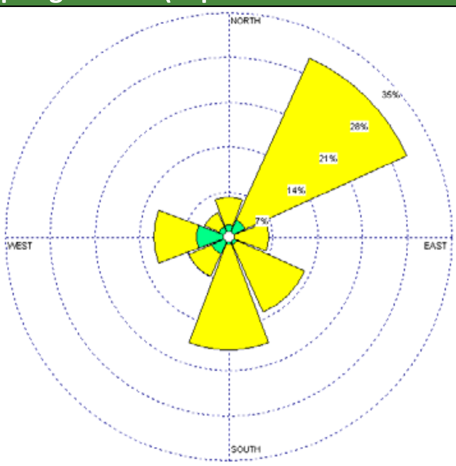
Average Wind Speed: 4.22 m/s
Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Winter Season (June – August)



Average Wind Speed: 5.41 m/s
Axis Frequencies: 9%, 18%, 27%, 36%, 45%

Spring Season (September – November)



Average Wind Speed: 4.92 m/s
Axis Frequencies: 7%, 14%, 21%, 28%, 35%

Legend

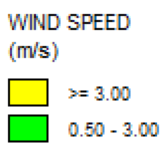
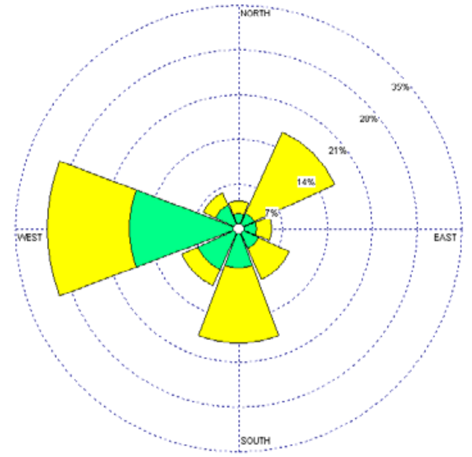


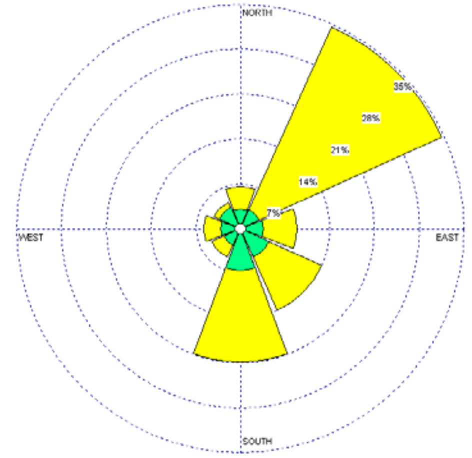
Figure 4-2: Wind Rose Plots– Bureau of Meteorology Albion Park (Wollongong Airport) 2018 Evening (18:00-22:00)

All Seasons



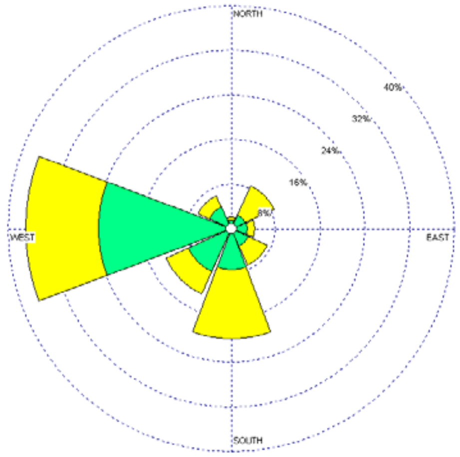
Average Wind Speed: 3.81 m/s
Axis Frequencies: 7%, 14%, 21%, 28%, 35%

Summer Season (December – February)



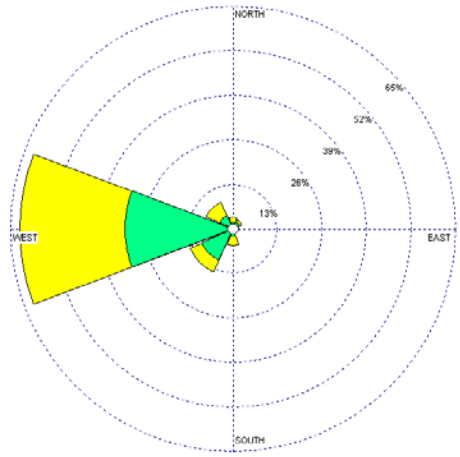
Average Wind Speed: 3.95 m/s
Axis Frequencies: 7%, 14%, 21%, 28%, 35%

Autumn Season (March – May)



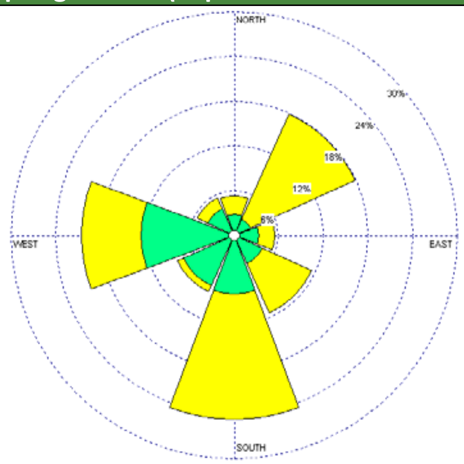
Average Wind Speed: 3.37 m/s
Axis Frequencies: 8%, 16%, 24%, 32%, 40%

Winter Season (June – August)



Average Wind Speed: 4.10 m/s
Axis Frequencies: 13%, 26%, 39%, 52%, 65%

Spring Season (September – November)



Average Wind Speed: 3.85 m/s
Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Legend

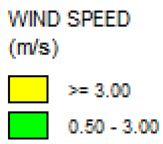
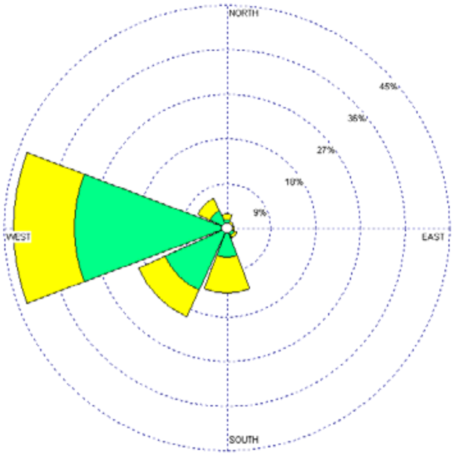


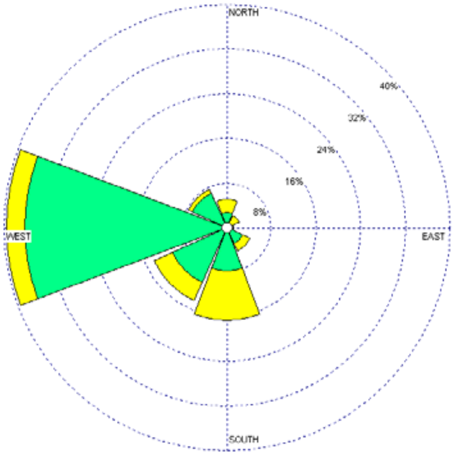
Figure 4-3: Wind Rose Plots– Bureau of Meteorology Albion Park (Wollongong Airport) 2018 Night (22:00-7:00)

All Seasons



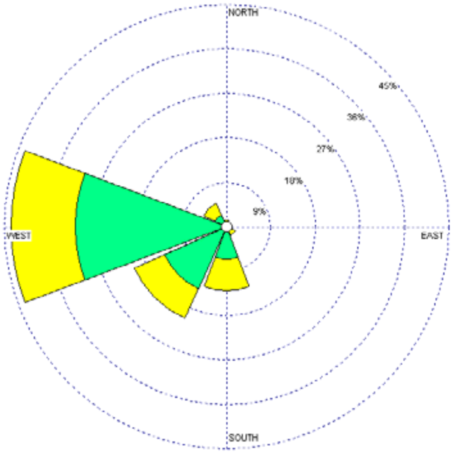
Average Wind Speed: 2.81 m/s
Axis Frequencies: 9%, 18%, 27%, 36%, 45%

Summer Season (December – February)



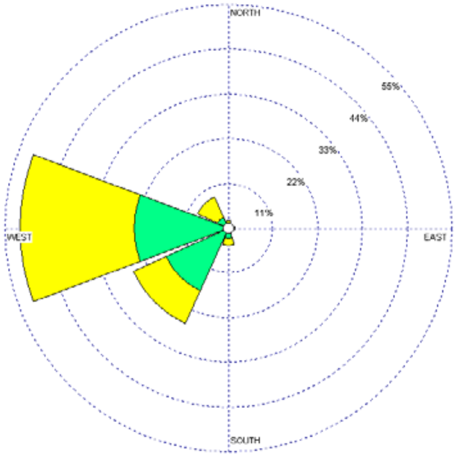
Average Wind Speed: 2.25 m/s
Axis Frequencies: 8%, 16%, 24%, 32%, 40%

Autumn Season (March – May)



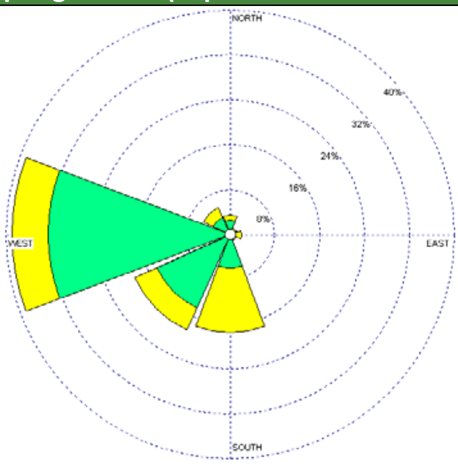
Average Wind Speed: 2.63 m/s
Axis Frequencies: 9%, 18%, 27%, 36%, 45%

Winter Season (June – August)



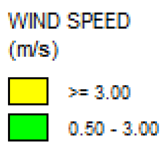
Average Wind Speed: 3.96 m/s
Axis Frequencies: 11%, 22%, 33%, 44%, 55%

Spring Season (September – November)



Average Wind Speed: 2.54 m/s
Axis Frequencies: 8%, 16%, 24%, 32%, 40%

Legend



Appendix D2 of the Noise Policy for Industry (EPA, 2017), refers to utilising the Noise Enhancing Wind Analysis (NEWA) program on the NSW EPA website to determine the significance of source-to-receiver winds.

Table 4-1 below contains the noise wind component analysis from the NEWA software. Wind speeds are taken up to 3 m/s and wind direction is taken from source-to-receiver, plus and minus 45 degrees, as per appendix D2 of the Noise Policy for Industry.

It can be seen from Table 4-1 that there are several instances during the evening and night periods, where more than 30% of wind speeds are less than 3 m/s in the plus and minus 45 degree arc from source to receiver.

Therefore worst case 3 m/s source-to-receiver winds have been included in the assessment. As a worst case scenario, the 3 m/s source-to-receiver winds are modelled for affected receivers.

Table 4-1: Noise Wind Component Analysis 2018 Albion Park (Wollongong Airport) – Percentage of time (%) wind speed 0.5-3 m/s

Receiver	Day				Evening				Night			
	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
R1	6.9	9.4	4.2	6.1	14.3	3.5	1.6	8	3.2	1.8	2.1	2.4
R2	5.7	7.8	3.7	4.2	14.3	6	1.6	9.3	5.3	1.9	2.3	2.6
R3	2.5	4.5	1.8	2.9	12.8	7.1	0.8	10.7	7.4	3.9	2.5	3.5
R4	1.7	3.7	1.5	1.9	11.2	6.3	0.5	10.2	6.5	3.4	2.3	3.2
R5	4	6.1	3.9	3.1	16.3	14.9	5.4	19.2	13.6	14.5	7	11.2
R6	3.4	5	4.5	4.1	8.2	6	5.7	7.7	6.9	3.5	4.5	5
R7	4.8	5.4	5.7	4.4	8.7	5.7	5.2	6.3	4.3	3	3.5	4.4
R8	4.9	6.7	5.7	5.2	8.7	22.6	22.8	17.9	33.4	18	13.3	23.1
R9	8.2	9	7	6.6	9.2	3.3	3.3	6	3.1	1.2	2.3	3.8
R10	8.6	8.5	6.4	6	8.7	3.5	3.3	6	3	1.2	2.4	3.4
R11	8.5	8.4	6.2	5.6	8.9	3.5	3.3	6	2.7	1.1	2.5	3.3
R12	8.7	8.6	6.3	5.8	8.9	3.5	3.3	6.3	3.1	1.1	2.5	3.2
R13	8.2	8.8	6.7	5	8.9	3.8	3.8	6	2.4	1.3	2.4	2.8
R14	8.9	9.7	6.6	5.7	12.8	4.6	2.2	8.2	2.2	1.8	2.1	2.1
R15	8.6	12.3	6.4	6.8	12.8	5.7	2.2	8.2	2.9	1.7	1.7	2.2
R16	8.8	12.1	6.7	6.7	14	4.6	2.4	6.9	2.7	1.8	1.8	2
R17	8.3	12.4	6.2	6.7	13	3.8	1.9	8.2	3.2	1.8	1.7	2.2
R18	1.9	3.7	1.7	2.1	11	6.8	0.5	10.2	6.7	3.5	2.3	3.3
R19	1.7	3.7	1.5	1.9	11.2	6.3	0.5	10.2	6.5	3.4	2.3	3.2
R20	1.5	3.3	1.5	1.5	11	6.3	0.5	8.8	6.3	3.1	2.2	3.2
R21	4.1	6.1	4	3.1	16.1	15.5	5.7	19.8	13.9	14.6	7	11.5
R22	5	6.3	5.4	3.8	14.8	17.4	8.2	21.2	17.4	18	11.5	16.5

Table 4-1: Noise Wind Component Analysis 2018 Albion Park (Wollongong Airport) – Percentage of time (%) wind speed 0.5-3 m/s

Receiver	Day				Evening				Night			
	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
R23	4.7	7.6	6.2	4.4	15.1	19.8	11.1	22.3	18.9	22.1	18.2	20.5
R24	5.2	8.2	6.8	4.2	12.8	21.5	17.9	22	23.4	29.4	23.4	27.8
R25	5.2	9.2	7.6	4.4	11.5	28.8	28	21.4	28.8	36.3	28.4	34.4
R26	5.9	9.6	8.1	5.3	9.9	33.4	35.9	26.1	36.1	40.2	31.3	41.2
R27	6.4	10.4	8.5	5.4	8.9	37	40.8	24.5	45.7	43.4	33.6	45.1
R28	8.4	8.6	6.2	4.8	9.4	4.6	3	5.2	1.5	2.2	2.2	2

Noise enhancing meteorological conditions occur for 30% or more of the period and season

4.4 TEMPERATURE INVERSIONS

Temperature inversions are considered a feature where they occur more than 30% of the total night time during winter (June, July and August) between 6:00pm and 7:00am. This is different from the night noise assessment period over which inversions are to be assessed, which is from 10:00pm to 7:00am.

This involves determining the percentage occurrence of moderate (Stability Class F) and strong (Stability Class G) inversions. Weak inversions (Stability Class E) should not be included in the analysis.

The analysis conducted on the 2018 weather data highlighted that during winter 27% of the nights presented temperature inversion conditions, therefore these effects have not been included in the noise impact assessment.

4.4.1 Weather Conditions Considered in the Assessment

The following weather conditions were considered in this assessment as they are considered to be a feature of the area as discussed in the above sections.

- Condition A: neutral weather conditions
- Condition B: 3m/s source-to-receiver wind conditions

The meteorological condition considered in the noise model has been displayed in detail in Table 4-2.

Table 4-2: Meteorological Conditions Assessed in Noise Propagation Modelling

Condition	Classification	Ambient Temp.	Ambient Humidity	Wind Speed	Wind Direction (blowing from)	Temperature Inversion	Affected Receivers	Applicability
A	Neutral	10°C	70%	–	–	No	All	All periods
B	Gradient Flow	10 °C	70%	3 m/s	Source-to-receiver	No	R8, R25, R26, R27	All periods

5. CURRENT LEGISLATION AND GUIDELINES

5.1 EXISTING EPL REQUIREMENTS

The site is currently required to satisfy specific NSW EPA requirements, as outlined in the site's Environment Protection Licence (Licence no. 555).

Condition L6 of the licence states the noise limits presented in the following table.

Table 5-1: Existing EPL Noise Limits

Receiver Location	LAeq (15 minute) night time limit
Monitoring location "A" (near 32 Coronet Place, Koonawarra)	28
Monitoring location "B" (near the entrance gate to Dapto Substation, Yallah)	35
Monitoring location "C (Central Park, Mogurah Point, overlooking south-western part of Lake Illawarra)	33
Monitoring location "D" (near the scout hall at Boonerah Point)	35
Monitoring location "E" (Residential boundary of Haywards Bay Estate, Yallah)	37

Note: Location B is not considered in this assessment as it significantly further away than other receivers.

The EPL will need to be updated when approval is obtained.

5.2 EXISTING PROJECT APPROVAL REQUIREMENTS

Schedule 1 of the existing approval (Application No: 07_0124) presents noise limits (clause 3.5) for the residential areas within and outside Tallawarra lands. These are reproduced as follows:

> *'The Proponent shall design, construct, operate and maintain the project to ensure that the total cumulative noise contribution from the combined operation of the Tallawarra Stage A and Tallawarra Stage B power stations to the background acoustic environment does not exceed the noise limits specified in Table 1* (Table 5-2) *and Table 2* (Table 5-3).'

Table 5-2: Maximum Allowable Noise limits Outside the Tallawarra Lands (Table 1 of Project Approval)

Location	Day 7:00am to 6:00pm Mondays to Saturdays 8:00am to 6:00pm Sundays and public holidays	Evening 6:00pm to 10:00pm on any day	Night 10:00pm to 7:00am Mondays to Saturdays 10:00pm to 8:00am Sundays and public holidays	
	$L_{Aeq(15\ minute)}$	$L_{Aeq(15\ minute)}$	$L_{Aeq(15\ minute)}$	L_{Amax}
Locality T2 Any residence on Carlyle Close, Wollin Place, Coronet Place, and Crompton Street, in Koonawarra	35 dB(A)	35 dB(A)	35 dB(A)	45 dB(A)
Locality T4 Any residence on Wyndarra Way and Malonga Place in Koonawarra	35 dB(A)	35 dB(A)	35 dB(A)	45 dB(A)
Locality ML#9 Any residence on The Boulevarde, Park Crescent, Horsley Road and Newton Crescent in Oak Flats	38 dB(A)	38 dB(A)	38 dB(A)	45 dB(A)
Locality ML#10 Any residence on Reddall Parade and Henricks Parade in Mt Warrigal	38 dB(A)	38 dB(A)	38 dB(A)	45 dB(A)
Locality ML#11 Any residence in Haywards Bay	35 dB(A)	35 dB(A)	35 dB(A)	45 dB(A)

'The localities set out in Table 1 are those described in Appendix E of the document listed in condition 1.1b). For the purpose of Table 1, "residence" is defined as any residential dwelling existing at the date of this approval and any residential dwelling, once constructed, on land zoned R2 – Low Density Residential under the Wollongong Local Environmental Plan 2009 at the identified locality.'

Table 5-3: Noise Limits for Tallawarra Lands Residential Areas (Table 2 of Project Approval)

Location	Day 7:00am to 6:00pm Mondays to Saturdays	Evening 6:00pm to 10:00pm on any day	Night 10:00pm to 7:00am Mondays to Saturdays 10:00pm to 8:00am Sundays and public holidays	
	$L_{Aeq(15\ minute)}$	$L_{Aeq(15\ minute)}$	$L_{Aeq(15\ minute)}$	L_{Amax}
Most affected residence – proposed northern residential area	If the Industrial Noise Policy (INP) Modification Factors for Low Frequency Noise apply – 40 dB(A), otherwise 38 dB(A)	If the Industrial Noise Policy (INP) Modification Factors for Low Frequency Noise apply – 40 dB(A), otherwise 38 dB(A)	If the Industrial Noise Policy (INP) Modification Factors for Low Frequency Noise apply – 40 dB(A), otherwise 38 dB(A)	50 dB(A)
Most affected residence – proposed central residential area	40 dB(A)	40 dB(A)	40 dB(A)	50 dB(A)
Most affected residence – proposed south-western residential area	41 dB(A)	41 dB(A)	41 dB(A)	51 dB(A)

'The proposed residential areas set out in Table 2 are those illustrated in Appendix A of the Tallawarra Concept Plan Application – Preliminary Assessment Report prepared by Don Fox Planning and dated June 2009. For the purpose of Table 2, "residence" is defined as any residential dwelling once constructed, either prior to or post the construction and operation of the power station, on land zoned R2 - Low Density Residential or R5 - Large Lot Residential under the Wollongong Local Environmental Plan 2009 within the proposed residential areas.

'If noise from an activity is substantially tonal, intermittent or impulsive in nature and contains major components within the low frequency range (as described in Chapter 4 of the NSW Industrial Noise Policy (Environment Protection Authority, 2000)), 5 dB(A) must be added to the measured noise level when comparing the measured noise with the limits specified in Tables 1 and 2, in accordance with the requirements of the Industrial Noise Policy.

'The noise limits set out in Table 1 and Table 2 do not apply under: wind speeds greater than 3 metres per second (measured at 10 metres above ground level); or under stability category G temperature inversion conditions; or under stability category F temperature inversion conditions and wind speeds greater than 2 metres per second at 10 metres above the ground.

'Stability category temperature inversion conditions are to be determined by the sigma-theta method referred to in Part 4E of Appendix E of the NSW Industrial Noise Policy (Environment Protection Authority, 2000).

'The data to be used for determining meteorological conditions is that recorded by the meteorological weather station located at the Tallawarra Stage A power station.'

This assessment has been done in accordance with the Noise Policy for Industry, as detailed in the following section.

5.3 NSW EPA Noise Policy for Industry

5.3.1 Introduction

The NSW Noise Policy for Industry was developed by the NSW EPA primarily for the assessment of noise emissions from industrial sites regulated by the NSW EPA.

The policy sets out two components that are used to assess potential site-related noise impacts. The intrusiveness noise level aims at controlling intrusive noise impacts in the short-term for residences. The amenity noise level aims at maintaining a suitable amenity for particular land uses including residences in the long-term. The more stringent of the intrusiveness or amenity level becomes the project noise trigger levels for the project.

5.3.2 Project Intrusiveness Noise Level

The project intrusiveness noise level is determined as follows:

$L_{Aeq,\ 15\ minute}$ = rating background noise level + 5 dB

Where the $L_{Aeq,(15minute)}$ is the predicted or measured L_{Aeq} from noise generated within the project site over a fifteen minute interval at the receiver.

This is to be assessed at the most affected point on or within the residential property boundary or if that is more than 30 m from the residence, at the most affected point within 30 m of the residential dwelling.

5.3.3 Amenity Noise Level

To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.2 of the NSW Noise Policy for Industry 2017. The relevant recommended noise levels applicable from the Noise Policy for Industry are reproduced in Table 5-4. The suburban category has been selected for the residential noise amenity criteria to match the characteristics of the area.

Table 5-4: Amenity noise levels.

Receiver	Noise Amenity Area	Time of Day	L_{Aeq} dB(A) Recommended amenity noise level
Residential	Rural	Day	50
		Evening	45
		Night	40
School Classroom	All	Noisiest 1-hour period when in use	Internal: 40[1]
			External: 50[2]
Commercial Premises	All	When in use	65
Holiday Accommodation	Rural	Day	55
		Evening	50
		Night	45

Note: 1) In the case where existing schools are affected by noise from existing sources, the acceptable L_{Aeq} noise level may be increased to L_{Aeq} 1 hour.
2) Where internal amenity noise levels are specified, they refer to the noise level at the centre of the habitable room that is most exposed to the noise and apply with windows opened sufficiently to provide adequate ventilation, except where alternative means of ventilation complying with the Building Code of Australia are provided. In cases where gaining internal access for monitoring is difficult, then external noise levels 10 dB(A) above the internal levels apply.
Source: Table 2.2 and Section 2.6, NSW Noise Policy for Industry

The project amenity noise level for industrial developments = recommended amenity noise level minus 5 dB(A)

The following exceptions to the above method to derive the project amenity noise levels apply:

1. *In areas with high traffic noise levels*
2. *In proposed developments in major industrial clusters*
3. *Where the resultant project amenity noise level is 10 dB or more lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.*
4. *Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such cases the relevant amenity noise level is assigned as the project amenity noise level for development.*

This development is not considered to be captured by the above exceptions.

5.3.4 Sleep Disturbance Criteria

In accordance with the NSW EPA Noise Policy for Industry, the potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

Where the subject development/premises night-time noise levels at a residential location exceed:

- **$L_{Aeq, 15 minute}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or**
- **L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,**

a detailed maximum noise level assessment should be undertaken.

5.3.5 Project Noise Trigger Levels

The project noise trigger levels for the site have been established in accordance with the principles and methodologies of the NSW Noise Policy for Industry (EPA, 2017).

The table below presents the rating background level, project intrusive noise level, recommended amenity noise level, and project amenity noise level. The project noise trigger level is the lowest value of intrusiveness or project amenity noise level after conversion to $L_{Aeq\ 15\ minute}$, dB(A) equivalent level. Sleep disturbance trigger levels associated with operational activities are presented in Table 5-5.

Different time periods apply for the noise criteria as the intrusive criterion considers a 15 minute assessment period while the amenity criterion requires assessment over the total length of time that a site is operational within each day, evening or night period. In order to ensure compliance under all circumstances, a 15 minute period assessment has been considered for all receivers.

Table 5-5: Project Noise Trigger Levels (PNTL) for Operational Activities, dB(A)

Receiver	Type of Receiver	Time of day	Rating background noise level	Project intrusiveness noise level $L_{eq\ 15\ minute}$	Recommended amenity noise level $L_{Aeq\ period}$	Project amenity noise level $L_{Aeq\ 15\ minute}$[1]	PNTL $L_{Aeq\ 15\ minute}$	Sleep Disturbance L_{Amax}
R1&R2	Residential – Rural	Day	36	**41**	50	48	**41**	**-**
		Evening	36[3]	**41**	45	43	**41**	**-**
		Night	34	39	40	**38**	**38**	**52**
R3-R5	Residential – Rural	Day	36	**41**	50	48	**41**	**-**
		Evening	34	**39**	45	43	**39**	**-**
		Night	30	**35**	40	38	**35**	**52**
R6 -R13 &R28	Residential – Rural & Future Residential - Rural	Day	35	**40**	50	48	**40**	**-**
		Evening	35[3]	**40**	45	43	**40**	**-**
		Night	34	39	40	**38**	**38**	**52**
R14-R17	Future Residential – Rural	Day	38	**43**	50	48	**43**	**-**
		Evening	38[3]	**43**	45	43	**43**	**-**
		Night	31	**36**	40	38	**36**	**52**
R18-R27	Future Residential – Rural	Day	35[4]	**40**	50	48	**40**	**-**
		Evening	34	**39**	45	43	**39**	**-**
		Night	31	**36**	40	38	**36**	**52**
R29-R30	Future Commercial	When in use	-	**-**	65	65	**65**	**-**
R31&R31B	Future School	When in use	-	**-**	$L_{Aeq\ 1hr}$ = 50 (external)	50[2]	**50**	**-**
R32	Future Holiday Accommodation	Day	-	**-**	55	53	**53**	**-**
		Evening			50	48	**48**	
		Night			45	43	**43**	

Notes:
1) These levels have been converted to $L_{Aeq\ 15\ minute}$ using the following: $L_{Aeq\ 15\ minute} = L_{Aeq\ period} + 3$ dB (NSW Noise Policy for Industry Section 2.
2) This value has been conservatively assumed that $L_{Aeq\ 15\ minute}$ is equivalent to $L_{Aeq\ 1hr}$.
3) As per the Noise Policy for Industry section 2.3 the project intrusiveness noise level for evening be set at no greater than the project intrusiveness noise level for daytime.
4) The minimum RBL has been used as per Table 2.1 Noise Policy for Industry as the RBL cannot be below this
Values in bold are those adopted as the applicable criteria

5.3.6 Annoying Noise Characteristics

In section 3.3.1 of the Noise Policy for Industry is a list of important parameters for predicting noise. Included in that list is the following:

- Annoying characteristics of the noise sources that may be experienced at receiver locations (for example, tonality, low frequency, and intermittency).

Low frequency is of relevance to the development and has been included in this assessment. Further details to assess low frequency noise are described in Fact Sheet C of the Noise Policy for Industry, summarised below.

Table 5-6: Excerpt from Table C1: Modifying factor corrections

Factor	Assessment/ measurement	When to apply	Correction[1]	Comments
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-thired octave measurements in the range 10-160 Hz	Measure/assess source contribution C- and A-weighted $L_{eq,T}$ levels over the same time period. Correction to be applied where the C minus A level is 15 dB or more and: • Where any of the one-thired octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period • Where any of the one-thired octave noise levels in Table c2 are exceeded by more than 5 dB and cannot be mitigated, a 5-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2-dB(A) positive adjustment applies for the daytime period.	2 or 5 dB[2]	A difference of 15 dB or more between C- and A-weighted measurements identifies the potential for an unbalance spectrum and potential increased annoyance. The values in Table C2 are derived from Moorhouse (2011) for DEFRA fluctuating low-frequency noise criteria with corrections to reflect external assessment locations.

Note 1. Corrections to be added to the measured or predicted levels, except in the case of duration where the adjustment is to be made to the criterion.
2. Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

Low frequency noise is defined as noise with an unbalanced spectrum and containing major components within the low-frequency range (10-160 Hz) of the frequency spectrum.

Table 5-7: Excerpt from Table C2: One-third octave low-frequency noise thresholds

Hz/dB(Z)	One-third octave $L_{Zeq,15min}$ threshold level											
Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB(Z)	92	89	86	77	69	61	54	50	50	48	48	46	44

Source: Noise Policy for Industry (2017)

5.4 NSW EPA Road Noise Policy

5.4.1 Introduction

The NSW Road Noise Policy (RNP) has been adopted to establish the noise criteria for the potential noise impact associated with additional traffic generated by the proposed development. The RNP was developed by the NSW EPA primarily to identify the strategies that address the issue of road traffic noise from:

- Existing roads;
- New road projects;
- Road redevelopment projects; and
- New traffic-generating developments.

5.4.2 Road Category

The subject site is accessed by Yallah Bay Road, which is a sub-arterial road off Princes Highway. No residential receivers are located on Yallah Bay Road. The closest residential receivers are located along Carlyle Close, Dapto however; there may be closer residential receivers when the future developments to the west and north-east of the site are built.

Carlyle Close would be unlikely to be affected by additional traffic generated by the proposed development. Therefore, Princes Highway has been considered in the road traffic noise assessment criteria.

Based on the RNP road classification description, Princes Highway would be classified as a 'Freeway or motorways/arterial road'.

5.4.3 Noise Assessment Criteria

Section 2.3 of the RNP outlines the criteria for assessing road traffic noise. The relevant sections of Table 3 of the RNP are shown in Table 5-8.

Table 5-8: Road Traffic Noise Assessment Criteria For Residential Land Uses, dB(A)

Road Category	Type of Project/Land Use	Assessment Criteria, dB(A)	
		Day (7am-10pm)	Night (10pm-7am)
Freeway or motorway/ arterial road	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq\ (15\ hour)}$ 60 dB (external)	$L_{Aeq\ (9\ hour)}$ 55 dB (external)

The noise level descriptor that has been adopted by the RNP for use with the above criteria is the L_{Aeq}.

5.4.4 Relative Increase Criteria

In addition to the assessment criteria outlined above, any increase in the total traffic noise level at a location due to a proposed project or traffic-generating development, must be considered. Residences experiencing increases in total traffic noise levels above the relative criteria should also be considered for mitigation as described in Section 3.4 of the RNP. For road projects where the main subject road is a local road, the relative increase criterion does not apply.

Table 6 of the RNP outlines the relative increase criteria for residential land uses and is shown in Table 5-9.

Table 5-9: Relative Increase Criteria For Residential Land Uses, dB(A)

Road Category	Type of Project/Land Use	Total Traffic Noise Level Increase, dB(A)	
		Day (7am-10pm)	Night (10pm-7am)
Freeway/arterial/sub-arterial roads and transit ways	New road corridor/redevelopment of existing road/land use development with potential to generate additional traffic on existing road	Existing traffic $L_{Aeq\ (15\ hour)}$ + 12 dB (external)	Existing traffic $L_{Aeq\ (9\ hour)}$ + 12 dB (external)

The assessment criteria provided in Table 5-8 and the relative increase criteria provided in Table 5-9 should both be considered when designing project specific noise levels, and the lower of the two should be adopted. For example, if the assessment criteria is 60 dB(A) and the relative increase criteria is 42 dB(A), then a project specific noise level of 42 dB(A) should be adopted. Similarly, if the assessment criteria is 60 dB(A) and the relative increase criteria is 65 dB(A), a project specific noise level of 60 dB(A) should be adopted.

5.4.5 Exceedance of Criteria

If the criteria shown in both Table 5-8 and Table 5-9 cannot be achieved, justification should be provided that all feasible and reasonable mitigation measures have been applied.

For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.

5.4.6 Assessment Locations for Existing Land Uses

Table 5-10: Assessment Locations for Existing Land Uses

Assessment Type	Assessment Location
External noise levels at residences	The noise level should be assessed at 1 metre from the façade and at a height of 1.5 metres from the floor. Separate noise criteria should be set and assessment carried out for each façade of a residence, except in straightforward situations where the residential façade most affected by road traffic noise can be readily identified. The residential noise level criterion includes an allowance for noise reflected from the façade ('façade correction'). Therefore, when taking a measurement in the free field where reflection during measurement is unlikely (as, for instance, when measuring open land before a residence is built), an appropriate correction – generally 2.5 dB – should be added to the measured value. The 'façade correction' should not be added to measurements taken 1 metre from the façade of an existing building. Free measurements should be taken at least 15 metres from any wall, building or other reflecting pavement surface on the opposite side of the roadway, and at least 3.5 metres from any wall, building or other pavement surface, behind or at the sides of the measurement point which would reflect the sound.
Noise levels at multi-level residential buildings	The external points of reference for measurement are the two floors of the building that are most exposed to traffic noise. On other floors, the internal noise level should be at least 10 dB less than the relevant external noise level on the basis of openable windows being opened sufficiently to provide adequate ventilation. (Refer to the Building Code of Australia (Australian Building Codes Board 2010) for additional information.)
Internal noise levels	Internal noise levels refer to the noise level at the centre of the habitable room that is most exposed to the traffic noise with openable windows being opened sufficiently to provide adequate ventilation. (Refer to the Building Code of Australia (Australian Building Codes Board 2010) for additional information.)
Open space – passive or active use	The noise level is to be assessed at the time(s) and location(s) regularly attended by people using the space. In this regard, 'regular' attendance at a location means at least once a week.

5.5 Construction Noise and Vibration Criteria

Criteria for construction and demolition noise has been obtained from the NSW Interim Construction Noise Guideline (DECC, 2009). Guidance for construction vibration has been taken from British Standard BS7385-Part 2: 1993 'Evaluation and measurement for vibration in buildings' and other standards.

5.5.1 NSW Interim Construction Noise Guideline

Residential Criteria

Table 2 of the Interim Construction Noise Guideline (DECC, 2009), sets out construction noise management levels for noise at residences and how they are to be applied. The management noise levels are reproduced in Table 5-11 below. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level.

Table 5-11: Management Levels at Residences Using Quantitative Assessment

Time of Day	Management Level $L_{Aeq(15\ minute)}$	How to Apply
Recommended standard hours: Monday to Friday 7am – 6pm Saturday 8am – 1pm No work on Sundays or Public Holidays	Noise Affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq(15\ minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practises to meet the noise affected level. • The proponent should also inform all potentially affected residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly Noise Affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school, or mid-morning or mid-afternoon for works near residents. 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Table 5-11: Management Levels at Residences Using Quantitative Assessment

Time of Day	Management Level $L_{Aeq(15\ minute)}$	How to Apply
Outside recommended standard hours	Noise Affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2 (RNP)

Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m from the residence.

Other Land Uses

Table 5-12 sets out management levels for construction noise at other land uses applicable to the surrounding area.

Table 5-12: Management Levels at Other Land Uses

Land use	Management Level $L_{Aeq(15\ minute)}$ (applies when properties are being used)
Schools	Internal Noise Level 45 dB(A) External Noise Level 55 dB(A)
Offices, retail outlets	External Noise Level 70 dB(A)
Hotels, accommodation	Internal Nosie Level 50 dB(A) External Noise Level 60 dB(A)

There are no other sensitive land uses in the area surrounding the site. The noise criterion for construction noise is presented in Table 5-13.

Table 5-13: Construction Noise Criterion dB(A)

Receiver	Land Use	Period	RBL L_{A90}	Management Level $L_{Aeq(15\ minute)}$
R1-R5	Residential	Day	36	46
R6-R13, R18-R28	Residential	Day	35	45
R14-R17	Residential	Day	38	48
R29-R30	Commercial	Day	-	70

Table 5-13: Construction Noise Criterion dB(A)

Receiver	Land Use	Period	RBL L_{A90}	Management Level $L_{Aeq(15\ minute)}$
R31 & R31B	School	Day	-	55[A]
R32	Holiday Accommodation	Day	-	58[B]

A: An external criteria of 55dB(A) based on a 10dB(A) difference between internal limits of 45dB(A).
B: A criteria 5dB(A) greater than the operational project specific noise levels shown in Table 5-5 has been adopted.

5.5.2 Vibration Criteria

Vibration criteria from construction works are outlined in this section, including guidelines to avoid cosmetic damage, structural damage or human discomfort. There is no specific vibration standard in NSW to assess cosmetic or structural damage to buildings. Usually the British Standard BS 7385–Part 2: 1993 'Evaluation and measurement for vibration in buildings' or the German standard DIN4150–Part 3: 1999 'Structural Vibration Part 3 – effects of vibration on structures' is referenced. The Assessing Vibration – A Technical Guideline (DEC, 2006) provides guidance on preferred levels for human exposure.

5.5.3 BS 7385-2:1993

The British Standard BS 7385–Part 2:1993 'Evaluation and measurement for vibration in buildings' provides vibration limits to avoid cosmetic damage on surrounding structures. Limits are set at the lowest limits where cosmetic damage has previously been shown.

Table 5-14: Vibration criteria for cosmetic damage (BS 7385:2 1993)

Type of building	Peak component particle velocity in frequency range of predominant pulse		
	4 Hz to 15 Hz	15 Hz to 40 Hz	40 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above		
Unreinforced or light framed structures. Residential or light commercial type buildings	15 to 20 mm/s	20 to 50 mm/s	50 mm/s

5.5.4 DIN4150-3:1999

The German standard DIN4150-Part 3:1999 'Structural Vibration Part 3 – effects of vibration on structures' has also been considered. The German standard is considered more onerous than the British standard, and specifically includes more stringent limits to avoid structural damage to surrounding heritage buildings.

Table 5-15: Structural damage criteria heritage structures (DIN4150-3 1999)

Type of building	Peak component particle velocity (PPV) mm/s			
	Vibration at the foundation at a frequency of:			Vibration of horizontal plane of highest floor at all frequencies
	1 to 10 Hz	10 to 50 Hz	50 to 100 Hz	
Buildings used for commercial purposes, industrial buildings or buildings of similar design	20	20 to 40	40 to 50	40
Residential dwellings and similar	5	5 to 15	15 to 20	15
Structures that, because of their particular sensitivity to vibration, cannot be classified as the two categories above, and are of intrinsic value (for example heritage listed buildings).	3	3 to 8	8 to 10	8

5.5.5 Human Exposure

The guideline Assessing Vibration – A Technical Guideline (DEC, 2006) describes preferred criteria for human exposure. The limits describe values where occupants of buildings would be impacted by construction work.

Table 5-16: Preferred and maximum weighted rms z-axis values, 1-80 Hz

Location	Daytime		Night time	
	Preferred	Maximum	Preferred	Maximum
Continuous Vibration (weighted root mean square (rms) vibration levels for continuous acceleration (m/s^2) in the vertical direction)				
Residences	0.01	0.02	0.007	0.014
Offices, schools, educational institutions and places of worship	0.02	0.04	0.02	0.04
Workshops	0.04	0.08	0.04	0.08
Impulsive Vibration (weighted root mean square (rms) vibration levels for impulsive acceleration (m/s^2) in the vertical direction)				
Residences	0.3	0.6	0.1	0.2
Offices, schools, educational institutions and places of worship	0.64	1.28	0.64	1.28
Workshops	0.64	1.28	0.64	1.28
Intermittent Vibration (m/s)				
Residences	0.2	0.4	0.13	0.26
Offices, schools, educational institutions and places of worship	0.4	0.8	0.4	0.8
Workshops	0.8	1.6	0.8	1.6

6. OPERATIONAL NOISE IMPACT ASSESSMENT

An outline of the predictive noise modelling methodology and operational noise modelling scenarios has been provided in this section of the report.

6.1 MODELLING METHODOLOGY

Noise propagation modelling was carried out using the Concawe algorithm within SoundPLAN. This model has been extensively utilised by Benbow Environmental for assessing noise emissions for existing and modified projects, and is recognised by regulatory authorities throughout Australia. The model allows for the prediction of noise from a site at the specified receiver, by calculating the contribution of each noise source. Other model inputs included the noise sources, topographical features of the subject area, surrounding buildings, noise walls and receiver locations.

The modelling scenario has been carried out using the L_{Aeq} descriptors. Using the model, noise levels were predicted at the potentially most affected receivers to determine the noise impact against the project specific noise levels and other relevant noise criteria in accordance with the NSW Noise Policy for Industry (EPA, 2017).

6.2 NOISE SOURCES

The sound power levels for the identified noise sources associated with Tallawarra A have been established from on-site measurements, while noise sources from the proposed Tallawarra B power station were established from Benbow Environmental's database. A-weighted third octave band centre frequency sound power levels have been used and are presented in Table 6-1, Table 6-2 and Table 6-3 below.

The location of noise sources is shown in Figure 6-1 to Figure 6-6.

The noise from the top of the stacks is modelled with directivity in accordance with NSW EPA Environmental Noise Control Manual Data Sheet 207-1 1994 Appendix 3.

Benbow Environmental has conducted verification measurements for numerous projects, including Smithfield Energy Facility, Visy Plants across Australia, and Huntly New Zealand and has consistently found that the practice of predicting noise levels using the Environmental Noise Control Manual for Directivity to produce accurate results, with the verification measurements generally being equal or below the predicted levels.

Table 6-1: A-weighted Sound Power Levels Associated with Operational Activities – Tallawarra A, dB(A)

Noise Source	LAmax	Overall LAeq	Third Octave Band Centre Frequency (Hz)									
			25	31	40	50	63	80	100	125	160	200
			250	315	400	500	630	800	1000	1250	1600	2000
			2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Tallawarra A												
Top of Stack	82	76	-	-	-	-	69	-	-	72	-	-
			69	-	-	69	-	-	61	-	-	59
			-	-	51	-	-	45	-	-	-	-
stack casing	-	80	37	39	43	54	51	57	69	60	65	63
			63	66	65	75	66	65	67	66	69	66
			69	65	62	62	60	59	55	-	-	-
Compressor	108	102	40	45	53	60	63	72	73	75	76	83
			93	83	88	96	91	89	94	90	90	88
			87	85	85	78	75	71	64	60	53	44
HRSG Piping	96	90	44	46	48	56	60	59	64	64	69	75
			79	74	76	77	78	78	78	79	79	79
			79	78	81	74	71	69	64	58	-	-
Air Intake	87	81	33	35	36	41	48	43	46	65	53	56
			69	70	61	73	70	70	73	69	69	70
			70	69	66	66	63	60	58	54	50	-
Turbine Piping	74	68	19	21	24	40	35	35	43	41	49	47
			56	52	53	55	56	57	56	57	57	58
			57	55	55	52	49	47	45	39	-	-
Inlet Piping	74	68	19	21	24	40	35	35	43	41	49	47
			56	52	53	55	56	57	56	57	57	58
			57	55	55	52	49	47	45	39	-	-
Feed Pumps	108	102	42	47	52	64	64	75	69	69	81	75
			75	76	81	85	87	98	88	86	95	88
			93	93	92	89	85	86	80	71	-	-
Transformer Cooling Fans	82	76	32	37	33	39	49	46	54	61	57	69
			62	62	60	62	61	71	67	61	59	54
			54	54	54	54	54	43	52	51	-	-
Water Tray	98	92	31	36	41	53	53	64	58	58	70	64
			64	65	70	74	76	87	77	75	84	77
			82	82	81	78	74	75	69	60	-	-
Pump 1	106	100	39	44	49	61	61	72	66	66	78	72
			72	73	78	82	84	95	85	83	92	85
			90	90	89	86	82	83	77	68	-	-
Exhaust vent	107	101	44	49	57	60	63	66	76	75	74	83
			78	82	86	87	97	86	86	89	85	91
			86	91	89	84	82	77	76	68	62	57
Exhaust casing	-	99	63	66	74	83	82	87	91	91	90	79
			80	82	81	91	83	81	83	82	85	83
			85	81	78	78	76	75	72	-	-	-

Table 6-1: A-weighted Sound Power Levels Associated with Operational Activities – Tallawarra A, dB(A)

Noise Source	LAmax	Overall LAeq	Third Octave Band Centre Frequency (Hz)									
			25	31	40	50	63	80	100	125	160	200
			250	315	400	500	630	800	1000	1250	1600	2000
			2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
HRSG internal point source	-	88	44	47	51	62	59	65	76	68	72	70
			71	73	72	83	74	73	75	74	77	74
			76	72	69	70	67	66	63	-	-	-
Turbine hall internal point source	-	98	63	66	76	82	84	86	90	89	83	72
			71	74	74	78	79	77	78	78	83	85
			92	80	82	88	80	76	77	-	-	-
Air-conditioning exhaust	82	76	40	44	47	49	52	55	67	57	61	59
			55	61	62	63	63	63	65	65	65	65
			66	62	60	62	61	61	50	-	-	-
Fan Motor	104	98	47	53	59	65	65	70	79	76	81	82
			83	82	84	85	92	89	88	87	86	85
			85	83	81	79	77	75	71	68	64	59

Table 6-2: A-weighted Sound Power Levels Associated with Operational Activities – Tallawarra B – F Class OCGT, dB(A)

Noise Source	LAmax	Overall LAeq	Third Octave Band Centre Frequency (Hz)									
			25	31	40	50	63	80	100	125	160	200
			250	315	400	500	630	800	1000	1250	1600	2000
			2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Tallawarra B												
Gas Turbine Walls	-	103	68	71	81	87	89	91	95	94	88	77
			76	79	79	83	84	82	83	83	88	90
			97	85	87	93	85	81	82	-	-	-
Exhaust Vent	102	96	60	64	67	69	72	75	87	77	81	79
			75	81	82	83	83	83	85	85	85	85
			86	82	80	82	81	81	70	62	58	-
Top of Stack	106	100	-	67	-	-	83	-	-	90	-	-
			97	-	-	95	-	-	90	-	-	80
			-	-	72	-	-	57	-	-	33	-
Stack Casing	-	77	14	22	33	38	47	55	60	55	60	71
			68	71	66	65	65	65	63	63	59	62
			62	50	49	48	35	28	16	20	-	-
Exhaust casing	-	99	56	58	62	73	70	76	88	79	84	82
			82	85	84	94	85	84	86	85	88	85
			88	84	81	81	79	78	74	-	-	-
Lube Oil Fin Cooler	-	94	43	46	53	54	59	75	67	58	64	64
			65	69	70	75	71	72	72	70	72	74
			93	85	72	79	72	69	62	56	48	-

Table 6-2: A-weighted Sound Power Levels Associated with Operational Activities – Tallawarra B – F Class OCGT, dB(A)

Noise Source	LAmax	Overall LAeq	Third Octave Band Centre Frequency (Hz)									
			25	31	40	50	63	80	100	125	160	200
			250	315	400	500	630	800	1000	1250	1600	2000
			2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Air Intake	86	81	33	35	36	41	48	43	46	65	53	56
			69	70	61	73	70	70	73	69	69	70
			70	69	66	66	63	60	58	54	50	-
Main Transformer	106	100	56	61	57	63	73	70	78	85	81	93
			86	86	84	86	85	95	91	85	83	78
			78	78	78	78	78	67	76	75	-	-

Table 6-3: A-weighted Sound Power Levels Associated with Operational Activities – Tallawarra B – E Class OCGT, dB(A)

Noise Source		Overall LAeq	Third Octave Band Centre Frequency (Hz)									
			25	31	40	50	63	80	100	125	160	200
			250	315	400	500	630	800	1000	1250	1600	2000
			2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Tallawarra B												
Gas Turbine Walls	-	102	67	70	80	86	88	90	94	93	87	76
			75	78	78	82	83	81	82	82	87	89
			96	84	86	92	84	80	81	-	-	-
Exhaust Vent	102	96	60	64	67	69	72	75	87	77	81	79
			75	81	82	83	83	83	85	85	85	85
			86	82	80	82	81	81	70	62	58	-
Top of Stack	106	100	-	67	-	-	83	-	-	90	-	-
			97	-	-	95	-	-	90	-	-	80
			-	-	72	-	-	57	-	-	33	-
Stack Casing	-	77	14	22	33	38	47	55	60	55	60	71
			68	71	66	65	65	65	63	63	59	62
			62	50	49	48	35	28	16	20	-	-
Exhaust casing	-	99	56	58	62	73	70	76	88	79	84	82
			82	85	84	94	85	84	86	85	88	85
			88	84	81	81	79	78	74	-	-	-
Lube Oil Fin Cooler	-	94	43	46	53	54	59	75	67	58	64	64
			65	69	70	75	71	72	72	70	72	74
			93	85	72	79	72	69	62	56	48	-
Air Intake	87	81	33	35	36	41	48	43	46	65	53	56
			69	70	61	73	70	70	73	69	69	70
			70	69	66	66	63	60	58	54	50	-
Main Transformer	106	100	56	61	57	63	73	70	78	85	81	93
			86	86	84	86	85	95	91	85	83	78
			78	78	78	78	78	67	76	75	-	-

Figure 6-1: Tallawarra A Noise Sources

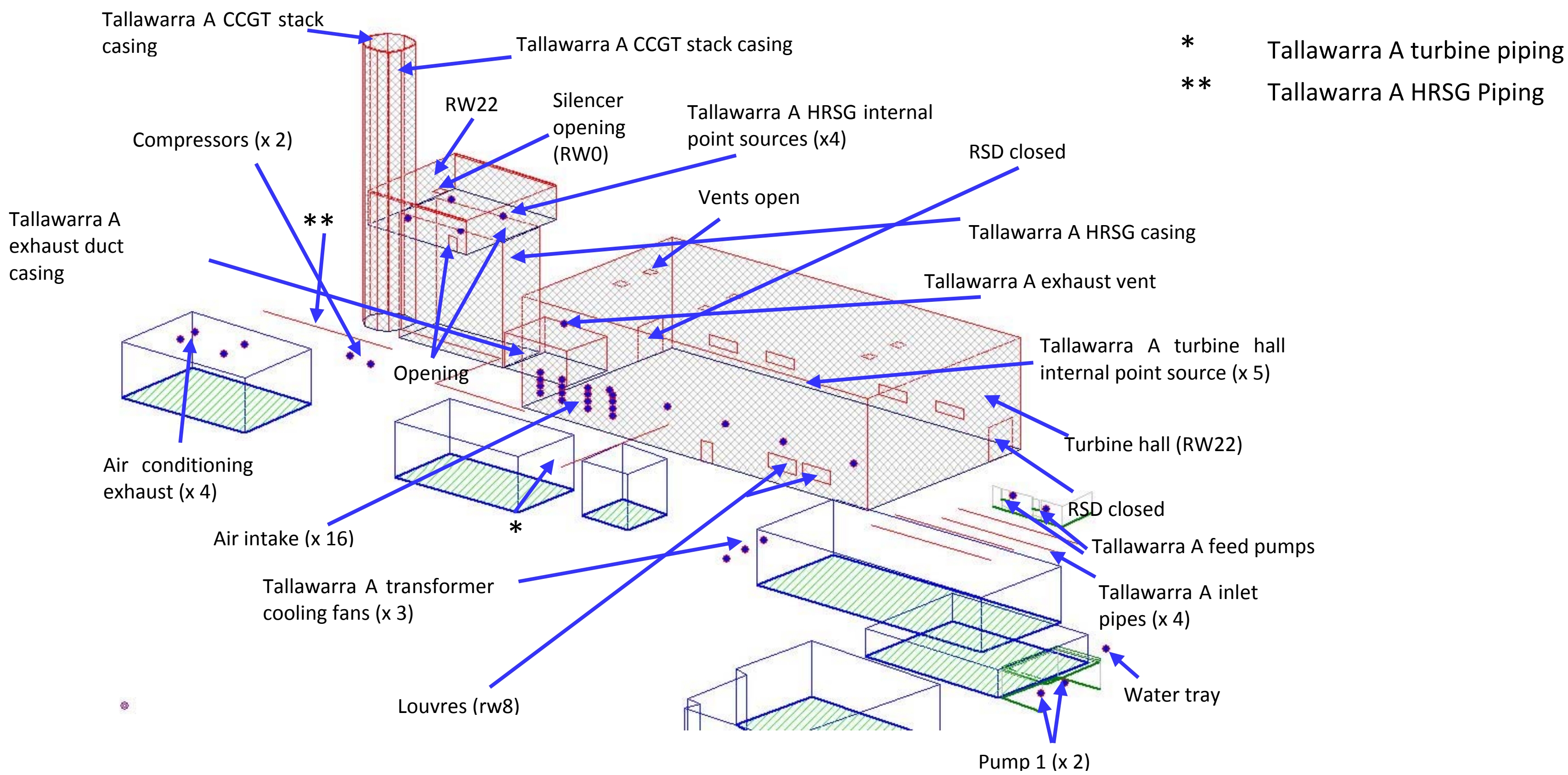


Figure 6-2: Tallawarra B 1xF Class OCGT

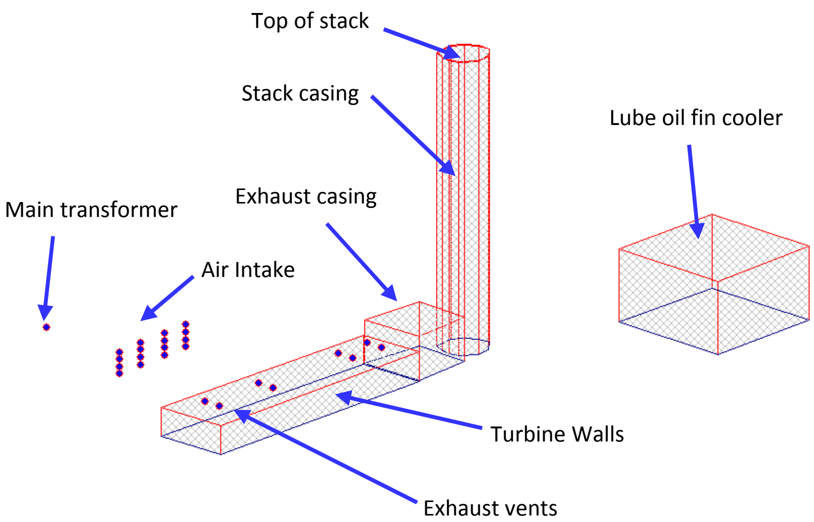
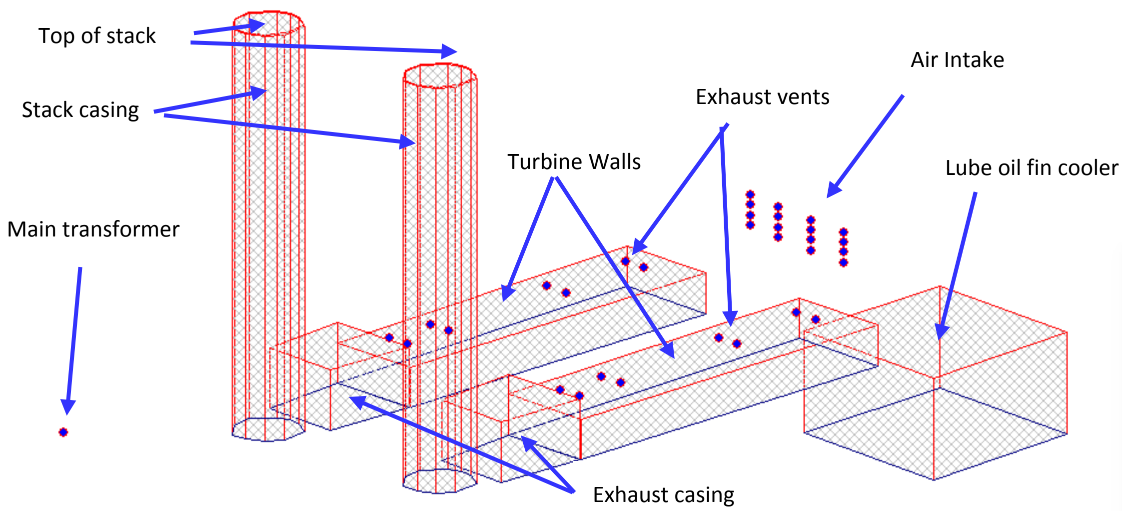


Figure 6-3: Tallawarra B 2xE Class OCGT



6.2.1 Modelling Scenarios

Table 6-4 presents the modelled scenarios for this noise assessment. Scenario 1 considers the existing noise levels generated from Tallawarra A calibrated based on onsite measurements (see Section 3.4). Scenario 2 considers the modified project, the F Class OCGT operating at the same time as Tallawarra A modelling the noise impacts of the modified project which is the subject of this noise assessment. Scenario 3 considers the approved project with 2 E Class OCGTs operating at the same time as Tallawarra A.

Table 6-4: Modelled Noise Scenarios

Scenario	Description
Scenario 1: Tallawarra A	This scenario models the existing power station - operating @ 100% load
Scenario 2: Tallawarra A + B 1xF Class OCGT	This scenario models the existing power station and the Tallawarra B: 1x F Class OCGT - operating @ 100% load
Scenario 3: Tallawarra A + B 2x E Class OCGT	This scenario models the existing power station and the Tallawarra B: 2x E Class OCGT - operating @ 100% load

Figure 6-4: Scenario 1 – Tallawarra A Noise Sources

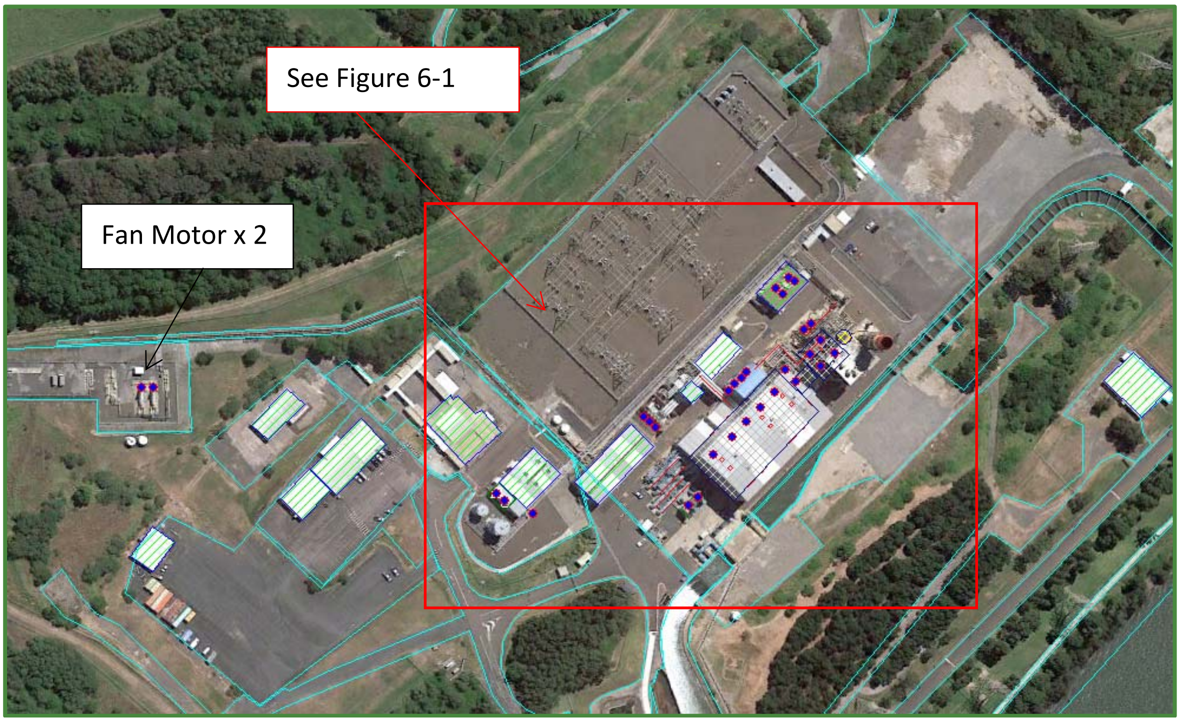


Figure 6-5: Scenario 2 – Tallawarra A + B 1xF Class OCGT

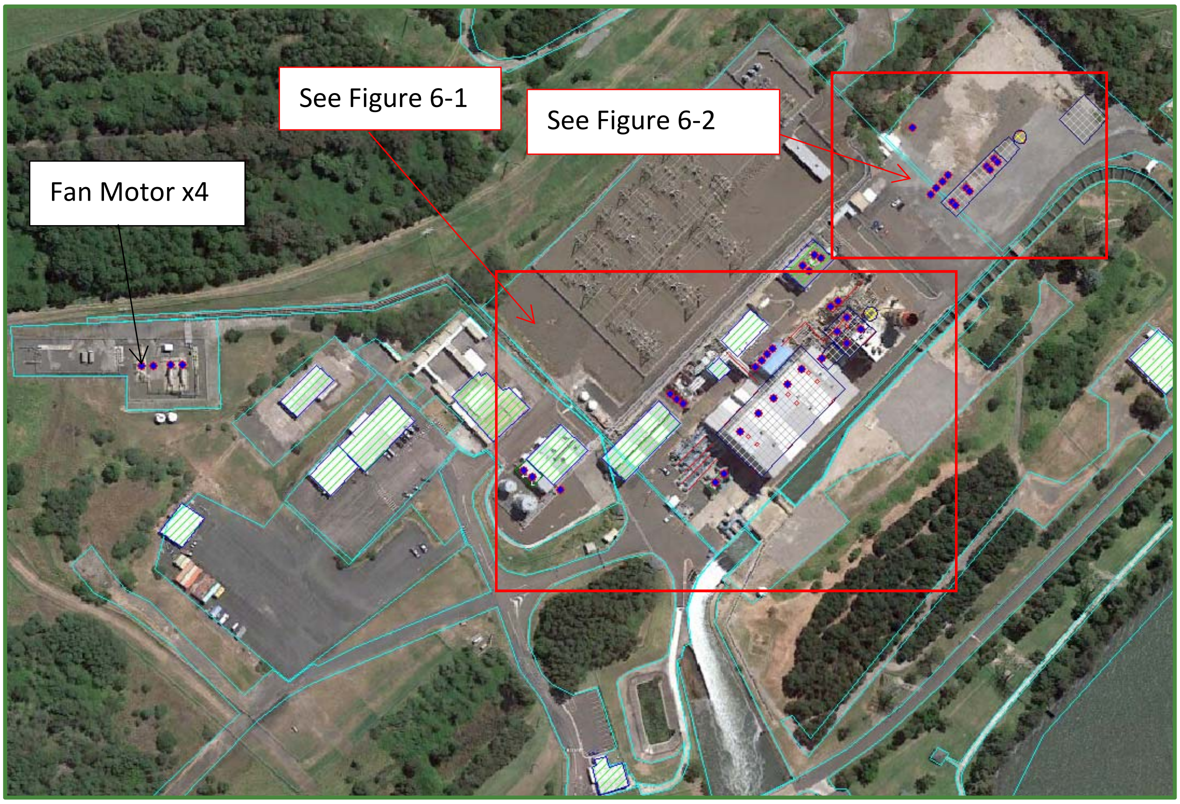
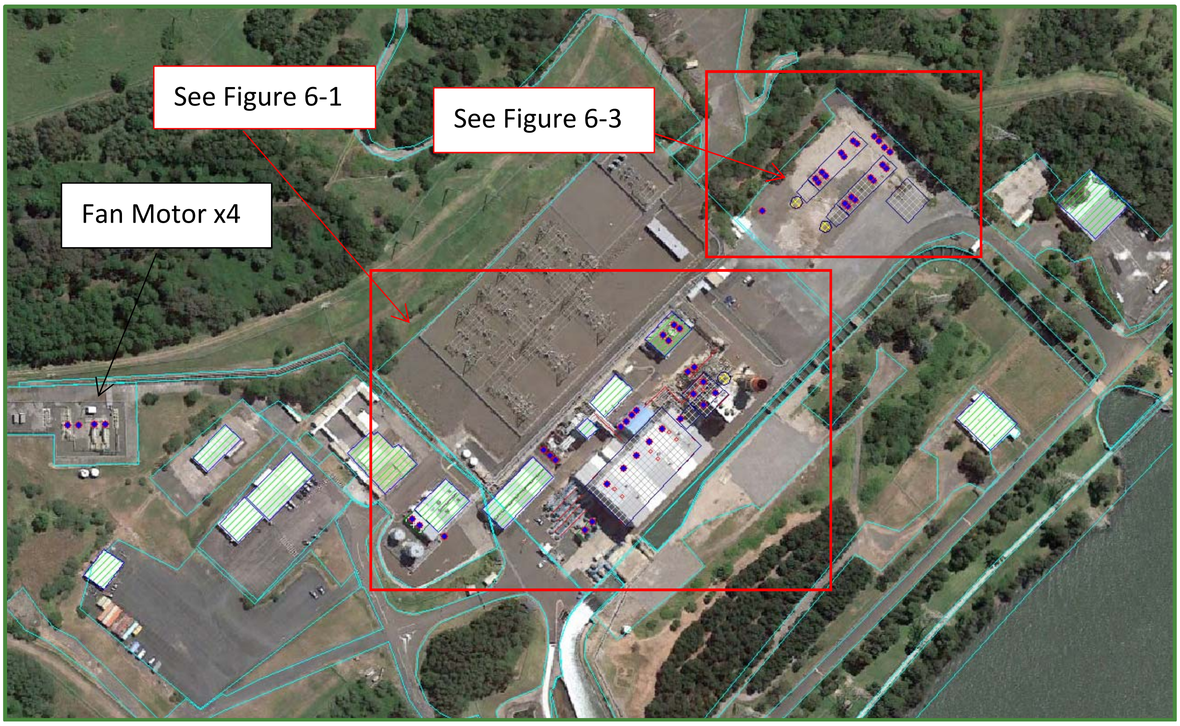


Figure 6-6: Scenario 3 – Tallawarra A + B 2xE Class OCGT



6.2.2 Modelling Assumptions

The relevant assessment period for operational noise emissions is 15 minutes when assessing noise levels against the project noise trigger levels. Therefore noise source durations detailed throughout the following assumptions section should be considered per 15 minute period in view of potential noise impacts under worst-case scenarios. Each assessment-specific assumption has been detailed below:

- Topographical information has been obtained from EnergyAustralia from a detailed aerial laser survey and implemented in SoundPLAN. Topographical information from outside the surveyed area was obtained from Google Earth and implemented in SoundPLAN.

- All ground areas surrounding the subject site and the nearest nominated occupancies have been modelled considering different ground factors ranging from 0 to 1. The site and surrounding industrial areas and water have been modelled with a ground absorption factor of 0 (hard). The existing and proposed residential areas have been modelled with a ground absorption factor of 0.5 (medium). Surrounding grassland has been modelled with a ground absorption factor of 1.

- Surrounding buildings and solid walls have been included in the noise model.

- All noise sources are considered to operate 100% of the 15 minute assessment period.

- The roller shutter doors to the Tallawarra A turbine hall have been modelled closed. These are only typically open during maintenance when the turbine is not running.

- All residential receivers were modelled at 1.5 m above ground level at the most noise-affected point within the property boundary.

6.3 PREDICTED NOISE LEVELS

Noise levels at the nearest receivers have been calculated and results of the predictive noise modelling considering existing and proposed operational activities are shown in Table 6-5.

Contours are presented in Attachment 9.

Table 6-5: Predicted Noise Levels – dB(A)

Receptor	Receiver Type	Project Criteria				Predicted Scenarios $L_{Aeq, 15 minute}$			Predicted Scenarios L_{AMAX}		
		$L_{Aeq(15 minute)}$			L_{AMAX}	1 - Talla A	2- Talla A +B 1xF-Class OCGT	3 – Talla A + B 2xE-Class OCGT	1 - Talla A	2- Talla A +B 1xF-Class OCGT	3 – Talla A + B 2xE-Class OCGT
		Day	Evening	Night	Night						
R1	Residential	41	41	38	52	16✓	21✓	21✓	19✓	23✓	23✓
R2	Residential	41	41	38	52	16✓	20✓	21✓	19✓	23✓	22✓
R3	Residential	41	39	35	52	15✓	20✓	22✓	18✓	24✓	24✓
R4	Residential	41	39	35	52	14✓	18✓	20✓	17✓	22✓	22✓
R5	Residential	41	39	35	52	12✓	17✓	20✓	15✓	23✓	22✓
R6	Residential	40	40	38	52	19✓	26✓	27✓	23✓	29✓	29✓
R7	Residential	40	40	38	52	15✓	22✓	22✓	19✓	24✓	24✓
R8*	Residential	40	40	38	52	27✓	32✓	33✓	31✓	34✓	35✓
R9	Residential	40	40	38	52	19✓	24✓	23✓	24✓	27✓	26✓
R10	Residential	40	40	38	52	18✓	20✓	20✓	24✓	24✓	24✓
R11	Residential	40	40	38	52	18✓	19✓	22✓	22✓	23✓	24✓
R12	Future Residential	40	40	38	52	24✓	25✓	26✓	29✓	29✓	29✓
R13	Future Residential	40	40	38	52	24✓	26✓	28✓	28✓	30✓	30✓
R14	Future Residential	43	43	36	52	31✓	33✓	33✓	36✓	37✓	37✓
R15	Future Residential	43	43	36	52	27✓	30✓	30✓	29✓	34✓	32✓
R16	Future Residential	43	43	36	52	26✓	30✓	29✓	28✓	32✓	31✓
R17	Future Residential	43	43	36	52	27✓	31✓	31✓	30✓	34✓	33✓
R18	Future Residential	40	39	36	52	17✓	21✓	24✓	21✓	24✓	26✓
R19	Future Residential	40	39	36	52	19✓	23✓	26✓	22✓	26✓	28✓
R20	Future Residential	40	39	36	52	23✓	28✓	31✓	26✓	33✓	33✓
R21	Future Residential	40	39	36	52	26✓	32✓	35✓	29✓	37✓	37✓
R22	Future Residential	40	39	36	52	25✓	31✓	34✓	28✓	36✓	36✓
R23	Future Residential	40	39	36	52	26✓	31✓	34✓	29✓	38✓	37✓
R24	Future Residential	40	39	36	52	22✓	27✓	30✓	25✓	31✓	32✓

Table 6-5: Predicted Noise Levels – dB(A)

Receptor	Receiver Type	Project Criteria				Predicted Scenarios $L_{Aeq, 15 minute}$			Predicted Scenarios L_{AMAX}		
		$L_{Aeq(15 minute)}$			L_{AMAX}	1 - Talla A	2- Talla A +B 1xF-Class OCGT	3 – Talla A + B 2xE-Class OCGT	1 - Talla A	2- Talla A +B 1xF-Class OCGT	3 – Talla A + B 2xE-Class OCGT
		Day	Evening	Night	Night						
R25*	Future Residential	40	39	36	52	26✓	31✓	35✓	31✓	37✓	37✓
R26*	Future Residential	40	39	36	52	24✓	30✓	33✓	29✓	33✓	35✓
R27*	Future Residential	40	39	36	52	29✓	31✓	36✓	34✓	36✓	39✓
R28	Future Age Care	40	40	38	52	20✓	25✓	24✓	24✓	29✓	27✓
R29	Future Commercial	60			-	44✓	47✓	47✓	-	-	-
R30	Future Commercial	60			-	34✓	35✓	35✓	-	-	-
R31 R31B	Future Development Area (Potential Primary School)	50			-	44✓ 34✓	45✓ 39✓	46✓ 39✓	- -	- -	- -
R32	Future Tourism Facility (Potential Holiday Accommodation)	53	48	43	-	34✓	38✓	37✓	-	-	-

✓Complies ✖ Non-compliance

* R8, R25, R26, R27 are modelled with wind conditions as shown in Section 4.4.1.

6.3.1 Low Frequency

Low frequency noise for the three scenarios described in this section, has been evaluated as part of this assessment. R14 has been assessed as it is cumulatively the worst receiver for low frequency noise. The results of the low frequency levels at R14 are shown below for all three scenarios.

Table 6-6: Predicted Low Frequency Contribution

	Worst Case Receiver	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz
Threshold levels	-	69	61	54	50	50	48	48	46	44
Scenario 1: Tallawarra A	R14	50✓	48✓	52✓	49✓	47✓	45✓	40✓	36✓	29✓
Scenario 2: Tallawarra A + B 1xF Class OCGT	R14	52✓	50✓	54✓	53×	50✓	49×	45✓	40✓	33✓
Scenario 3: Tallawarra A + B 2x E Class OCGT	R14	52✓	50✓	54✓	53×	50✓	48✓	48✓	46✓	44✓

As can be seen the existing plant exceeds the threshold level by 3 dB at 50 Hz for Scenario 2 and Scenario 3 and by 1 dB at 80 Hz for scenario 2. Low frequency noise complies at all other frequencies assessed.

If the threshold levels are exceeded by 1-5 dB(Z) a 2 dB(A) penalty applies to the levels generated from the plant. If the threshold levels are exceed by greater than 5 dB(Z) then a 5 dB(A) penalty applies.

Whilst the exceedances are unlikely to generate offensive noise to warrant a noise penalty, if a 2 dB(A) penalty were applied to the worst case affected receiver, R14, the resulting noise levels would still remain under the project noise criteria for the proposed scenarios.

6.3.2 Discussion

Noise levels are predicted to comply at all existing and future sensitive receivers. As can be seen from the predicted results the proposed F Class OCGT plant noise levels are slightly lower than the already approved 2xE Class OCGT plant.

6.4 Start Up Noise

6.4.1 Start Up Noise Sources

The following table presents the Tallawarra A startup source that has been added to the model to represent the additional noise from Tallawarra A during start up calibrated/ adjusted to produce the same measurement results presented in Section 3.4.2.

Table 6-7: A-weighted Sound Power Levels Associated with Startup Activities – Tallawarra A, dB(A)

Noise Source	Overall LAeq	Third Octave Band Centre Frequency (Hz)									
		25	31	40	50	63	80	100	125	160	200
		250	315	400	500	630	800	1000	1250	1600	2000
		2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Tallawarra A											
Tallawarra A Start-up/shut-down Source*	116	65	70	74	82	84	86	90	88	88	90
		92	91	98	99	103	108	106	106	107	106
		107	105	102	97	90	81	70	65	62	107

*Horizontal directivity (max+2.5dB towards the NE; min -4.1dB towards the SW) for the startup source in order to meet measurement results.

6.4.2 Start Up Scenarios

The start up scenarios do not include Tallawarra B start up as the start up for a combined co-generation plant (Tallawarra A) is well known to be considerably worse than an open cycle plant and the two plants starting up at the same time is extremely unlikely to occur. The following table shows the scenarios modelled.

Table 6-8: Start up scenarios

Scenario	Description
Scenario 1: Tallawarra A Start Up	This scenario models the existing power station start up
Scenario 2: Tallawarra A Start Up + B 1xF Class OCGT	This scenario models the existing power station start up and the Tallawarra B: 1x F Class OCGT - operating @ 100% load
Scenario 3: Tallawarra A Start Up+ B 2x E Class OCGT	This scenario models the existing power station start up and the Tallawarra B: 2x E Class OCGT - operating @ 100% load

6.4.3 Start Up Predicted Results

The predicted results are displayed in the table below.

Table 6-9: Predicted Noise Levels – dB(A)

Receiver	Receiver Type	Project Criteria				Predicted Scenarios $L_{Aeq, 15 minute}$			Predicted Scenarios L_{AMAX}		
		$L_{Aeq(15 minute)}$			L_{AMAX}	1 - Talla A Start Up	2- Talla A Start Up +B 1xF-Class OCGT	3 – Talla A Start Up + B 2xE-Class OCGT	1 - Talla A	2- Talla A +B 1xF-Class OCGT	3 – Talla A + B 2xE-Class OCGT
		Day	Evening	Night	Night						
R1	Residential	41	41	38	52	18✓	21✓	22✓	20✓	24✓	23✓
R2	Residential	41	41	38	52	17✓	21✓	21✓	19✓	23✓	22✓
R3	Residential	41	39	35	52	17✓	21✓	23✓	20✓	24✓	24✓
R4	Residential	41	39	35	52	16✓	19✓	21✓	18✓	22✓	22✓
R5	Residential	41	39	35	52	14✓	17✓	20✓	16✓	23✓	22✓
R6	Residential	40	40	38	52	20✓	26✓	27✓	23✓	29✓	29✓
R7	Residential	40	40	38	52	15✓	22✓	22✓	19✓	24✓	24✓
R8*	Residential	40	40	38	52	27✓	32✓	33✓	25✓	34✓	35✓
R9	Residential	40	40	38	52	19✓	24✓	23✓	24✓	27✓	26✓
R10	Residential	40	40	38	52	18✓	20✓	20✓	24✓	24✓	25✓
R11	Residential	40	40	38	52	18✓	19✓	22✓	22✓	23✓	25✓
R12	Future Residential	40	40	38	52	24✓	25✓	26✓	29✓	29✓	30✓
R13	Future Residential	40	40	38	52	24✓	27✓	28✓	28✓	30✓	30✓
R14	Future Residential	43	43	36	52	31✓	33✓	33✓	36✓	37✓	37✓
R15	Future Residential	43	43	36	52	29✓	31✓	31✓	30✓	34✓	33✓
R16	Future Residential	43	43	36	52	28✓	30✓	30✓	30✓	33✓	32✓
R17	Future Residential	43	43	36	52	29✓	31✓	31✓	31✓	34✓	33✓
R18	Future Residential	40	39	36	52	20✓	22✓	24✓	22✓	25✓	26✓
R19	Future Residential	40	39	36	52	21✓	24✓	26✓	24✓	27✓	28✓
R20	Future Residential	40	39	36	52	24✓	28✓	31✓	26✓	33✓	33✓
R21	Future Residential	40	39	36	52	27✓	32✓	35✓	29✓	37✓	37✓
R22	Future Residential	40	39	36	52	29✓	32✓	35✓	31✓	37✓	37✓
R23	Future Residential	40	39	36	52	30✓	33✓	35✓	32✓	38✓	37✓
R24	Future Residential	40	39	36	52	26✓	29✓	30✓	28✓	32✓	32✓

Table 6-9: Predicted Noise Levels – dB(A)

Receiver	Receiver Type	Project Criteria				Predicted Scenarios $L_{Aeq, 15 minute}$			Predicted Scenarios L_{AMAX}		
		$L_{Aeq(15 minute)}$			L_{AMAX}	1 - Talla A Start Up	2- Talla A Start Up +B 1xF-Class OCGT	3 – Talla A Start Up + B 2xE-Class OCGT	1 - Talla A	2- Talla A +B 1xF-Class OCGT	3 – Talla A + B 2xE-Class OCGT
		Day	Evening	Night	Night						
R25*	Future Residential	40	39	36	52	31✓	33✓	36✓	34✓	37✓	38✓
R26*	Future Residential	40	39	36	52	26✓	31✓	33✓	30✓	33✓	35✓
R27*	Future Residential	40	39	36	52	30✓	32✓	36✓	34✓	37✓	39✓
R28	Future Age Care	40	40	38	52	20✓	25✓	24✓	24✓	29✓	27✓
R29	Future Commercial	60			-	44✓	47✓	47✓	-	-	-
R30	Future Commercial	60			-	34✓	36✓	36✓	-	-	-
R31 R31B	Future Development Area (Potential Primary School)	50			-	45✓ 34✓	45✓ 39✓	46✓ 39✓	- -	- -	- -
R32	Future Tourism Facility (Potential Holiday Accommodation)	50	45	40	-	35✓	38✓	37✓	-	-	-

6.4.4 Start Up Low Frequency

Low frequency noise is not considered a feature during start up, as the noise during start up is mainly associated with movement of air/steam such as air intakes and steam dumping which is not dominant in the low frequency range. This is validated by measurements of existing startup operations presented in section 3.4.2.

6.4.5 Start Up Discussion

The Start Up scenarios are predicted to comply with the L_{Aeq} and L_{Amax} criteria at all receivers.

7. ROAD TRAFFIC NOISE ASSESSMENT

A description of the calculation methodology and the noise predictions associated with road traffic has been provided below.

The most likely route for vehicles that have receivers along them would involve travelling along Yallah Bay Road onto Princes Highway. The nearest residential receiver to the site along this route is located adjacent to Princes Highway an arterial road, at 6 Semillon Place, Dapto,

The proposed modification to the Tallawarra Power Station is expected to generate less than 60 staff car movements per day, as there will be 30 full time staff. Regular truck movements are not expected as part of the site's activities. Major shut downs will occur approximately every 5 years for a period of 2 months, where 200 additional staff will be required, resulting in 230 cars (460 car movements) per day. Both of these scenarios have been modelled.

Calculation of road traffic noise contribution has been undertaken using SoundPLAN v7.3.

The $L_{Aeq,\ 15\ hour\ and}$ noise descriptors have been calculated at the most affected residential receiver located along the closest arterial road which is 6 Semillion Place, Dapto adjacent to Princes Highway. The cars are modelled as a moving point source at 1 m above the ground with a SWL of 82 dB(A) travelling at 80 km/h on both side of the road. 60 movements a day have been modelled in the operational scenario and 640 car movements a day in the shut down (maintenance) scenario. The receiver has been placed conservatively 4.5 m above the ground 1 m away from the façade to represent the second storey that rises above the boundary fence of the property. The predicted noise levels are displayed in Table 7-1.

Table 7-1: Predicted Levels for Road Traffic Noise

Receiver	Scenario	Arterial Roads Noise Criteria (Day)	Site Contribution (Day)
6 Semillon Place, Dapto	Operational - 30 cars	60 $L_{Aeq,\ 15\ hour}$	15 $L_{Aeq,\ 15\ hour}$ ✓
6 Semillon Place, Dapto	Shut down (Maintenance) - 230 cars	60 $L_{Aeq,\ 15\ hour}$	25 $L_{Aeq,\ 15\ hour}$ ✓

From Table 7-1, it can be seen that the predicted road traffic noise contributions will comply with the road noise criteria.

Therefore, the proposed vehicle movements are predicted to comply with the NSW Road Noise Policy, and no additional mitigation strategies are recommended.

8. CONSTRUCTION NOISE ASSESSMENT

8.1 CONSTRUCTION ACTIVITIES

Construction activities are proposed to include the following:

- Removal of existing concrete and minor earthworks;
- Concreting works of the plant base, hardstand areas and driveways; and
- Structure works for the proposed plant.

No demolition works are proposed.

8.2 MODELLED NOISE GENERATING SCENARIOS

Considering the construction activities outlined in Section 8.1, the two construction stages listed in Table 8-1 are modelled for:

- Concrete removal and earthworks;
- Concreting works; and
- Structure works.

The noise generating stages consider a worst case scenario in which all equipment is running for 100% of the time over the 15 minute assessment period.

The equipment list for the stages is detailed in Table 8-1, with an equipment location diagrams in Figure 6-1 to Figure 6-6. Equipment is primarily located near the entrance to the site, as equipment such as trucks will have greatest access and are most likely to be positioned at this spot.

All construction works are proposed to be undertaken during standard construction hours mentioned in Table 5-11, that is

- Monday to Friday, 7am to 6pm;
- Saturday 8am to 1pm; and
- No work on Sundays or public holidays.

Table 8-1: Modelled Noise Stages for Proposed Construction Works

Scenario	Time of the day	Noise Sources for Worst 15-minute Period
1. Concrete removal and earthworks	Standard hours	• Concrete saw • Front End Loader • Excavator
2. Concreting works	Standard hours	• Concrete mixer truck • Concrete pump • Hand tools
3. Structure works	Standard hours	• Truck • Crane x 2 • Hand Tools x 2

Note 1: As per Section 4.5 of the Interim Construction Noise Guideline (DECC, 2009), a number of activities have proven to be particularly annoying to residents and have therefore had 5 dB added to their predicted levels.

Figure 8-1: Construction Scenario 1

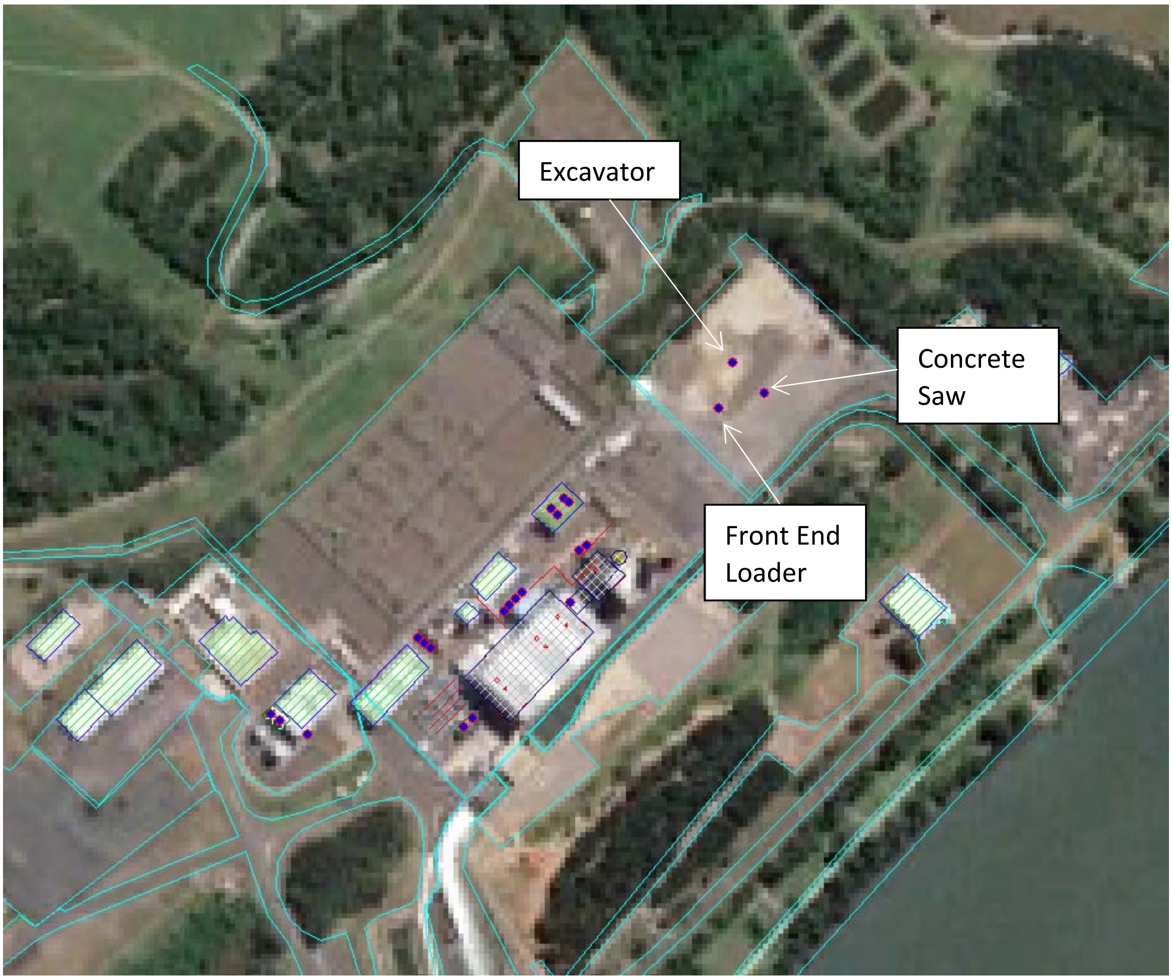


Figure 8-2: Construction Scenario 2

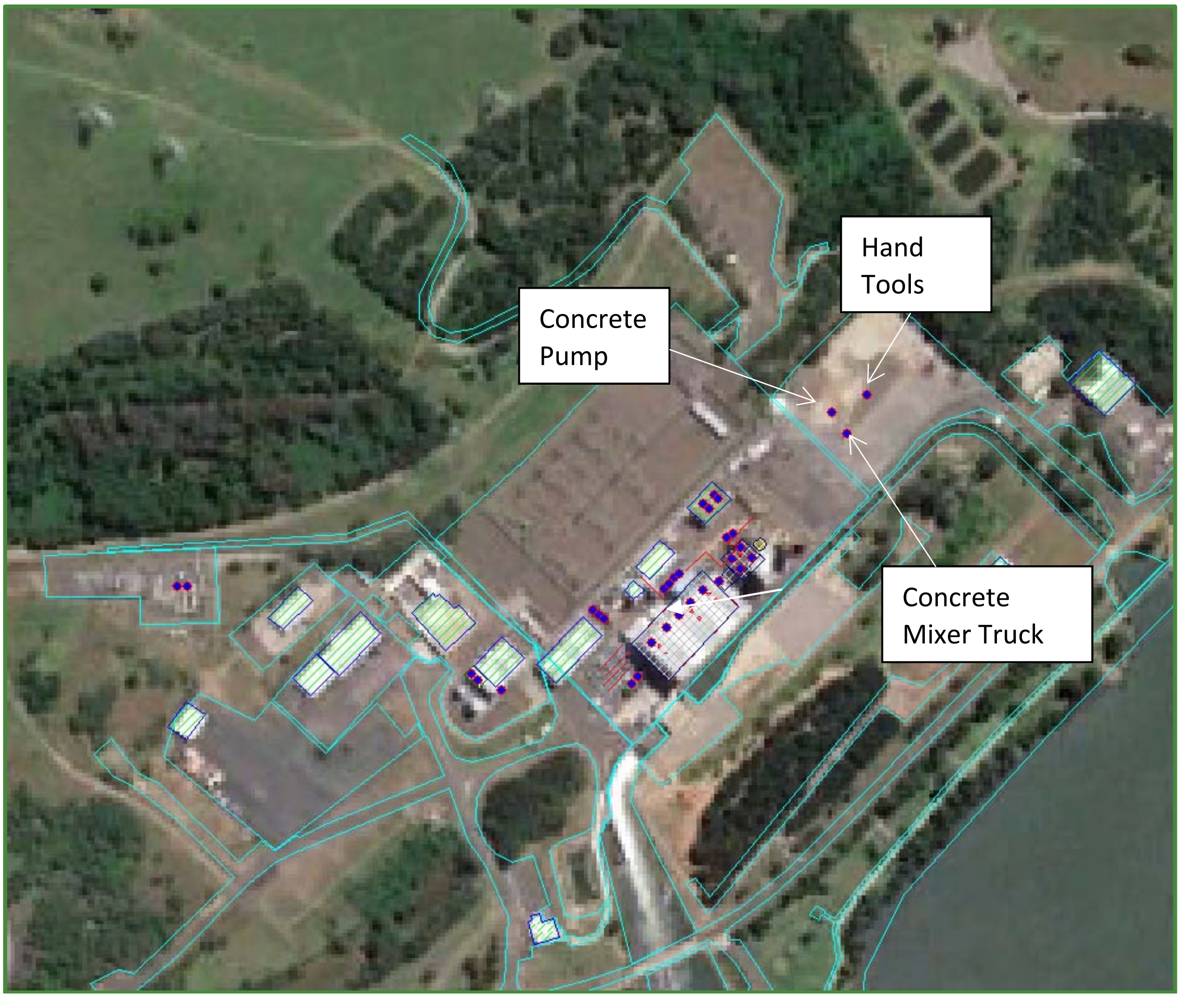
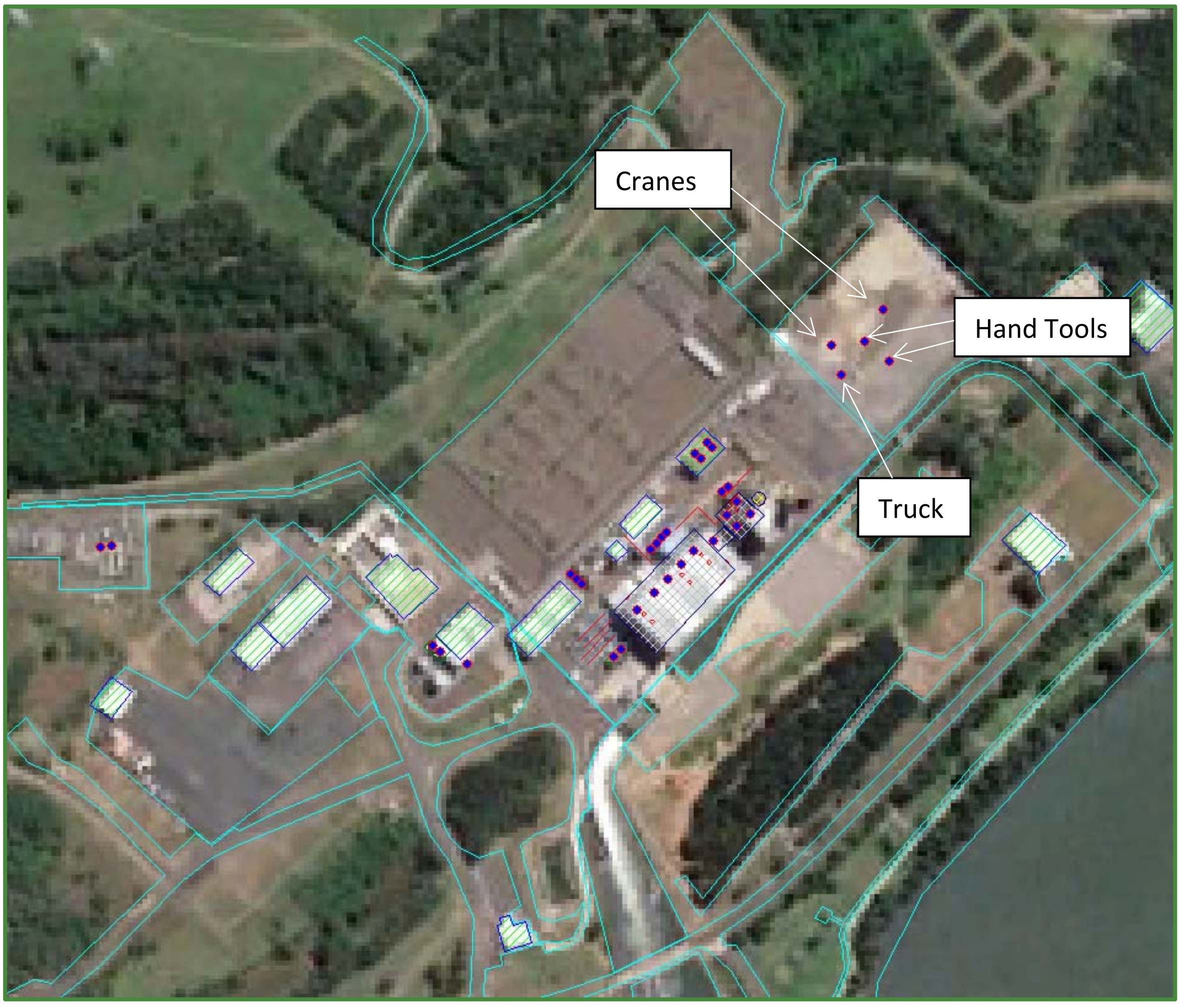


Figure 8-3: Construction Scenario 3



8.3 Modelling Methodology

8.3.1 Noise Model

Noise propagation modelling for the construction activities was carried out using the ISO 9613-2:1996 algorithm within SoundPLAN. The construction stages were modelled using the $L_{Aeq,\ 15\ minutes}$ descriptor.

Assumptions made in the noise modelling of the construction noise stages are as follows:

- The relevant assessment period for operational noise emissions has been considered to be 15 minutes. Construction stages assume all equipment is running 100% of the time during the 15 minute assessment period, to provide a worst case scenario;
- Topographical information for off-site areas was obtained from Google Earth;
- Topographical information for on-site areas was obtained from the site survey;
- All receivers were modelled at 1.5 m above ground level;
- All ground areas have been modelled considering different ground factors ranging from 0 to 1 (Soft to Hard ground). The subject site has been modelled with a ground absorption factor of 0 (hard) and the surrounding rural area, 1 (soft).
- All noise sources associated with the construction works have been modelled as point sources.

8.3.2 Noise Sources

A-weighted third octave band and octave band centre frequency sound power levels are presented shown in Table 8-2 and Table 8-3 below. The sound power levels for the relevant noise sources have been calculated from measurements of sound pressure levels undertaken by an acoustic engineer from Benbow Environmental at similar sites and sourced from Benbow Environmental's noise source database, as well as taken from AS 2436-2010 and the UK Department for Environmental Food and Rural Affairs (DEFRA) database, 'Update of noise database for prediction of noise on construction and open sites'.

Table 8-2: A-weighted Sound Power Levels Associated with Construction Activities, dB(A) Third Octave Spectrum

Noise Source	Overall LAeq	Third Octave Band Centre Frequency (Hz)									
		25	31	40	50	63	80	100	125	160	200
		250	315	400	500	630	800	1000	1250	1600	2000
		2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Front End Loader	102	44	51	59	85	84	77	77	78	80	85
		89	85	85	88	88	90	93	94	93	92
		91	90	88	87	84	81	77	73	66	60
Excavator	101	38	46	52	59	75	69	71	77	76	80
		81	81	86	87	87	89	91	92	92	92
		92	90	89	87	85	81	76	71	64	57

Table 8-3: A-weighted Sound Power Levels Associated with Construction Activities, dB(A)

Noise Source	Overall	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Concrete saw	**113**	87	86	91	95	100	105	111	104
Truck	**106**	77	84	89	104	95	93	88	88
Hand tools	**100**	71	81	91	96	94	90	87	81
Concrete mixer truck	**103**	70	84	92	96	97	98	92	85
Concrete pump truck	**105**	77	92	97	99	100	95	95	89
Crane	**103**	84	84	87	94	98	97	95	85

8.4 Construction Predicted Noise Levels

Results of the predictive noise modelling of the construction activities are shown in Table 8-4. Compliance with the noise criteria is predicted at all receivers, during all construction scenarios. Noise levels are also predicted to be well below the highly noise affected criteria of 75 dB(A).

Table 8-4: Noise Modelling Results Associated with Construction Activities for L_{eq}, dB(A)

Receiver	Criteria: PSNL ($L_{eq,15\ minute}$ dB(A))	Predicted Levels: Scenario (Standard Hours) (L_{eq}, dB(A))		
	Standard Hours	1	2	3
R1	46	25 ✓	25 ✓	25 ✓
R2	46	23 ✓	23 ✓	23 ✓
R3	46	26 ✓	26 ✓	26 ✓
R4	46	25 ✓	25 ✓	26 ✓
R5	46	26 ✓	27 ✓	28 ✓
R6	45	21 ✓	21 ✓	22 ✓
R7	45	20 ✓	20 ✓	20 ✓
R8	45	23 ✓	23 ✓	23 ✓
R9	45	26 ✓	26 ✓	26 ✓
R10	45	25 ✓	25 ✓	25 ✓
R11	45	24 ✓	25 ✓	25 ✓
R12	45	28 ✓	28 ✓	28 ✓
R13	45	28 ✓	29 ✓	29 ✓
R14	48	33 ✓	33 ✓	33 ✓
R15	48	32 ✓	32 ✓	32 ✓
R16	48	32 ✓	32 ✓	32 ✓
R17	48	34 ✓	34 ✓	34 ✓

Table 8-4: Noise Modelling Results Associated with Construction Activities for L_{eq}, dB(A)

Receiver	Criteria: PSNL ($L_{eq,15\ minute}$ dB(A))	Predicted Levels: Scenario (Standard Hours) (L_{eq}, dB(A))		
	Standard Hours	1	2	3
R18	45	23 ✓	23 ✓	24 ✓
R19	45	24 ✓	24 ✓	25 ✓
R20	45	29 ✓	30 ✓	30 ✓
R21	45	32 ✓	33 ✓	34 ✓
R22	45	33 ✓	33 ✓	34 ✓
R23	45	34 ✓	34 ✓	35 ✓
R24	45	32 ✓	32 ✓	32 ✓
R25	45	32 ✓	32 ✓	33 ✓
R26	45	31 ✓	31 ✓	31 ✓
R27	45	32 ✓	32 ✓	33 ✓
R28	45	28 ✓	28 ✓	29 ✓
R29	70	44 ✓	45 ✓	45 ✓
R30	70	34 ✓	35 ✓	35 ✓
R31	55	43 ✓	44 ✓	44 ✓
R31B	55	34 ✓	35 ✓	35 ✓
R32	58	36 ✓	36 ✓	36 ✓

8.5 Construction Noise Mitigation Measures

Construction activities should only take place during standard **construction** hours as follows:

Monday to Friday:	7am to 6pm
Saturday:	8am to 1pm
Sunday and Public Holidays:	No works permitted

9. VIBRATION IMPACT ASSESSMENT

In the NSW TfNSW Construction Noise Strategy document and Assessing Vibration – a Technical Guideline, construction equipment that may cause vibration impacts includes hydraulic hammers, vibratory pile drivers, pile boring, jackhammers, wacker packers, concrete vibrators and pavement breakers, amongst other equipment. It is understood that none of these equipment, or any equipment likely to cause significant vibration, is proposed as part of the works. Furthermore, the nearest off-site building is located over 30 m from any part of the proposed works. Given this distance, there is no prospect of either cosmetic damage (as per BS 7385) or human response (OH&E Vibration Guideline) given the proposed construction activities. Due to the proximity of the site to nearest receivers and limited vibration generating activities, no vibration impacts are expected from the proposed construction or operational activities. A detailed Vibration Impact Assessment is not considered warranted.

10. MITIGATION AND MANAGEMENT

Whilst specific control measures to meet compliance are not warranted the following additional measures will aid in reducing noise emissions:

- When shutting down the plant, a volume of gas will be trapped in the gas supply system. This gas is normally released which can create a reasonable noise, but for a short period of up to 30 seconds. This will be common to the CCGT and OCGT. If problematic, the noise emissions can be reduced by first passing the gas through a silencer as a contingency measure.
- During start up and shut down, the gas turbine compressor bypass valves open, venting air to the exhaust stack or in the case of a CCGT, the HRSG. This can result in a brief period of considerable noise. This discharge is normally piped to bypass air system eventually going to the atmosphere via the exhaust silencers for an OCGT or the HRSG and then the exhaust silencers for a CCGT. This may be implemented as a contingency measure.

11. CONCLUDING REMARKS

Benbow Environmental has been commissioned by EnergyAustralia to undertake a noise impact assessment to support EnergyAustralia's modification application for one new F Class Open Cycle Gas Turbine (OCGT) located adjacent to the existing combined cycle gas power station in Tallawarra NSW. This new F Class OCGT (280 – 400 MW) will replace the two proposed E Class OCGTs with a nominal capacity of 300 – 450 MW (application number: 07_0124).

The predicted results for the proposed F Class OCGT plant noise levels show slightly lower noise emissions compared to the currently approved 2xE Class OCGT plant. Predicted noise levels for all operational, start up, construction and road noise scenarios comply with the relevant criteria.

A full vibration assessment is not considered warranted as the impacts will be negligible.

All though not required to achieve compliance mitigation and management practices are outlined in Section 10.

This concludes the report.

Emma Hansma
Senior Engineer

Victoria Hale
Environmental Scientist

Linda Zanotto
Senior Environmental Engineer

R T Benbow
Principal Consultant

12. LIMITATIONS

Our services for this project are carried out in accordance with our current professional standards for site assessment investigations. No guarantees are either expressed or implied.

This report has been prepared solely for the use of EnergyAustralia, as per our agreement for providing environmental services. Only EnergyAustralia is entitled to rely upon the findings in the report within the scope of work described in this report. Otherwise, no responsibility is accepted for the use of any part of the report by another in any other context or for any other purpose.

Although all due care has been taken in the preparation of this study, no warranty is given, nor liability accepted (except that otherwise required by law) in relation to any of the information contained within this document. We accept no responsibility for the accuracy of any data or information provided to us by EnergyAustralia for the purposes of preparing this report.

Any opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal advice.

ATTACHMENTS

Attachment 1: Noise Terminology

‘A’ FREQUENCY WEIGHTING

The ‘A’ frequency weighting roughly approximates to the Fletcher-Munson 40 phon equal loudness contour. The human loudness perception at various frequencies and sound pressure levels is equated to the level of 40 dB at 1 kHz. The human ear is less sensitive to low frequency sound and very high frequency sound than midrange frequency sound (i.e. 500 Hz to 6 kHz). Humans are most sensitive to midrange frequency sounds, such as a child’s scream. Sound level meters have inbuilt frequency weighting networks that very roughly approximates the human loudness response at low sound levels. It should be noted that the human loudness response is not the same as the human annoyance response to sound. Here low frequency sounds can be more annoying than midrange frequency sounds even at very low loudness levels. The ‘A’ weighting is the most commonly used frequency weighting for occupational and environmental noise assessments. However, for environmental noise assessments, adjustments for the character of the sound will often be required.

AMBIENT NOISE

The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc. Usually assessed as an energy average over a set time period ‘T’ (L_{Aeq},T).

AUDIBLE

Audible refers to a sound that can be heard. There are a range of audibility grades, varying from “barely audible”, “just audible” to “clearly audible” and “prominent”.

BACKGROUND NOISE LEVEL

Total silence does not exist in the natural or built-environments, only varying degrees of noise. The Background Noise Level is the minimum repeatable level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc.. It is quantified by the noise level that is exceeded for 90 % of the measurement period ‘T’ (L_{A90}, T). Background Noise Levels are often determined for the day, evening and night time periods where relevant. This is done by statistically analysing the range of time period (typically 15 minute) measurements over multiple days (often 7 days). For a 15 minute measurement period the Background Noise Level is set at the quietest level that occurs at 1.5 minutes.

‘C’ FREQUENCY WEIGHTING

The ‘C’ frequency weighting approximates the 100 phon equal loudness contour. The human ear frequency response is more linear at high sound levels and the 100 phon equal loudness contour attempts to represent this at various frequencies at sound levels of approximately 100 dB.

DECIBEL

The decibel (dB) is a logarithmic scale that allows a wide range of values to be compressed into a more comprehensible range, typically 0 dB to 120 dB. The decibel is ten times the logarithm of the ratio of any two quantities that relate to the flow of energy (i.e. power). When used in acoustics it is the ratio of square of the sound pressure level to a reference sound pressure level, the ratio of the sound power level to a reference sound power level, or the ratio of the sound intensity level to a reference sound intensity level. See also Sound Pressure Level and Sound Power Level. Noise levels in decibels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dB, and another similar machine is placed beside it, the level will increase to 53 dB (from $10 \log_{10} (10^{(50/10)} + 10^{(50/10)})$ and not 100 dB. In theory, ten similar machines placed side by side will increase the sound level by 10 dB, and one hundred machines increase the sound level by 20 dB. The human ear has a vast sound-sensitivity range of over a thousand billion to one so the logarithmic decibel scale is useful for acoustical assessments.

dBA – See 'A' frequency weighting

dBC – See 'C' frequency weighting

EQUIVALENT CONTINUOUS SOUND LEVEL, LAeq

Many sounds, such as road traffic noise or construction noise, vary repeatedly in level over a period of time. More sophisticated sound level meters have an integrating/averaging electronic device inbuilt, which will display the energy time-average (equivalent continuous sound level - L_{Aeq}) of the 'A' frequency weighted sound pressure level. Because the decibel scale is a logarithmic ratio, the higher noise levels have far more sound energy, and therefore the LAeq level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than any other descriptor.

'F'(FAST) TIME WEIGHTING

Sound level meter design-goal time constant which is 0.125 seconds.

FLETCHER–MUNSON EQUAL LOUDNESS CONTOUR CURVES

The Fletcher–Munson curves are one of many sets of equal loudness contours for the human ear, determined experimentally by Harvey Fletcher and Wilden A. Munson, and reported in a 1933 paper entitled "Loudness, its definition, measurement and calculation" in the Journal of the Acoustic Society of America.

FREE FIELD

In acoustics a free field is a measurement area not subject to significant reflection of acoustical energy. A free field measurement is typically not closer than 3.5 metres to any large flat object (other than the ground) such as a fence or wall or inside an anechoic chamber.

FREQUENCY

The number of oscillations or cycles of a wave motion per unit time, the SI unit is the hertz (Hz). 1 Hz is equivalent to one cycle per second. 1000 Hz is 1 kHz.

IMPACT ISOLATION CLASS (IIC)

The American Society for Testing and Materials (ASTM) has specified that the IIC of a floor/ceiling system shall be determined by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The IIC is a number found by fitting a reference curve to the measured octave band levels and then deducting the sound pressure level at 500 Hz from 110 decibels. Thus the higher the IIC, the better the impact sound isolation. Not commonly used in Australia.

'I' (IMPULSE) TIME WEIGHTING

Sound level meter time constant now not in general use. The 'I' (impulse) time weighting is not suitable for rating impulsive sounds with respect to their loudness. It is also not suitable for assessing the risk of hearing impairment or for determining the 'impulsiveness' of a sound.

IMPACT SOUND INSULATION ($L_{nT,w}$)

Australian Standard AS ISO 717.2 – 2004 has specified that the Impact Sound Insulation of a floor/ceiling system be quantified by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The Weighted Standardised Impact Sound Pressure Level ($L_{nT,w}$) is the sound pressure level at 500 Hz for a reference curve fitted to the measured 1/3 octave band levels. Thus the lower $L_{nT,w}$ the better the impact sound insulation.

IMPULSE NOISE

An impulse noise is typified by a sudden rise time and a rapid sound decay, such as a hammer blow, rifle shot or balloon burst.

LOUDNESS

The volume to which a sound is audible to a listener is a subjective term referred to as loudness. Humans generally perceive an approximate doubling of loudness when the sound level increases by about 10 dB and an approximate halving of loudness when the sound level decreases by about 10 dB.

MAXIMUM NOISE LEVEL, LAFmax

The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'F' (Fast) time weighting. Often used for noise assessments other than aircraft.

MAXIMUM NOISE LEVEL, LASmax

The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'S' (Slow) time weighting. Often used for aircraft noise assessments.

NOISE RATING NUMBERS

A set of empirically developed equal loudness curves has been adopted as Australian Standard AS1469-1983. These curves allow the loudness of a noise to be described with a single NR number. The Noise Rating number is that curve which touches the highest level on the measured spectrum of the subject noise. For broadband noise such as fans and engines, the NR number often equals the 'A' frequency weighted dB level minus five.

NOISE

Noise is unwanted, harmful or inharmonious (discordant) sound. Sound is wave motion within matter, be it gaseous, liquid or solid. Noise usually includes vibration as well as sound.

NOISE REDUCTION COEFFICIENT – See: "Sound Absorption Coefficient"

OFFENSIVE NOISE

Reference: Dictionary of the NSW Protection of the Environment Operations Act (1997). "Offensive Noise means noise:
(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:
(i) is harmful to (or likely to be harmful to) a person who is outside the premise from which it is emitted, or
(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or
(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulations."

PINK NOISE

Pink noise is a broadband noise with an equal amount of energy in each octave or third octave band width. Because of this, Pink Noise has more energy at the lower frequencies than White Noise and is used widely for Sound Transmission Loss testing.

REVERBERATION TIME, T60

The time in seconds, after a sound signal has ceased, for the sound level inside a room to decay by 60 dB. The first 5 dB decay is often ignored, because of fluctuations that occur while reverberant sound conditions are being established in the room. The decay time for the next 30 dB is measured and the result doubled to determine the T_{60}. The Early Decay Time (EDT) is the slope of the decay curve in the first 10 dB normalised to 60 dB.

SOUND ABSORPTION COEFFICIENT, α

Sound is absorbed in porous materials by the viscous conversion of sound energy to a small amount of heat energy as the sound waves pass through it. Sound is similarly absorbed by the flexural bending of internally damped panels. The fraction of incident energy that is absorbed is termed the Sound Absorption Coefficient, α. An absorption coefficient of 0.9 indicates that 90% of the incident sound energy is absorbed. The average α from 250 to 2 kHz is termed the Noise Reduction Coefficient (NRC).

'S' (SLOW) TIME WEIGHTING

Sound level meter design-goal time constant which is 1 second.

SOUND ATTENUATION

A reduction of sound due to distance, enclosure or some other devise. If an enclosure is placed around a machine, or an attenuator (muffler or silencer) is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 20 dB reduces the sound energy by one hundred times.

SOUND EXPOSURE LEVEL (LAE)

Integration (summation) rather than an average of the sound energy over a set time period. Use to assess single noise events such as truck or train pass by or aircraft flyovers. The sound exposure level is related to the energy average (L_{Aeq}, T) by the formula L_{Aeq}, T = L_{AE} – 10 $\log_{10}$ T. The abbreviation (SEL) is sometimes inconsistently used in place of the symbol (L_{AE}).

SOUND PRESSURE

The rms sound pressure measured in pascals (Pa). A pascal is a unit equivalent to a newton per square metre (N/m^2).

SOUND PRESSURE LEVEL, Lp

The level of sound measured on a sound level meter and expressed in decibels (dB). Where L_P = 10 $\log_{10}$ $(Pa/Po)^2$ dB (or 20 log10 (Pa/ Po) dB) where Pa is the rms sound pressure in Pascal and Po is a reference sound pressure conventionally chosen is 20 µPa (20 x 10^{-6} Pa) for airborne sound. L_p varies with distance from a noise source.

SOUND POWER

The rms sound power measured in watts (W). The watt is a unit defined as one joule per second. A measures the rate of energy flow, conversion or transfer.

SOUND POWER LEVEL, Lw

The sound power level of a noise source is the inherent noise of the device. Therefore sound power level does not vary with distance from the noise source or with a different acoustic environment. Lw = Lp + 10 $\log_{10}$ 'a' dB, re: 1pW, (10^{-12} watts) where 'a' is the measurement noise-emission area (m^2) in a free field.

SOUND TRANSMISSION CLASS (STC)

An internationally standardised method of rating the sound transmission loss of partition walls to indicate the sound reduction from one side of a partition to the other in the frequency range of 125 Hz to 4000 kHz. (Refer: Australian Standard AS 1276 – 1979). Now not in general use in Australia see: weighted sound reduction index.

SOUND TRANSMISSION LOSS

The amount in decibels by which a random sound is reduced as it passes through a sound barrier. A method for the measurement of airborne Sound Transmission Loss of a building partition is given in Australian Standard AS 1191 - 2002.

STATISTICAL NOISE LEVELS, Ln.

Noise which varies in level over a specific period of time 'T' (standard measurement times are 15 minute periods) may be quantified in terms of various statistical descriptors for example:-

- The noise level, in decibels, exceeded for 1 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF1}, T. This may be used for describing short-term noise levels such as could cause sleep arousal during the night.
- The noise level, in decibels, exceeded for 10 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF10}, T. In most countries the LAF10, T is measured over periods of 15 minutes, and is used to describe the average maximum noise level.
- The noise level, in decibels, exceeded for 90 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF90}, T. In most countries the LAF90, T is measured over periods of 15 minutes, and is used to describe the average minimum or background noise level.

STEADY NOISE

Noise, which varies in level by 6 dB or less, over the period of interest with the time-weighting set to "Fast", is considered to be "steady" (refer AS 1055.1–1997).

WEIGHTED SOUND REDUCTION INDEX, Rw

This is a single number rating of the airborne sound insulation of a wall, partition or ceiling. The sound reduction is normally measured over a frequency range of 100 Hz to 3.150 kHz and averaged in accordance with ISO standard weighting curves (Refer AS/NZS 1276.1:1999). Internal partition wall Rw + C ratings are frequency weighted to simulate insulation from human voice noise. The R_w + C is similar in value to the STC rating value. External walls, doors and windows may be R_w + C_{tr} rated to simulate insulation from road traffic noise. The spectrum adaptation term Ctr adjustment factor takes account of low frequency noise. The weighted sound reduction index is normally similar or slightly lower number than the STC rating value.

WHITE NOISE

White noise is broadband random noise whose spectral density is constant across its entire frequency range. The sound power is the same for equal bandwidths from low to high frequencies. Because the higher frequency octave bands cover a wider spectrum, white noise has more energy at the higher frequencies and sounds like a hiss.

'Z' FREQUENCY WEIGHTING

The 'Z' (Zero) frequency weighting is 0 dB within the nominal 1/3 octave band frequency range centred on 10 Hz to 20 kHz. This is within the tolerance limits given in AS IEC 61672.1–2004: 'Electroacoustics - Sound level meters – Specifications'.

Attachment 2: Calibration Certificates

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: 23016

EQUIPMENT TESTED: Sound Level Calibrator

Manufacturer: B & K
Type No: 4230 **Serial No:** 565912
Owner: Benbow Environmental
13 Daking Street
North Parramatta NSW 2151

Tests Performed: Measured output pressure level was found to be:

Parameter	Pre-Adj	Adj Y/N	Output: (db re 20 µPa)	Frequency: (Hz)	THD&N (%)
Level 1:	NA	N	93.94	987.48	0.50
Level 2:	NA	N	NA	NA	NA
Uncertainty:			±0.11 dB	±0.05%	±0.20 %
Uncertainty (at 95% c.l.) k=2					

CONDITION OF TEST:
Ambient Pressure: 1015 hPa ±1.5 hPa **Relative Humidity:** 46% ±5%
Temperature: 22 °C ±2° C
Date of Calibration: 27/06/2018 **Issue Date:** 27/06/2018
Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2004

CHECKED BY: ...... **AUTHORISED SIGNATURE:** ....
Jack Kielt

.Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.
The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.

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Acoustic and Vibration Measurements

ACU-VIB
ELECTRONICS

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Mobile: 0413 809806
Web site: www.acu-vib.com.au

Certificate Of Calibration

Certificate No.: **SLM 21111 & FILT 4097**

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-957	**Serial No:**	15336
Microphone Type:	7052E	**Serial No:**	47869
Filter Type:	1/3 Octave	**Serial No:**	15336
Comments:	All tests passed for class 1. (See over for details)		
Owner:	Benbow Environmental 13 Daking Street North Parramatta 2151		
Ambient Pressure:	1004 hPa ±1.5 hPa		
Temperature:	21 °C ±2° C	**Relative Humidity:**	36% ±5%
Date of Calibration:	25/07/2017	**Issue Date:**	26/07/2017
Acu-Vib Test Procedure:	AVP10 (SLM) & AVP06 (Filters)		

Checked by: .... **Authorised Signature:** ....
Jack Kielt

Accredited for compliance with ISO/IEC 17025
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

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Sound Level Meter

IEC 61672-3.2013

Calibration Certificate

Calibration Number C17611

Client Details Benbow Environmental
13 Daking Street
North Parramatta NSW 2151

Equipment Tested/ Model Number : ARL Ngara
Instrument Serial Number : 8780AC
Microphone Serial Number : 317859
Pre-amplifier Serial Number : 27984

Pre-Test Atmospheric Conditions
Ambient Temperature : 22.6°C
Relative Humidity : 50.2%
Barometric Pressure : 99.88kPa

Post-Test Atmospheric Conditions
Ambient Temperature : 22.3°C
Relative Humidity : 49.2%
Barometric Pressure : 99.84kPa

Calibration Technician : Vicky Jaiswal
Calibration Date : 15/11/2017

Secondary Check: Riley Cooper
Report Issue Date : 15/11/2017

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2002 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002 and because the periodic tests of IEC 61672-3:2006 cover only a limited subset of the specifications in IEC 61672-1:2002.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.16dB*	*Temperature*	*±0.05°C*
12.5kHz	*±0.2dB*	*Relative Humidity*	*±0.46%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.017kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.12dB*		

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.

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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.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

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Sound Level Meter

IEC 61672-3.2013

Calibration Certificate

Calibration Number C17612

Client Details Benbow Environmental
13 daking Street
North Parramatta NSW 2151

Equipment Tested/ Model Number : ARL Ngara
Instrument Serial Number : 8780AD
Microphone Serial Number : 317856
Pre-amplifier Serial Number : 27983

Pre-Test Atmospheric Conditions
Ambient Temperature : 22.7°C
Relative Humidity : 48.7%
Barometric Pressure : 99.83kPa

Post-Test Atmospheric Conditions
Ambient Temperature : 22.3°C
Relative Humidity : 49.1%
Barometric Pressure : 99.76kPa

Calibration Technician : Vicky Jaiswal
Calibration Date : 15/11/2017

Secondary Check: Riley Cooper
Report Issue Date : 15/11/2017

Approved Signatory : [signature] Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2002 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002 and because the periodic tests of IEC 61672-3:2006 cover only a limited subset of the specifications in IEC 61672-1:2002.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.16dB*	*Temperature*	*±0.05°C*
12.5kHz	*±0.2dB*	*Relative Humidity*	*±0.46%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.017kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.12dB*		

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.

NATA
WORLD RECOGNISED ACCREDITATION

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
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Sound Level Meter

IEC 61672-3.2013

Calibration Certificate

Calibration Number C17613

Client Details Benbow Environmental
13 Daking Street
North Parramatta NSW 2151

Equipment Tested/ Model Number : ARL Ngara
Instrument Serial Number : 8780AE
Microphone Serial Number : 321775
Pre-amplifier Serial Number : 27982

Pre-Test Atmospheric Conditions
Ambient Temperature : 22.6°C
Relative Humidity : 48.7%
Barometric Pressure : 99.74kPa

Post-Test Atmospheric Conditions
Ambient Temperature : 22.5°C
Relative Humidity : 46.1%
Barometric Pressure : 99.68kPa

Calibration Technician : Vicky Jaiswal
Calibration Date : 15/11/2017

Secondary Check: Riley Cooper
Report Issue Date : 15/11/2017

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*Pass*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2002 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002 and because the periodic tests of IEC 61672-3:2006 cover only a limited subset of the specifications in IEC 61672-1:2002.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.16dB*	*Temperature*	*±0.05°C*
12.5kHz	*±0.2dB*	*Relative Humidity*	*±0.46%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.017kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.12dB*		

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.

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Sound Level Meter

AS 1259.1:1990 - AS 1259.2:1990

Calibration Certificate

Calibration Number C18129_Reissued

Client Details Benbow Environmental
13 Daking Street
North Paramatta NSW 2151

Equipment Tested/ Model Number : ARL EL-215
Instrument Serial Number : 194593
Microphone Serial Number : N/A
Pre-amplifier Serial Number : N/A

Atmospheric Conditions
Ambient Temperature : 23°C
Relative Humidity : 51.2%
Barometric Pressure : 100.57kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 9 Mar 2018
Secondary Check: Sandra Minto
Report Issue Date : 3 Oct 2018

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	*Pass*	10.3.4: Inherent system noise level	*Pass*
10.2.3: Frequency weighting	*Pass*	10.4.2: Time weighting characteristic F and S	*Pass*
10.3.2: Overload indications	*Pass*	10.4.3: Time weighting characteristic I	*Pass*
10.3.3: Accuracy of level range control	*Pass*	10.4.5: R.M.S performance	*Pass*
8.9: Detector-indicator linearity	*Pass*	9.3.2: Time averaging	*Pass*
8.10: Differential level linearity	*Pass*	9.3.5: Overload indication	*Pass*

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.15dB*	*Temperature*	*±0.2°C*
12.5kHz	*±0.21dB*	*Relative Humidity*	*±2.4%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.015Pa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.12dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

The sound level meter under test has been shown to conform to the type 2 requirements for periodic testing as described in AS 1259.1:1990 and AS 1259.2:1990 for the tests stated above.

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 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/National standards.

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Sound Level Meter
AS 1259.1:1990 - AS 1259.2:1990
Calibration Certificate

Calibration Number C18438

Client Details Benbow Environmental
13 Daking Street
North Parramatta, NSW 2151

Equipment Tested/ Model Number : ARL EL-215
Instrument Serial Number : 194438
Microphone Serial Number : N/A
Pre-amplifier Serial Number : N/A

Atmospheric Conditions
Ambient Temperature : 21.9°C
Relative Humidity : 32%
Barometric Pressure : 99.06kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 15 Aug 2018
Secondary Check: Lewis Boorman
Report Issue Date : 16 Aug 2018

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	*Pass*	10.3.4: Inherent system noise level	*Pass*
10.2.3: Frequency weighting	*Pass*	10.4.2: Time weighting characteristic F and S	*Pass*
10.3.2: Overload indications	*Pass*	10.4.3: Time weighting characteristic I	*Pass*
10.3.3: Accuracy of level range control	*Pass*	10.4.5: R.M.S performance	*Pass*
8.9: Detector-indicator linearity	*Pass*	9.3.2: Time averaging	*Pass*
8.10: Differential level linearity	*Pass*	9.3.5: Overload indication	*Pass*

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.15dB*	*Temperature*	*±0.3°C*
12.5kHz	*±0.21dB*	*Relative Humidity*	*±2.5%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.017Pa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.12dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

The sound level meter under test has been shown to conform to the type 2 requirements for periodic testing as described in AS 1259.1:1990 and AS 1259.2:1990 for the tests stated above.

This calibration certificate is to be read in conjunction with the calibration test report.

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Attachment 3: QA/QC Procedures

Calibration of Sound Level Meters

A sound level meter requires regular calibration to ensure its measurement performance remains within specification. Benbow Environmental sound level meters are calibrated by a National Association of Testing Authority (NATA) registered laboratory or a laboratory approved by the NSW Environment Protection Authority (EPA) every two years and after each major repair, in accordance with AS 1259-1990.

The calibration of the sound level meter was checked immediately before and after each series of measurements using an acoustic calibrator. The acoustic calibrator provides a known sound pressure level, which the meter indicates when the calibrator is activated while positioned on the meter microphone.

The sound level meters also incorporate an internal calibrator for use in setting up. This provides a check of the electrical calibration of the meter, but does not check the performance of the microphone. Acoustical calibration checks the entire instrument including the microphone. Calibration certificates for the instrument sets used have been included as Attachment 3.

Care and Maintenance of Sound Level Meters

Noise measuring equipment contains delicate components and therefore must be handled accordingly. The equipment is manufactured to comply with international and national standards and is checked periodically for compliance. The technical specifications for sound level meters used in Australia are defined in Australian Standard AS 1259 – 1990 "Sound Level Meters".

The sound level meters and associated accessories are protected during storage, measurement and transportation against dirt, corrosion, rapid changes of temperature, humidity, rain, wind, vibration, electric and magnetic fields. Microphone cables and adaptors are always connected and disconnected with the power turned off. Batteries are removed (with the instrument turned off) if the instrument is not to be used for some time.

Investigation Procedures

All investigative procedures were conducted in accordance with AS 1055.1–1997 Acoustics – "Description and Measurement of Environmental Noise (Part 1: General Procedures)".

The following information was recorded and kept for reference purposes:

- type of instrumentation used and measurement procedure conducted;
- description of the time aspect of the measurements, ie. measurement time intervals; and
- positions of measurements and the time and date were noted.

As per AS 1055.1–1997, all measurements were carried out at least 3.5 m from any reflecting structure other than the ground. The preferred measurement height of 1.2 m above the ground was utilised. A sketch of the area was made identifying positions of measurement and the approximate location of the noise source and distances in meters (approx.).

Unattended Noise Monitoring

NOISE MONITORING EQUIPMENT

ARL noise loggers, type Ngara and EL-215, were used to conduct the long-term unattended noise monitoring. This equipment complies with Australian Standard 1259.2–1990 "Acoustics – Sound Level Meters" and is designated as a Type 1 and Type 2 instrument suitable for field use.

The measured data is processed statistically and stored in memory every 15 minutes. The equipment was calibrated prior and subsequent to the measurement period using a Rion NC-73 sound level calibrator. There were no significant variances observed in the reference signal between the pre-measurement and post-measurement calibrations. Instrument calibration certificates have also been included in Attachment 3.

METEOROLOGICAL CONSIDERATION DURING MONITORING

For the long-term attended monitoring, meteorological data for the relevant periods were provided by the Bureau of Meteorology, which was considered representative of the site for throughout the monitoring period.

DESCRIPTORS & FILTERS USED FOR MONITORING

Noise levels are commonly measured using A-weighted filters and are usually described as dB(A). The "A-weighting" refers to standardised amplitude versus frequency curve used to "weight" sound measurements to represent the response of the human ear. The human ear is less sensitive to low frequency sound than it is to high frequency sound. Overall A-weighted measurements quantify sound with a single number to represent how people subjectively hear different frequencies at different levels.

Noise environments can be described using various descriptors depending on characteristics of noise or purpose of assessments. For this survey the L_{A90} was used to analyse the monitoring results. The statistical descriptors L_{A90} measures the noise level exceeded for 90% of the sample measurement time, and is used to describe the “Background noise”. Background noise is the underlying level of noise present in the ambient noise, excluding extraneous noise or the noise source under investigation.

Measurement sample periods were fifteen minutes. The Noise -vs- Time graphs representing measured noise levels at the noise monitoring location are presented in Attachment 4.

ATTENDED NOISE MONITORING

NOISE MONITORING EQUIPMENT

The attended short-term noise monitoring was carried out using a SVANTEK SVAN957 Class 1 Precision Sound Level Meter. The instrument was calibrated by a NATA accredited laboratory within two years of the measurement period. The instrument sets comply with AS 1259 and was set on A-weighted, fast response.

The microphone was positioned at 1.5 metres above ground level and was fitted with a windsock. The instrument was calibrated using a Rion NC-73 sound level calibrator prior and subsequent to the measurement period to ensure the reliability and accuracy of the instrument sets. There were no significant variances observed in the reference signal between the pre-measurement and post-measurement calibrations. Instrument calibration certificates have also been included in Attachment 3.

WEATHER CONDITIONS

It was clear, moderate wind gusts were present for some of the measurements.

METHODOLOGY

The attended noise measurements were carried out generally in accordance with Australian Standard AS 1055-1997 - "Acoustics – Description and Measurement of Environmental Noise".

Attachment 4: Logger Location Photographs

Figure 12-1: Logger A - EnergyAustralia Lands (Yallah Bay Road, Yallah)

Figure 12-2: Logger B - 54 Carlyle Close, Dapto

Figure 12-3: Logger C - 13 Malonga Place, Koonawarra

Figure 12-4: Logger D - EnergyAustralia Lands (Yallah Bay Road, Yallah)

Figure 12-5: Logger E - 108 Haywards Bay Drive, Haywards Bay

Figure 12-6: Location 1

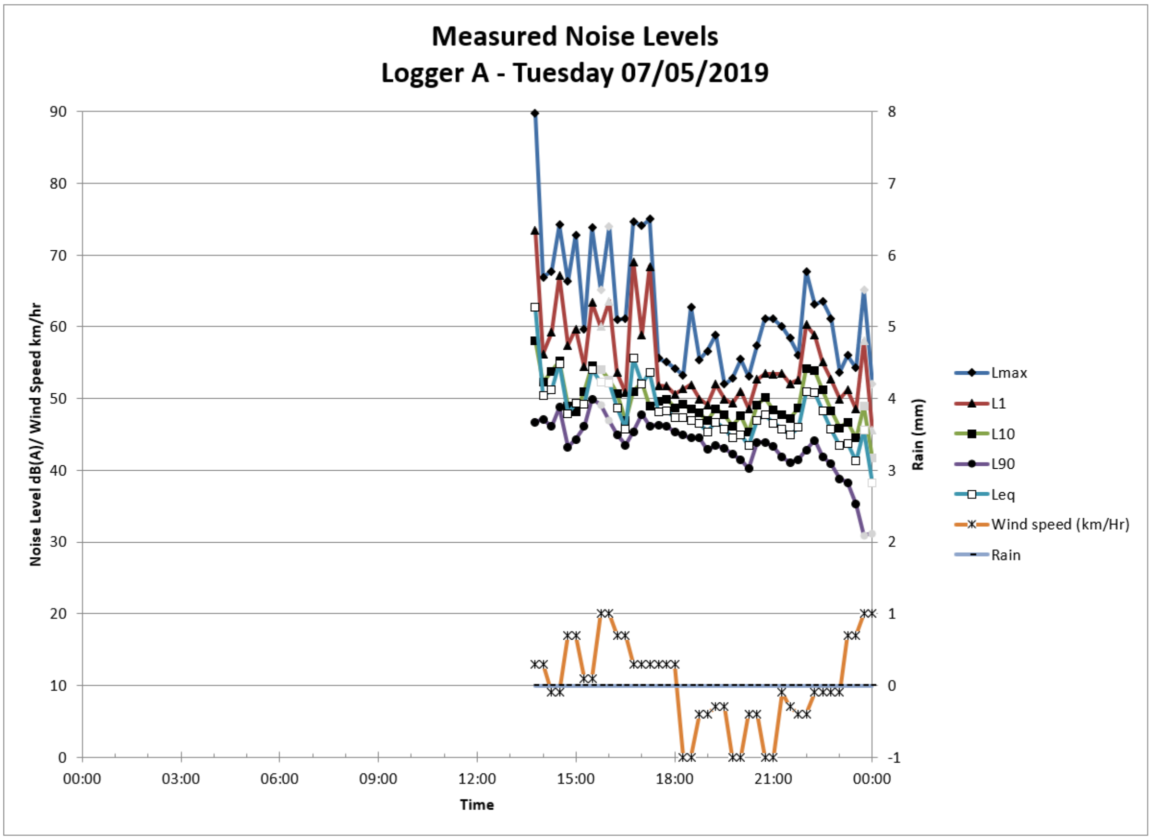
Figure 12-7: Location 2

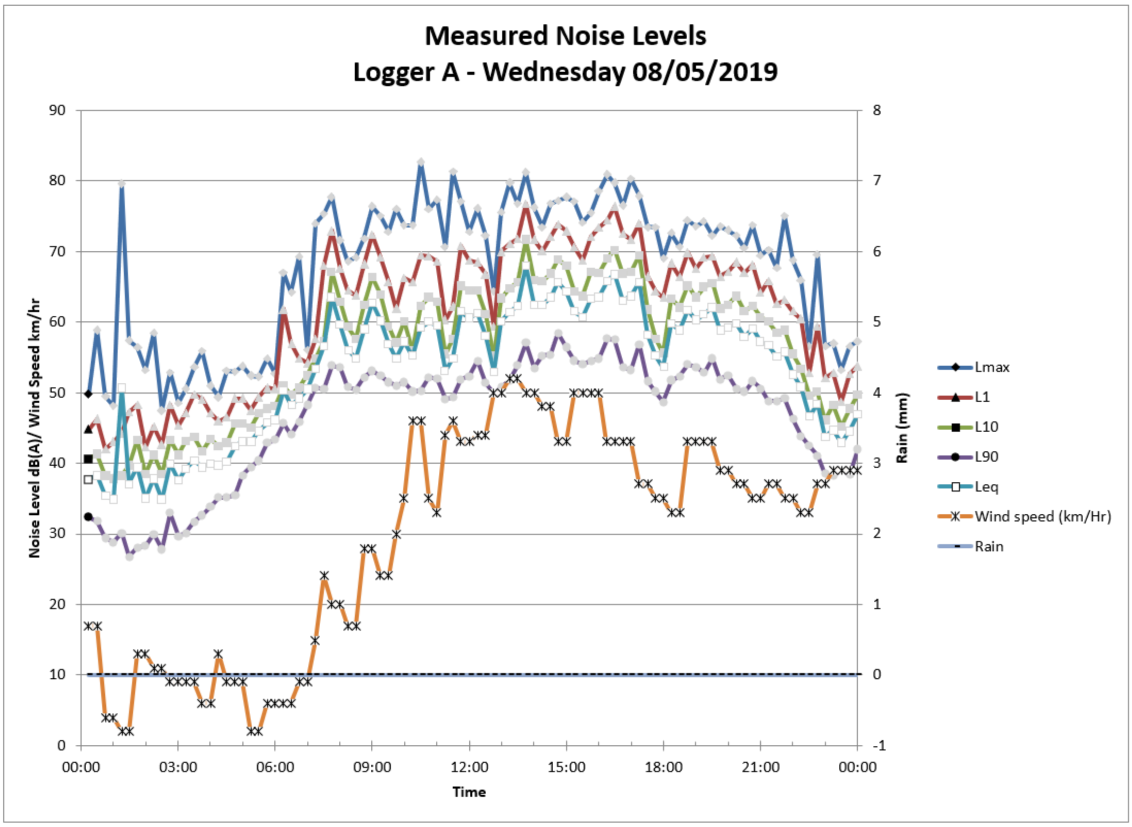
Figure 12-8: Location 3

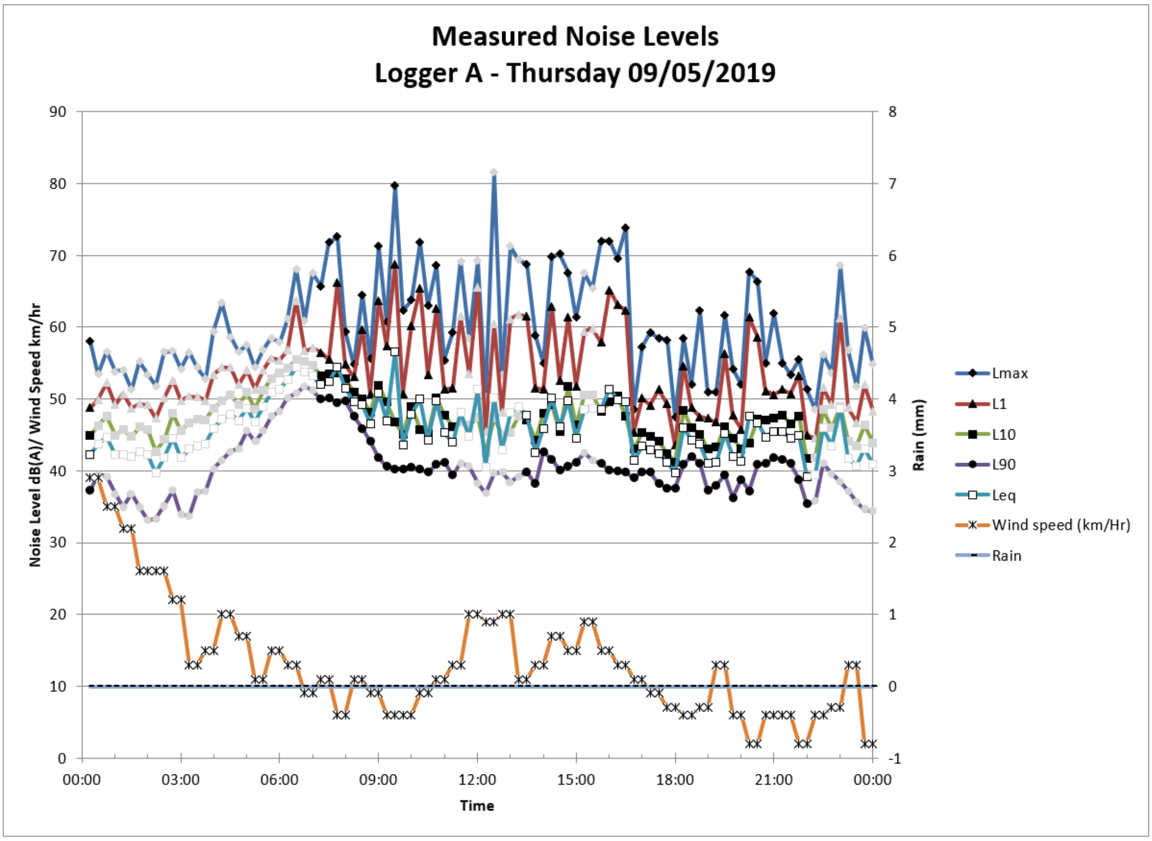
Attachment 5: Background Noise Logger Graphs

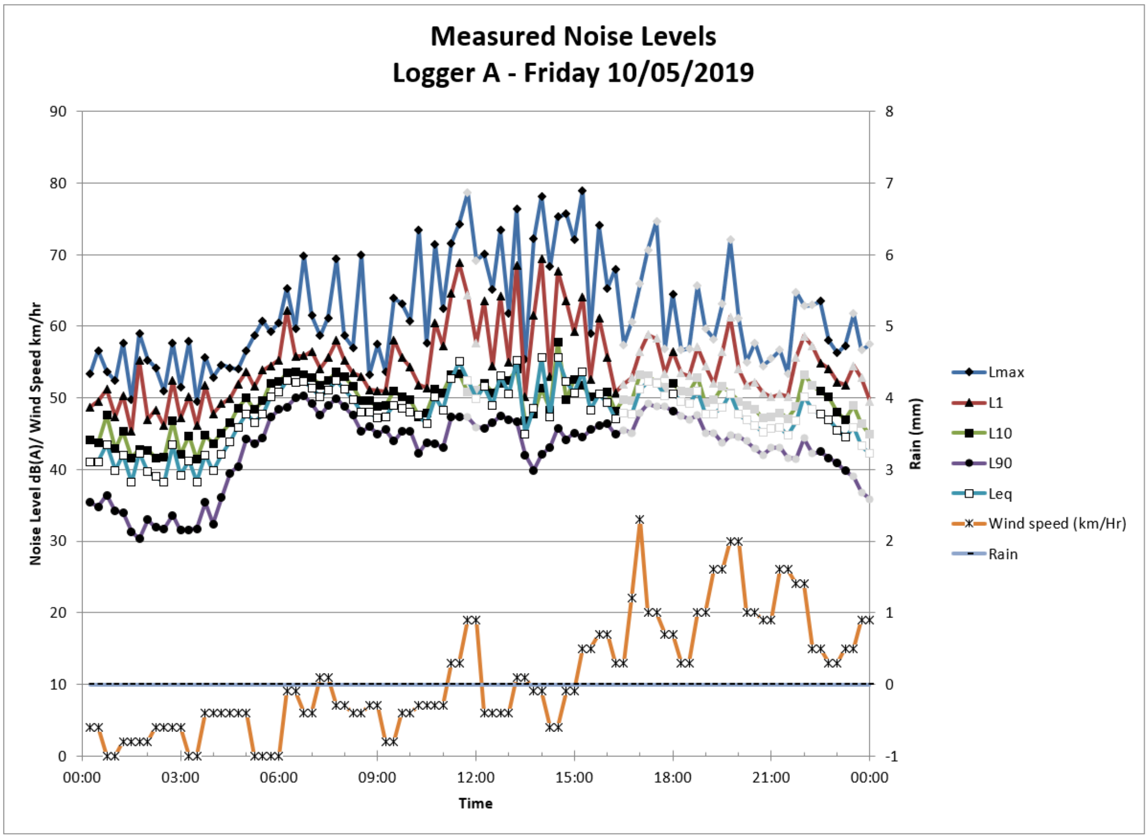
Table 1: Logger A Results

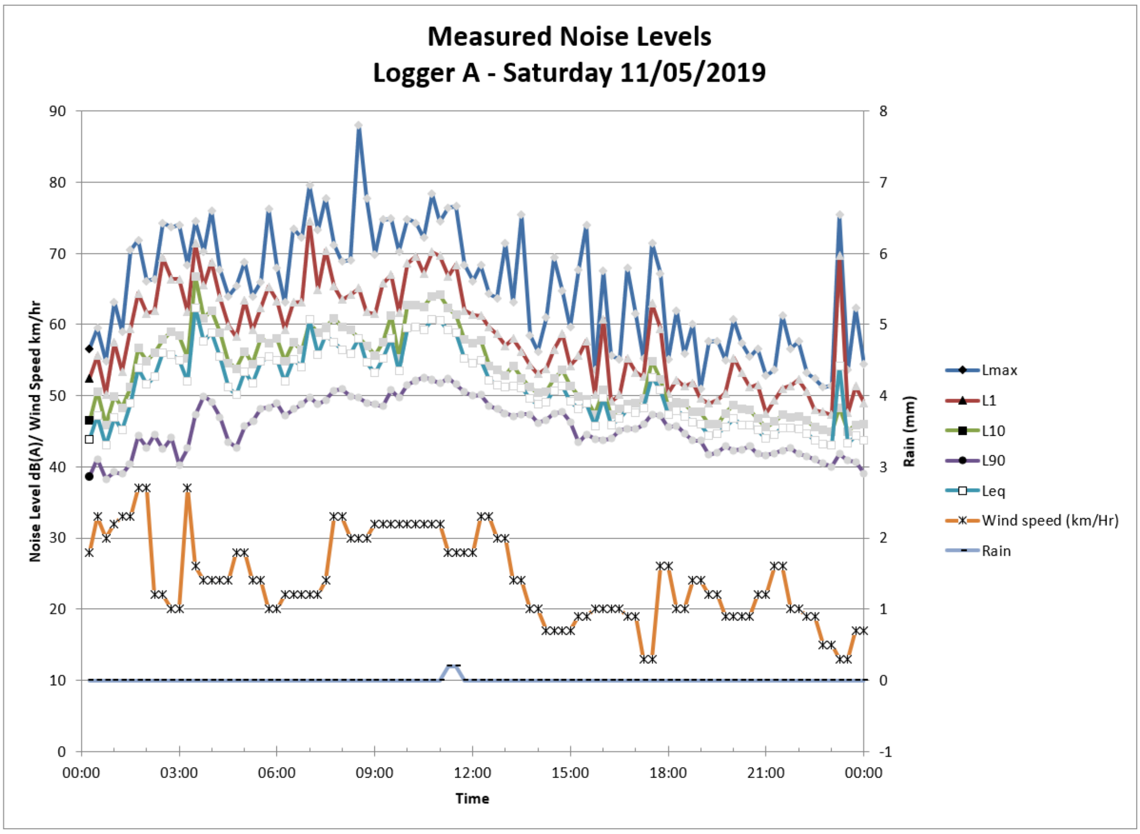
	Average L1			Average L10			ABL (L90)			Leq		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
7/05/2019	59	52	53	51	48	48	44	41	37	43	47	47
8/05/2019	-	-	-	-	-	-	-	-	-	-	-	-
9/05/2019	56	51	-	48	46	-	38	37	-	49	44	-
10/05/2019	58	-	51	51	-	47	43	-	32	51	-	47
11/05/2019	-	-	-	-	-	-	-	-	-	-	-	-
12/05/2019	-	52	-	-	50	-	-	43	-	-	48	-
13/05/2019	-	52	50	-	46	45	-	36	30	-	45	46
14/05/2019	-	52	51	-	49	47	-	41	31	-	47	50
15/05/2019	57	53	53	47	50	48	35	43	33	57	49	52
16/05/2019	56	53	52	48	49	47	37	40	31	49	48	48
17/05/2019	59	50	51	49	48	46	33	38	30	55	47	51
18/05/2019	61	50	51	48	47	45	36	41	31	55	46	48
19/05/2019	60	49	47	47	46	43	34	37	32	59	44	42
20/05/2019	59	57	52	50	50	46	38	39	30	52	50	53
21/05/2019	64	58	56	56	51	50	44	42	33	54	50	52
22/05/2019	62	64	57	53	53	49	40	44	32	54	53	52
Average	59	53	52	50	49	47	38	40	32	53	48	49
Median	59	52	52	49	49	47	38	41	31	54	47	49
Logarithmic Average	60	56	53	51	49	47	40	41	32	54	48	50

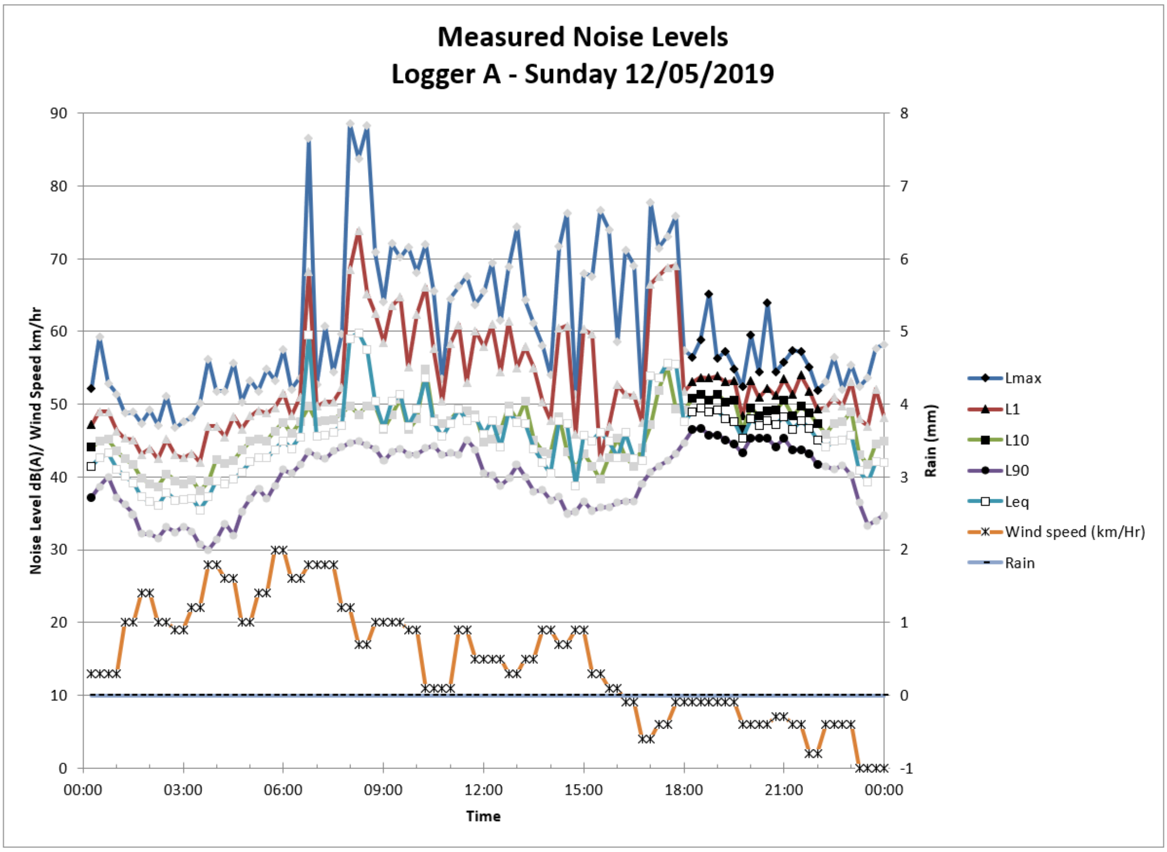

Measured Noise Levels
Logger A - Tuesday 07/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

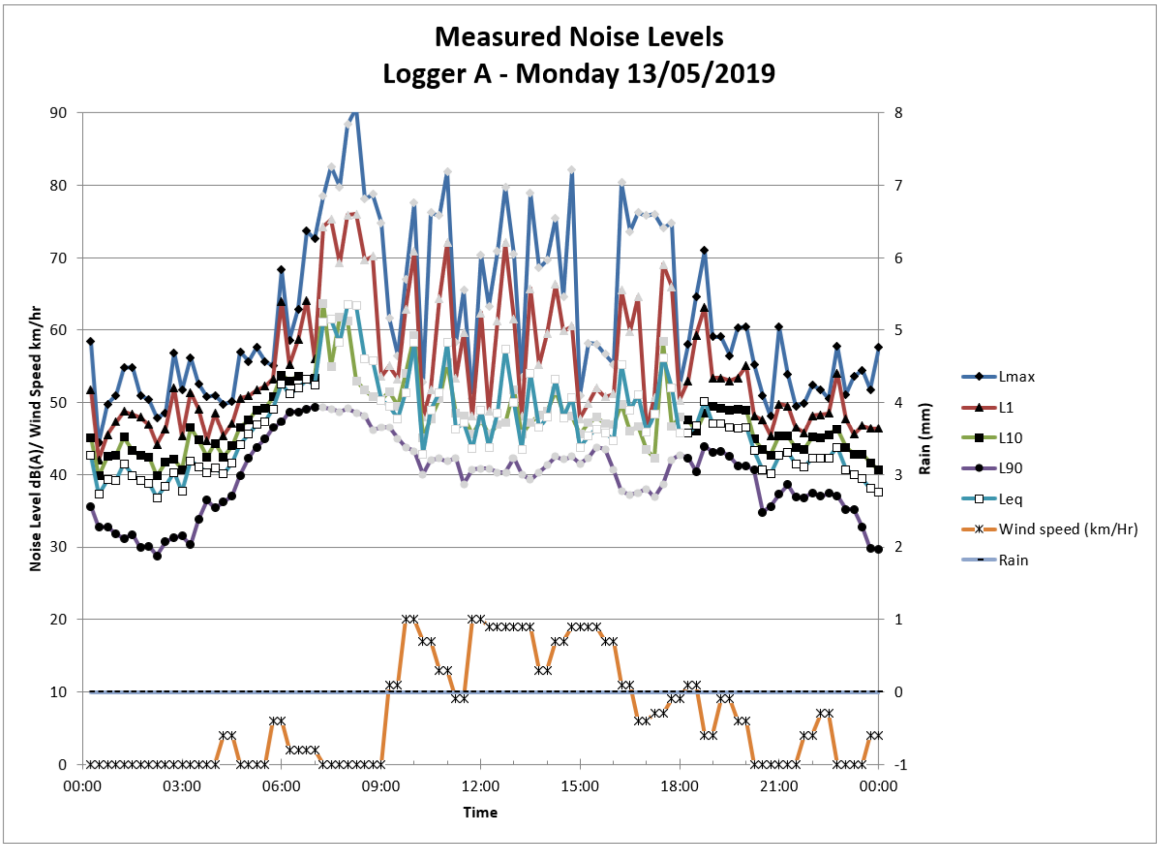

Measured Noise Levels
Logger A - Wednesday 08/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Logger A - Thursday 09/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

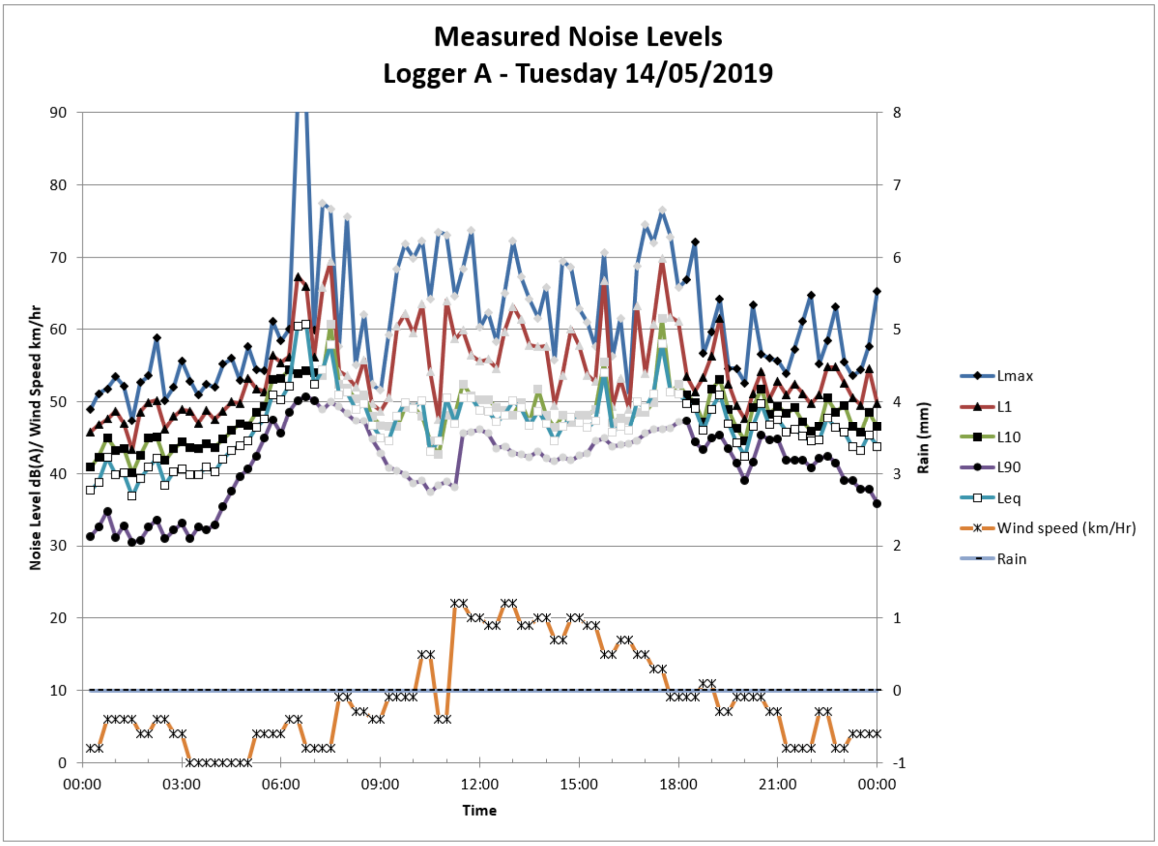

Measured Noise Levels
Logger A - Friday 10/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Logger A - Saturday 11/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
0
10
20
30
40
50
60
70
80
90
-1
0
1
2
3
4
5
6
7
8
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

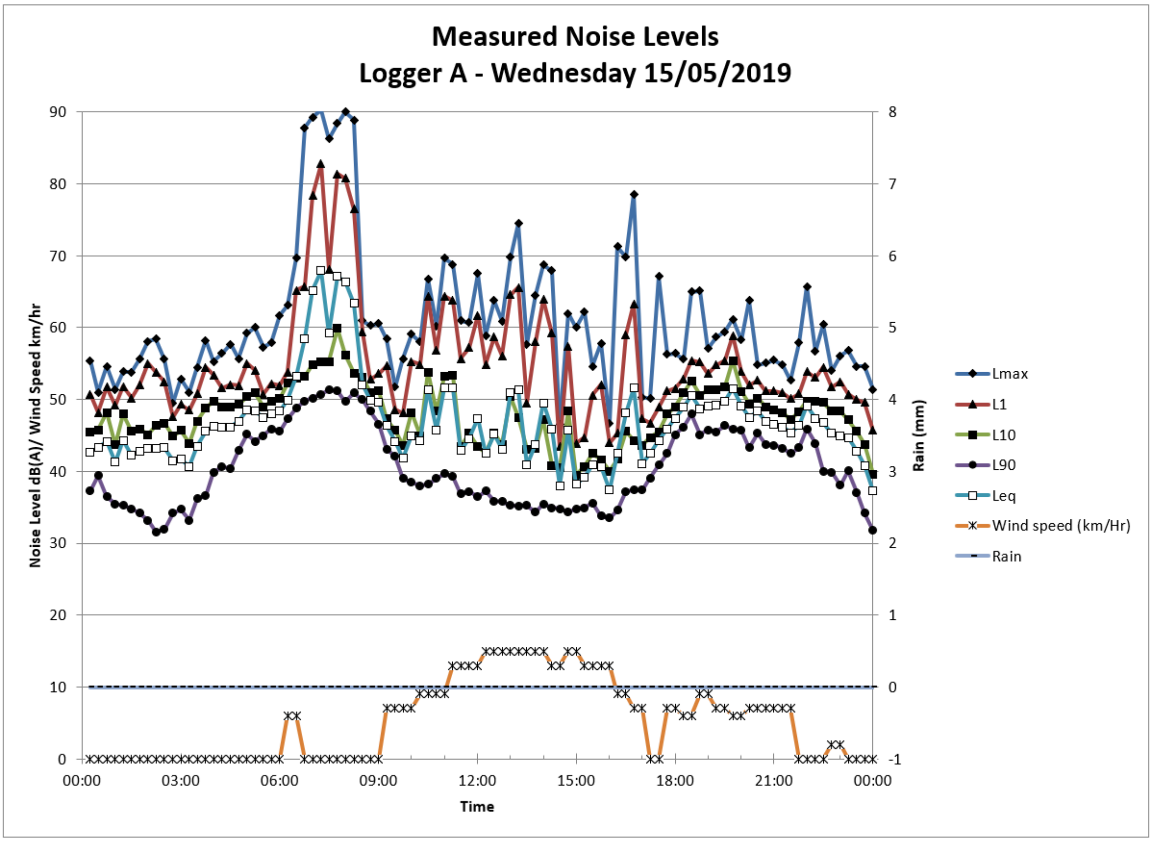

Measured Noise Levels
Logger A - Sunday 12/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
0
10
20
30
40
50
60
70
80
90
-1
0
1
2
3
4
5
6
7
8
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



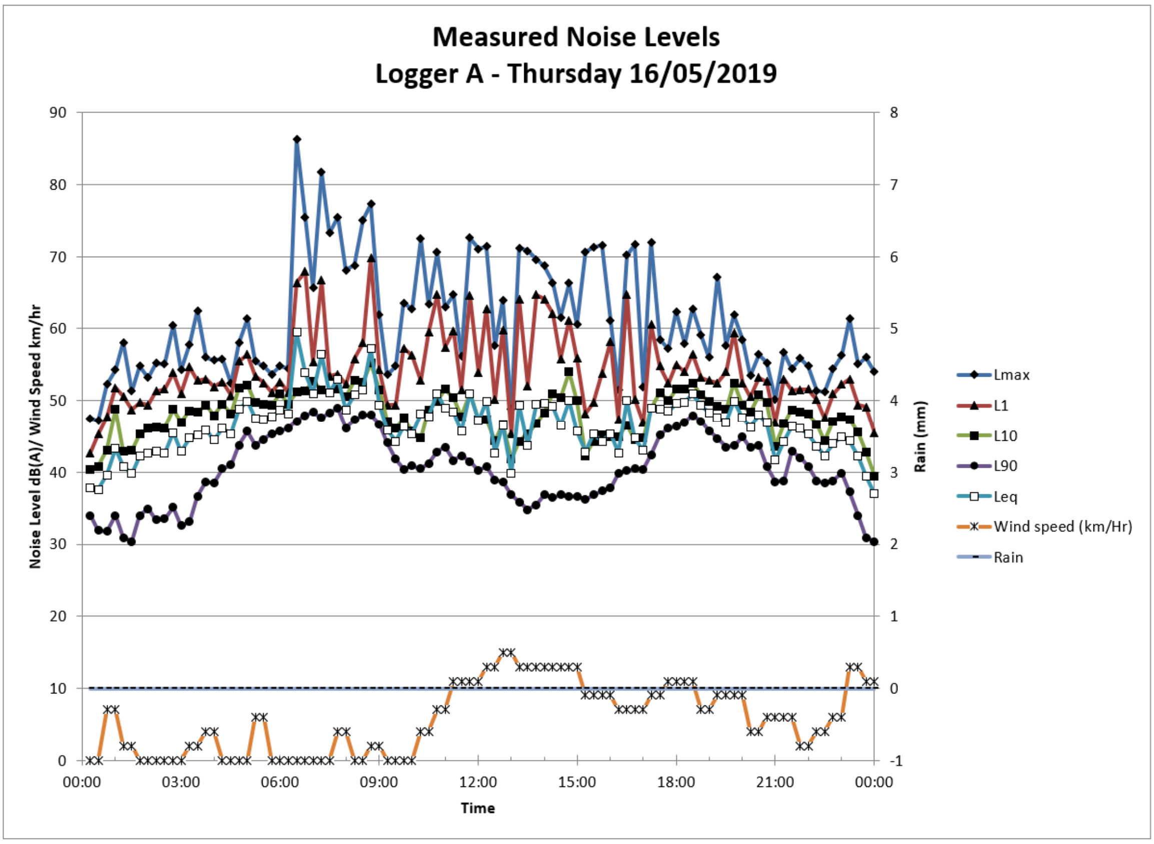
Measured Noise Levels
Logger A - Monday 13/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



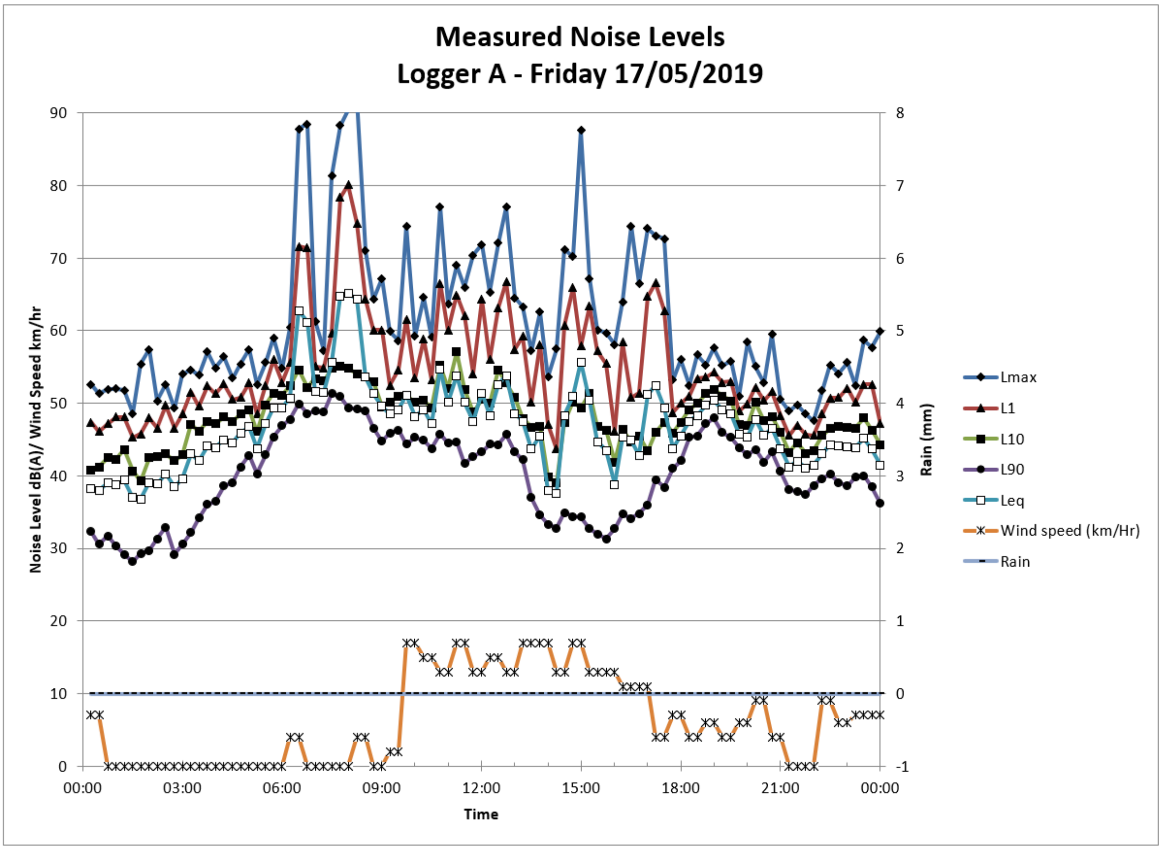
Measured Noise Levels
Logger A - Tuesday 14/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



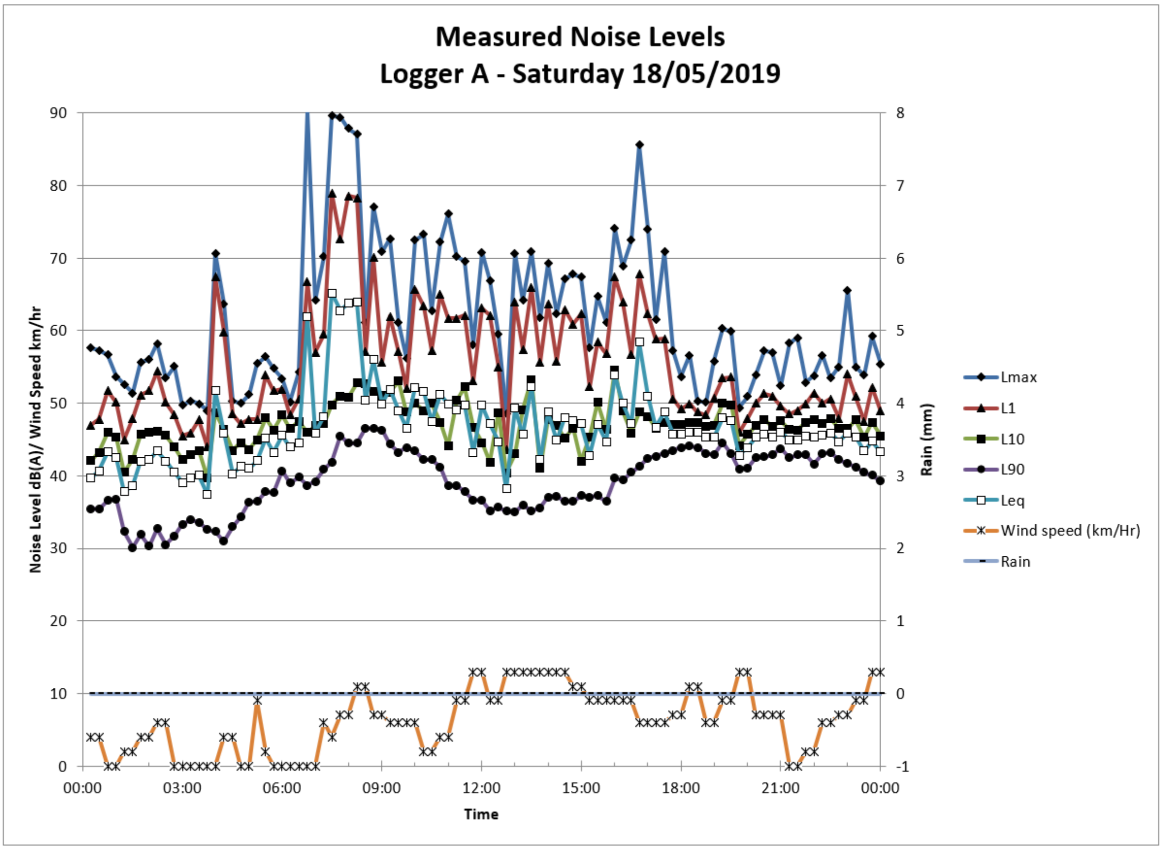
Measured Noise Levels
Logger A - Wednesday 15/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



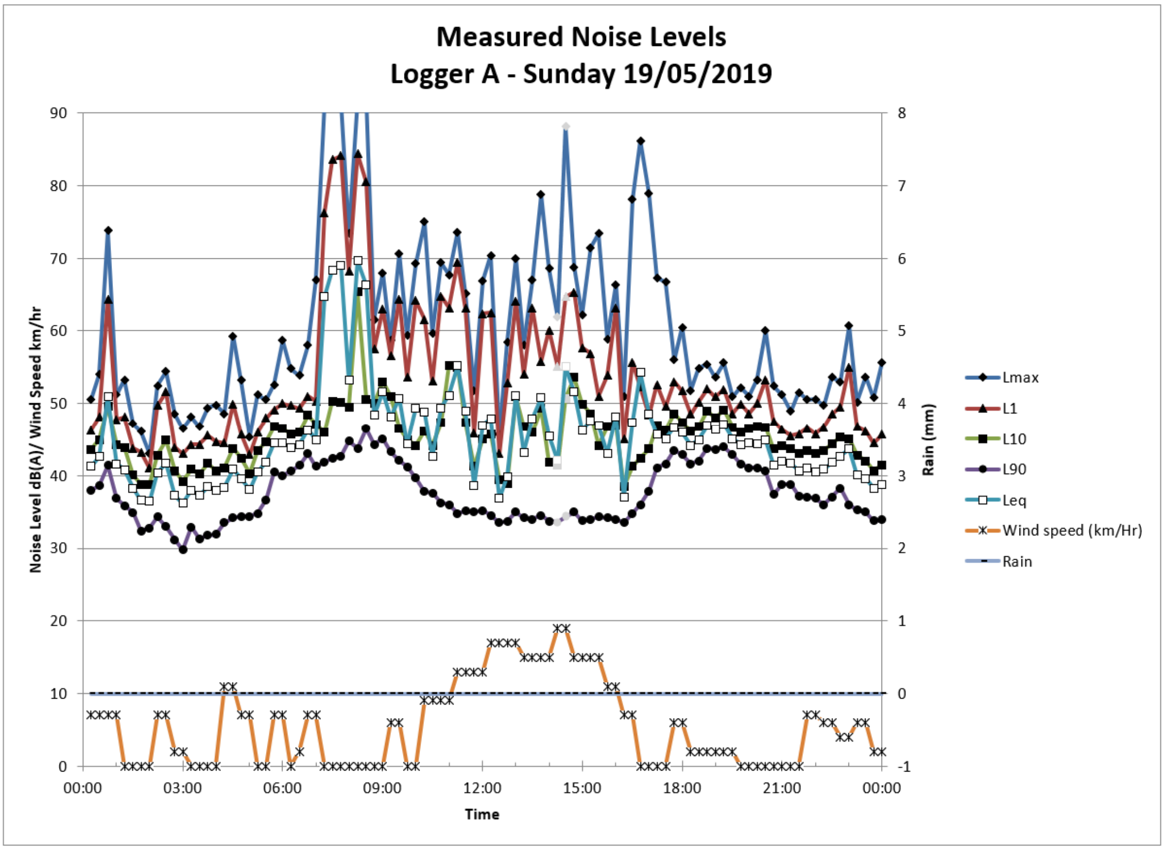
Measured Noise Levels
Logger A - Thursday 16/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



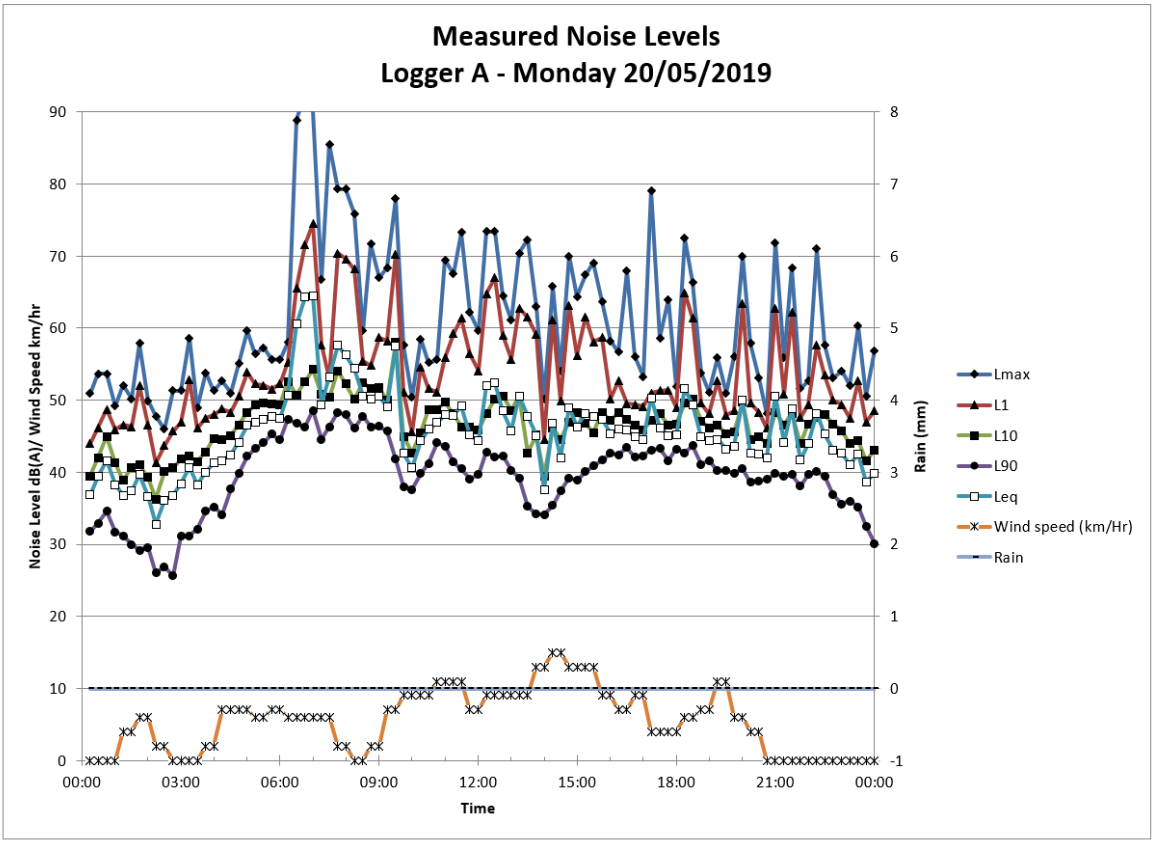
Measured Noise Levels
Logger A - Friday 17/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



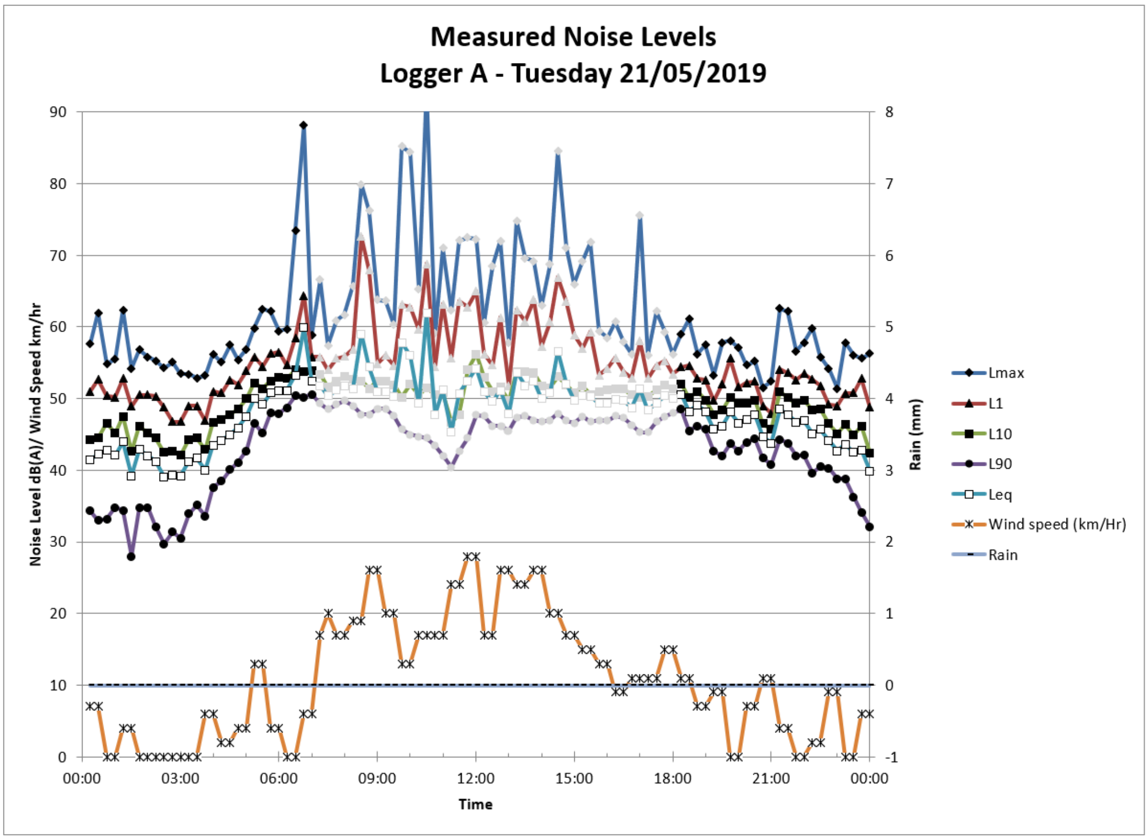
Measured Noise Levels
Logger A - Saturday 18/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



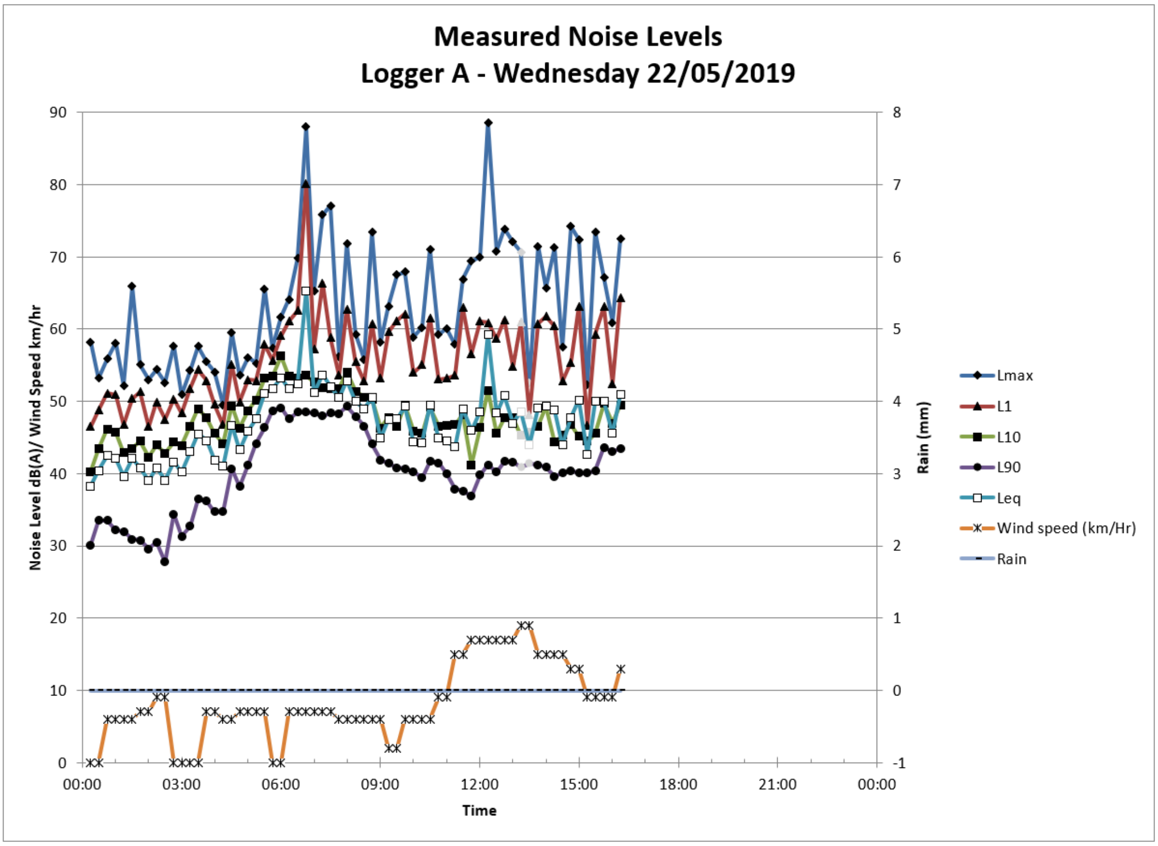
Measured Noise Levels
Logger A - Sunday 19/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00



Measured Noise Levels
Logger A - Monday 20/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00



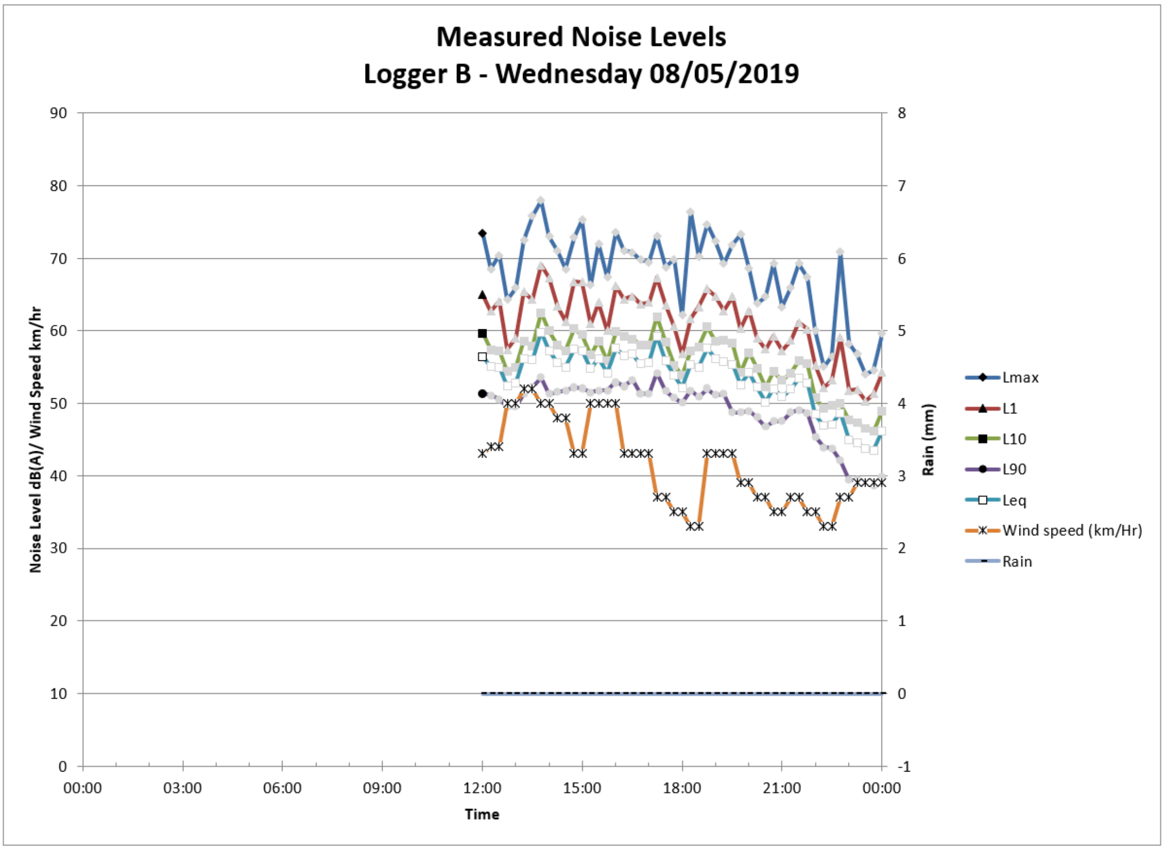
Measured Noise Levels
Logger A - Tuesday 21/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



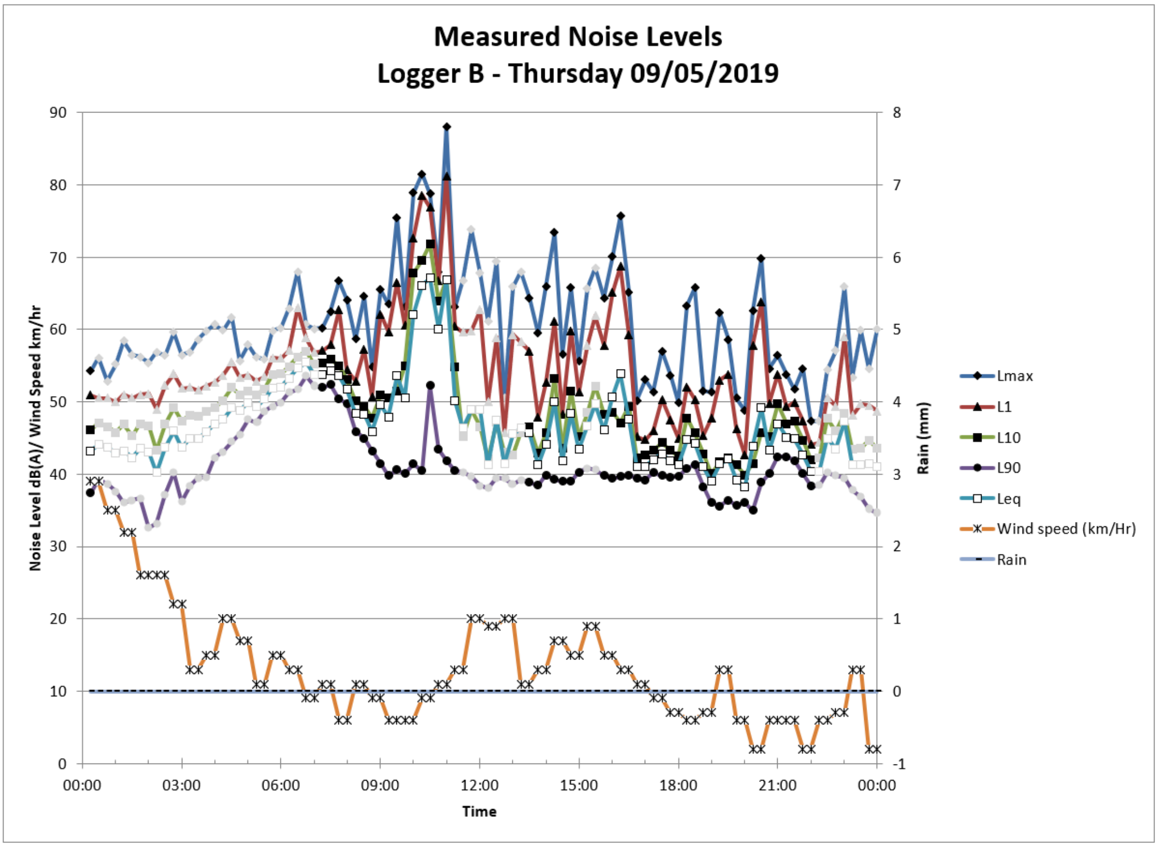
Measured Noise Levels
Logger A - Wednesday 22/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

Table 2: Logger B Results

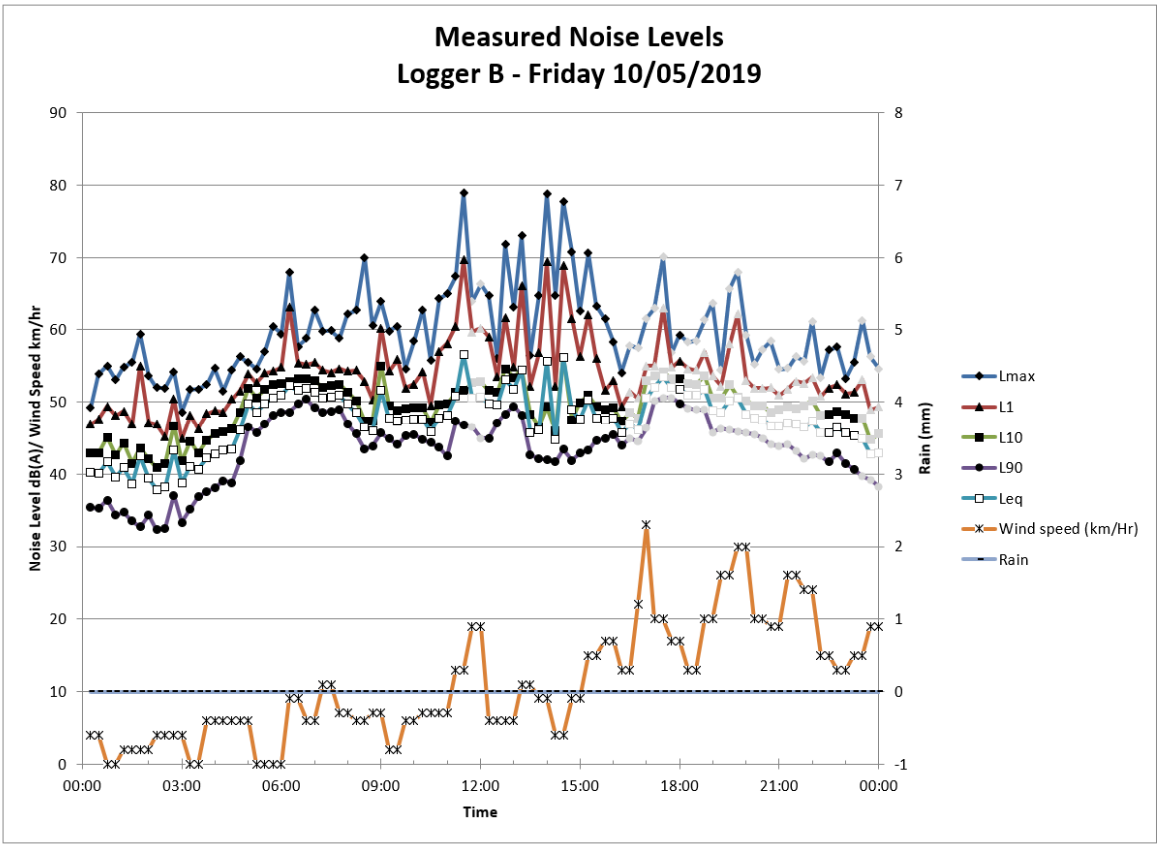
	Average L1			Average L10			ABL (L90)			Leq		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
8/05/2019	-	-	-	-	-	-	-	-	-	-	-	-
9/05/2019	58	50	-	51	44	-	39	36	-	58	44	-
10/05/2019	58	-	51	50	-	47	42	-	33	51	-	47
11/05/2019	-	-	-	-	-	-	-	-	-	-	-	-
12/05/2019	-	53	-	-	50	-	-	43	-	-	49	-
13/05/2019	-	50	51	-	47	47	-	38	33	-	45	48
14/05/2019	-	54	52	-	51	48	-	46	36	-	50	48
15/05/2019	57	54	53	51	51	49	36	45	36	53	49	49
16/05/2019	56	53	52	49	51	48	36	42	34	48	49	47
17/05/2019	57	52	50	49	50	47	36	40	35	51	48	47
18/05/2019	64	59	53	55	50	46	31	42	34	54	49	45
Average	58	53	52	51	49	47	37	41	35	37	48	47
Median	57	53	52	50	50	47	36	42	34	**36**	49	47
Logarithmic Average	59	54	52	51	50	48	38	42	35	53	48	47



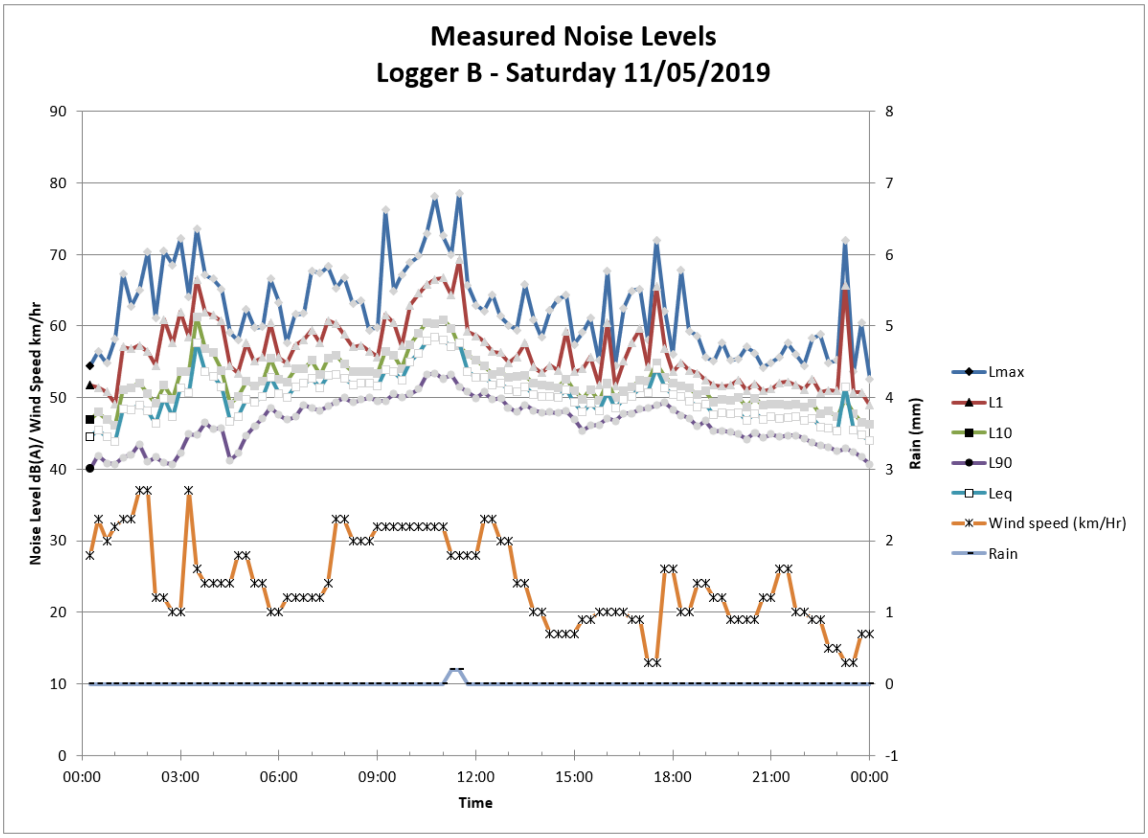
Measured Noise Levels
Logger B - Wednesday 08/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



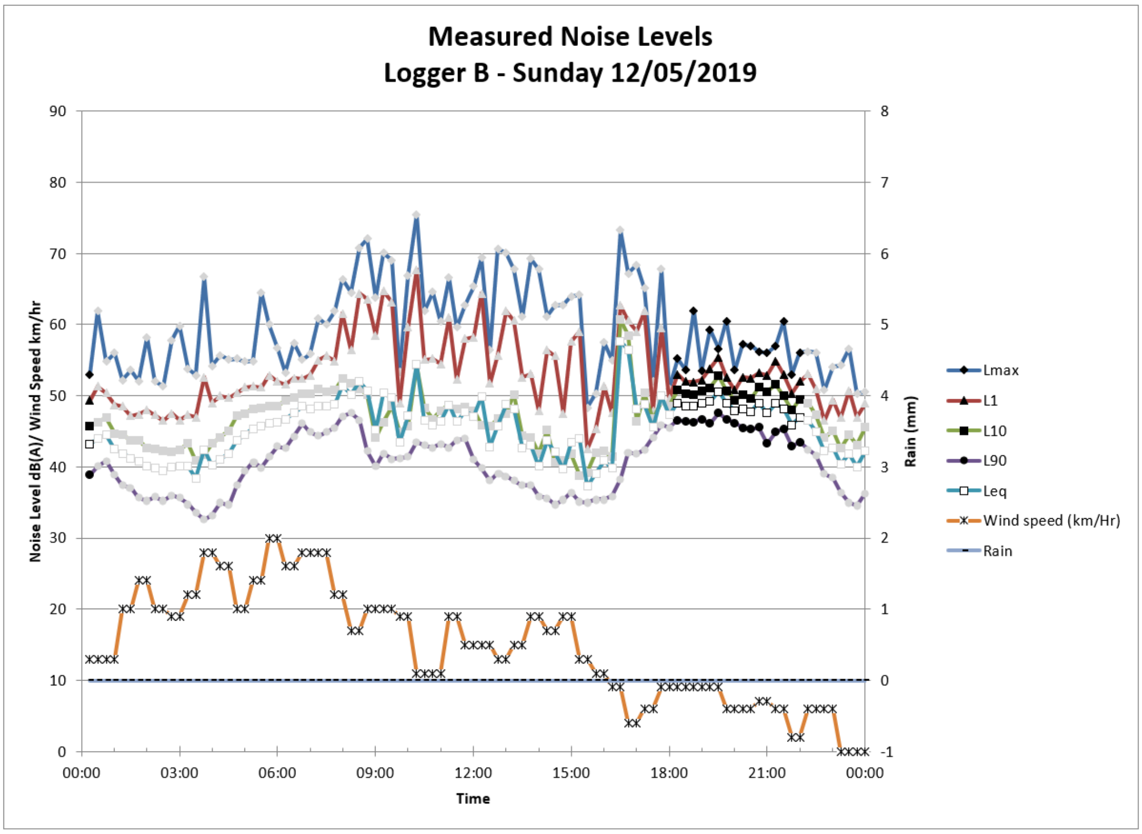
Measured Noise Levels
Logger B - Thursday 09/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



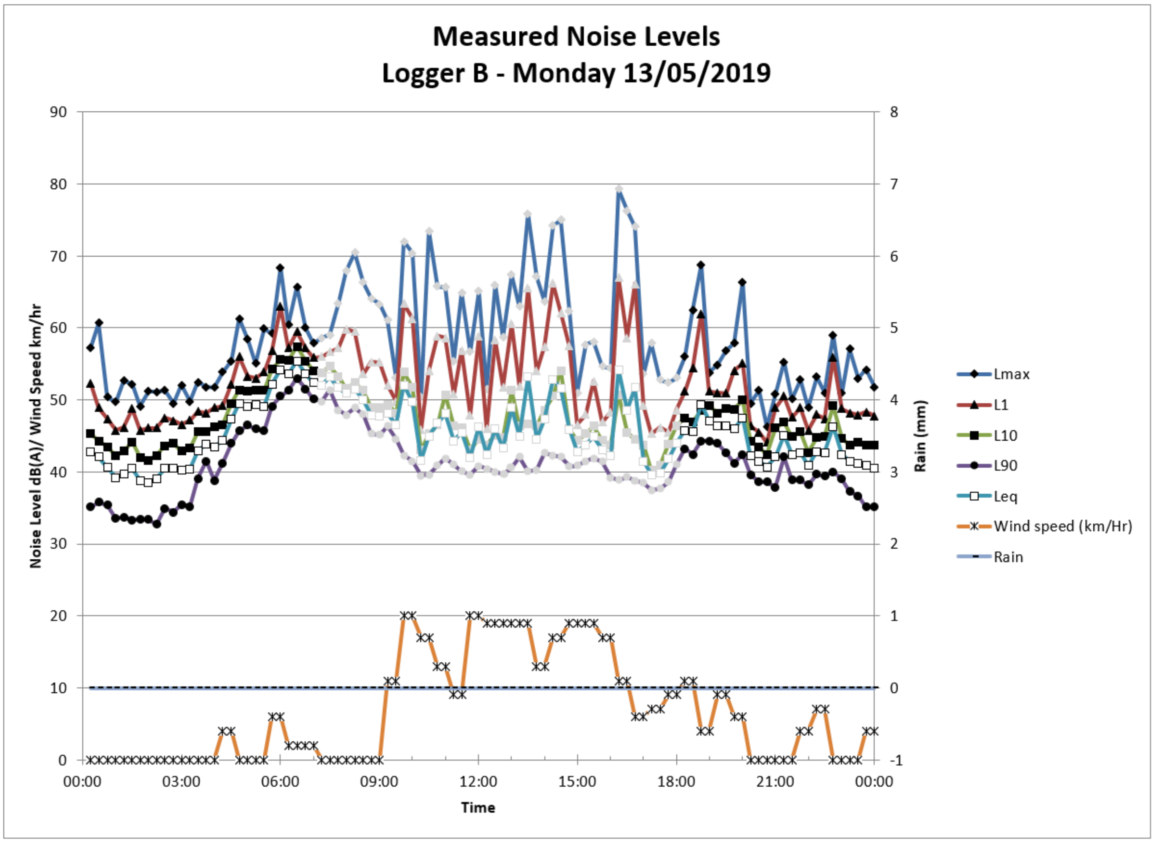
Measured Noise Levels
Logger B - Friday 10/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



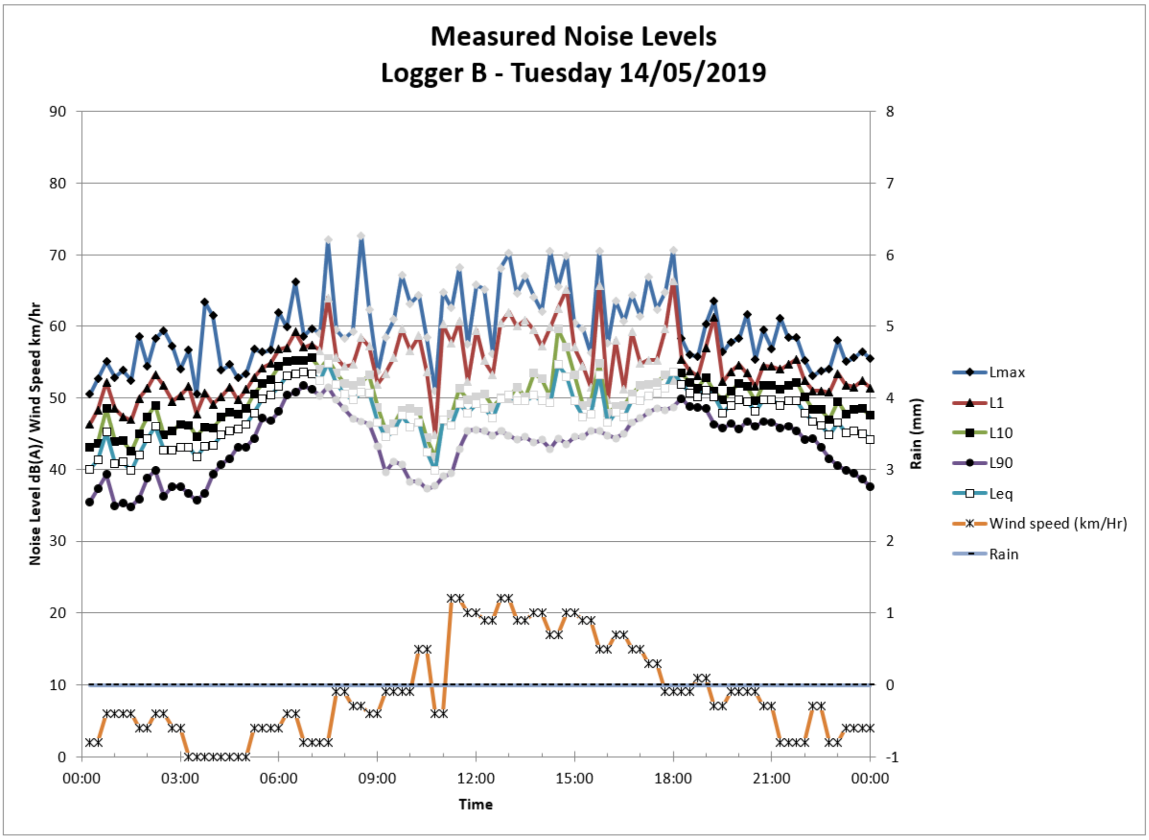
Measured Noise Levels
Logger B - Saturday 11/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



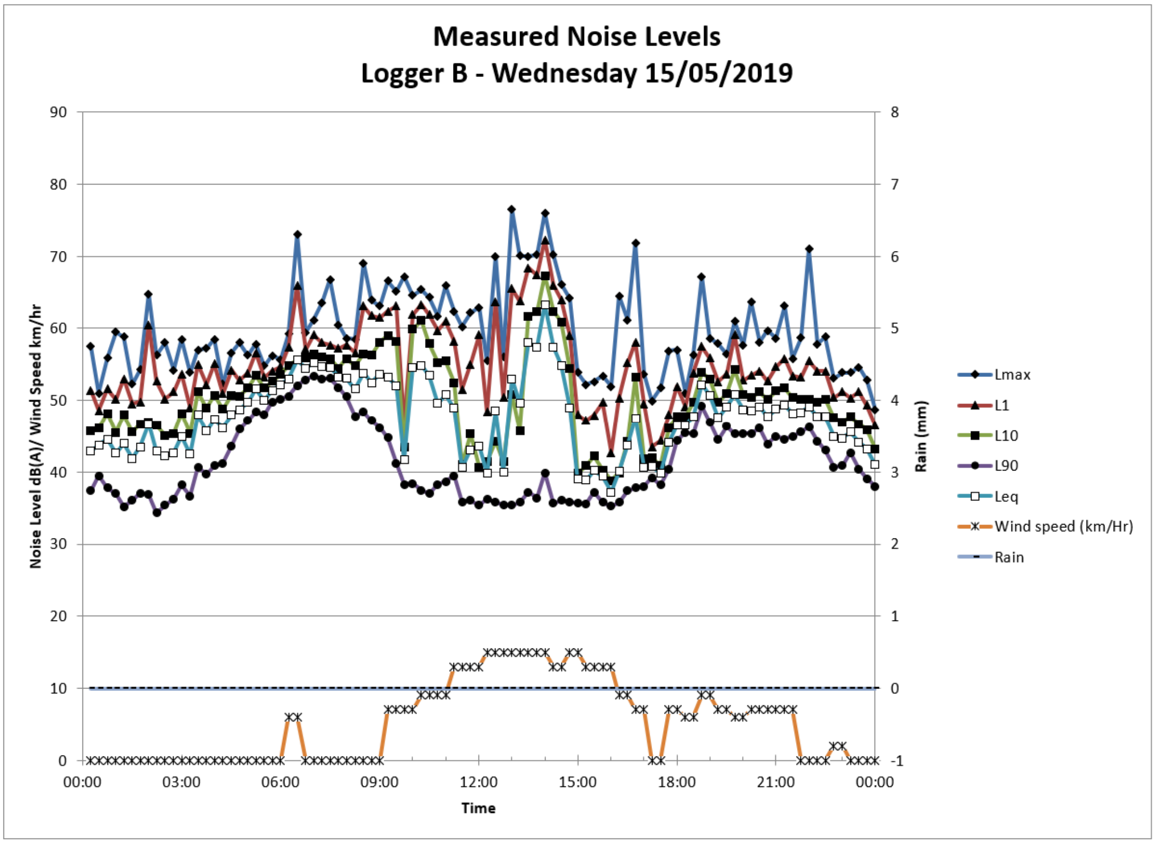
Measured Noise Levels
Logger B - Sunday 12/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



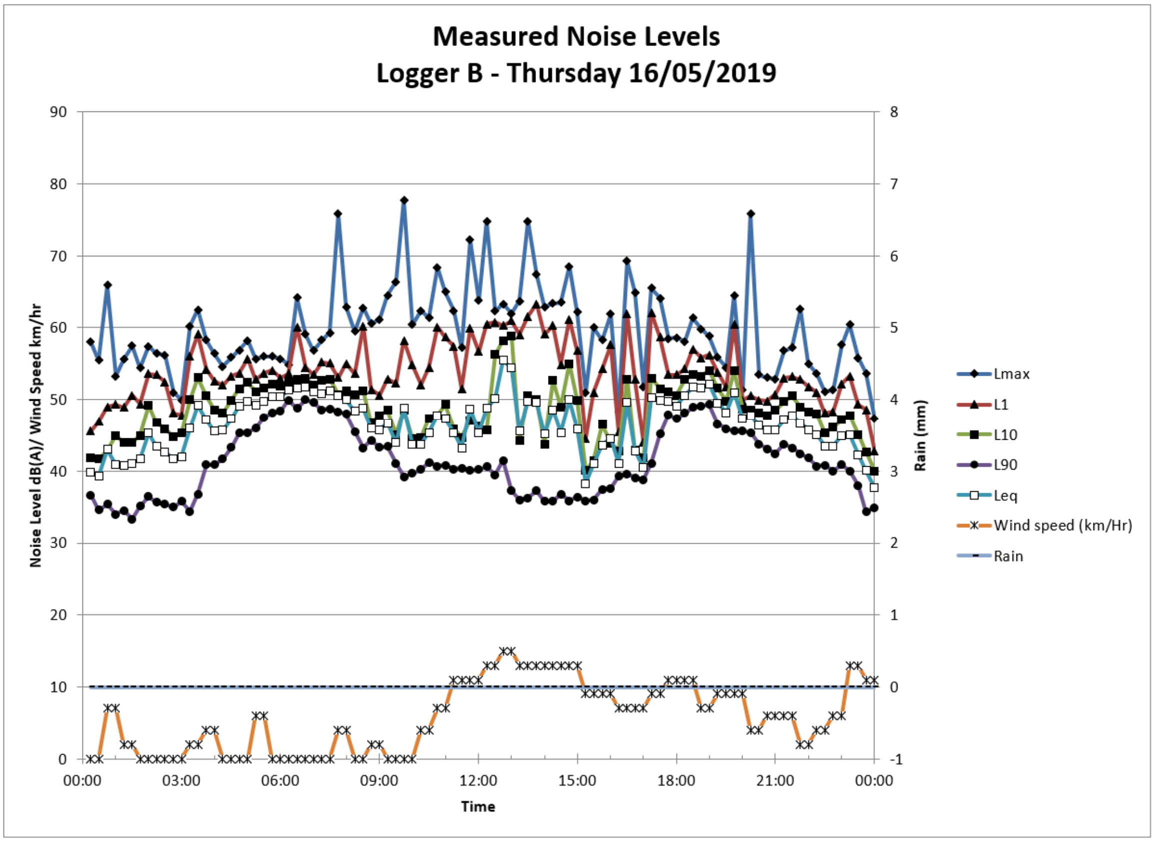
Measured Noise Levels
Logger B - Monday 13/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



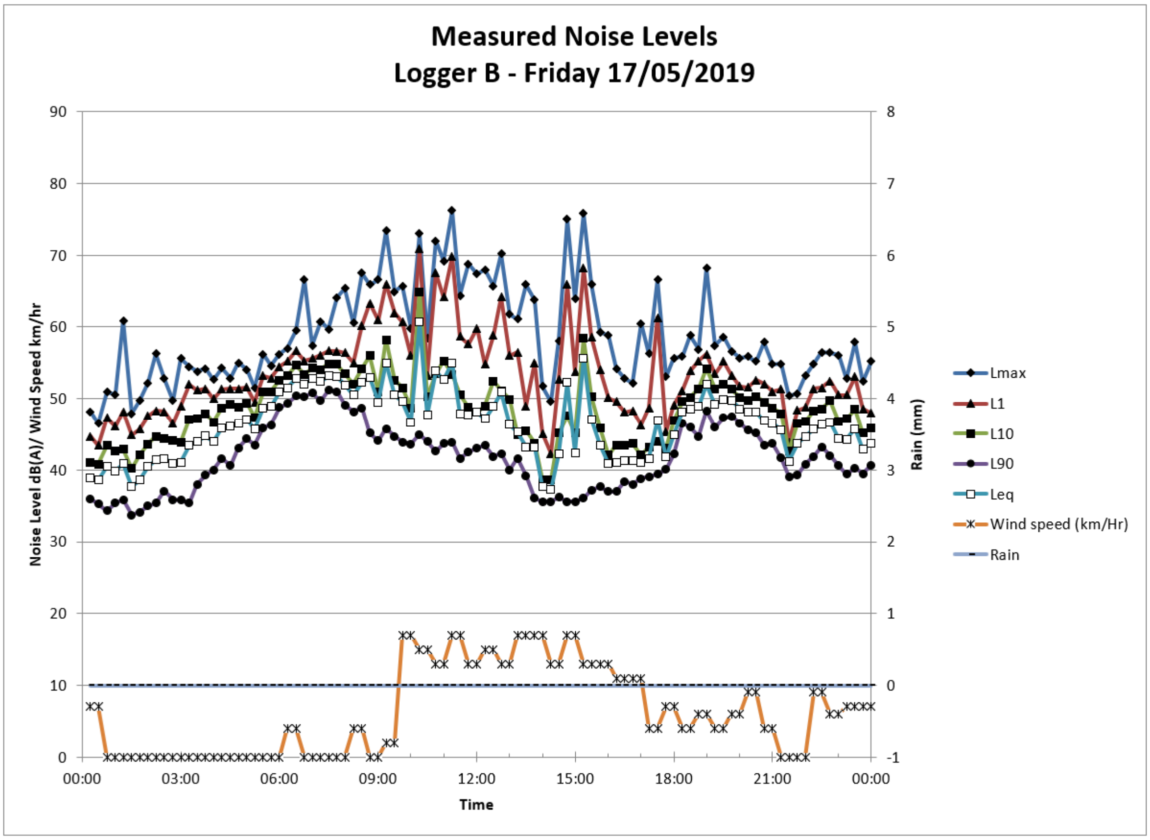
Measured Noise Levels
Logger B - Tuesday 14/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



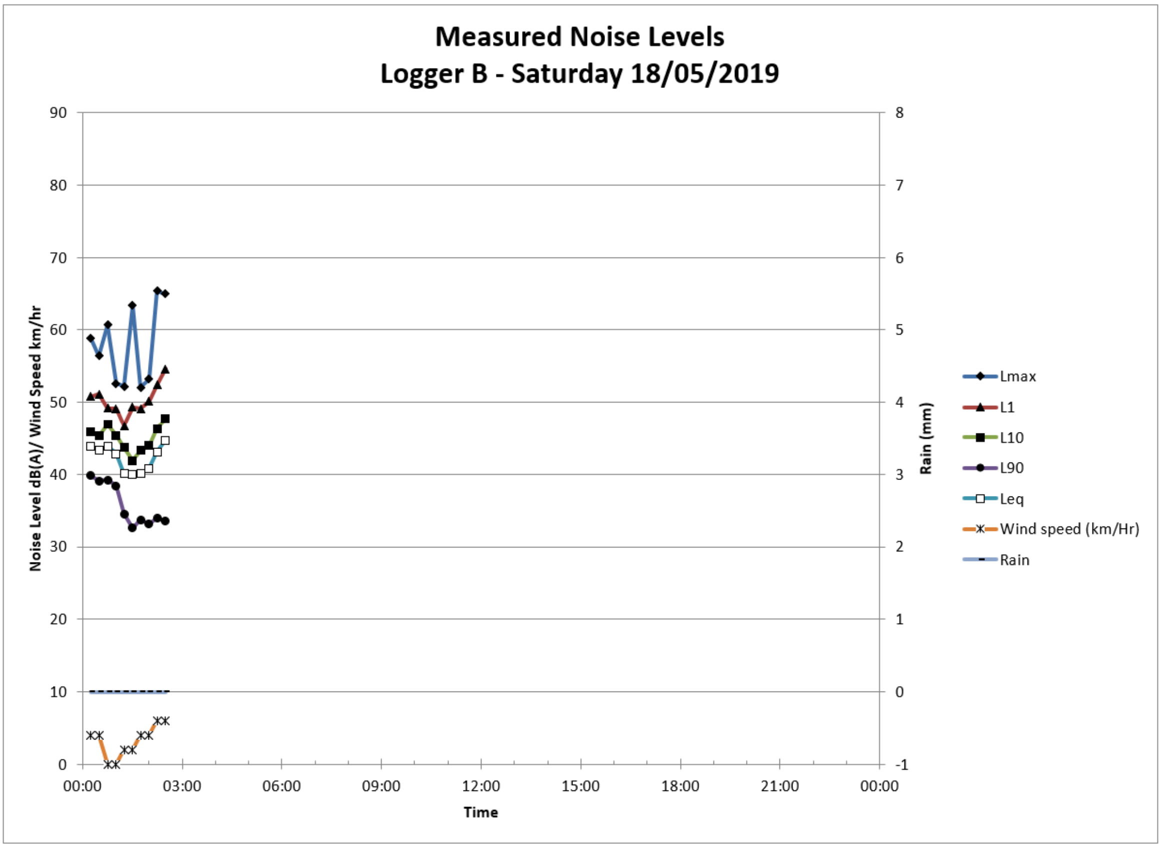
Measured Noise Levels
Logger B - Wednesday 15/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



Measured Noise Levels
Logger B - Thursday 16/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



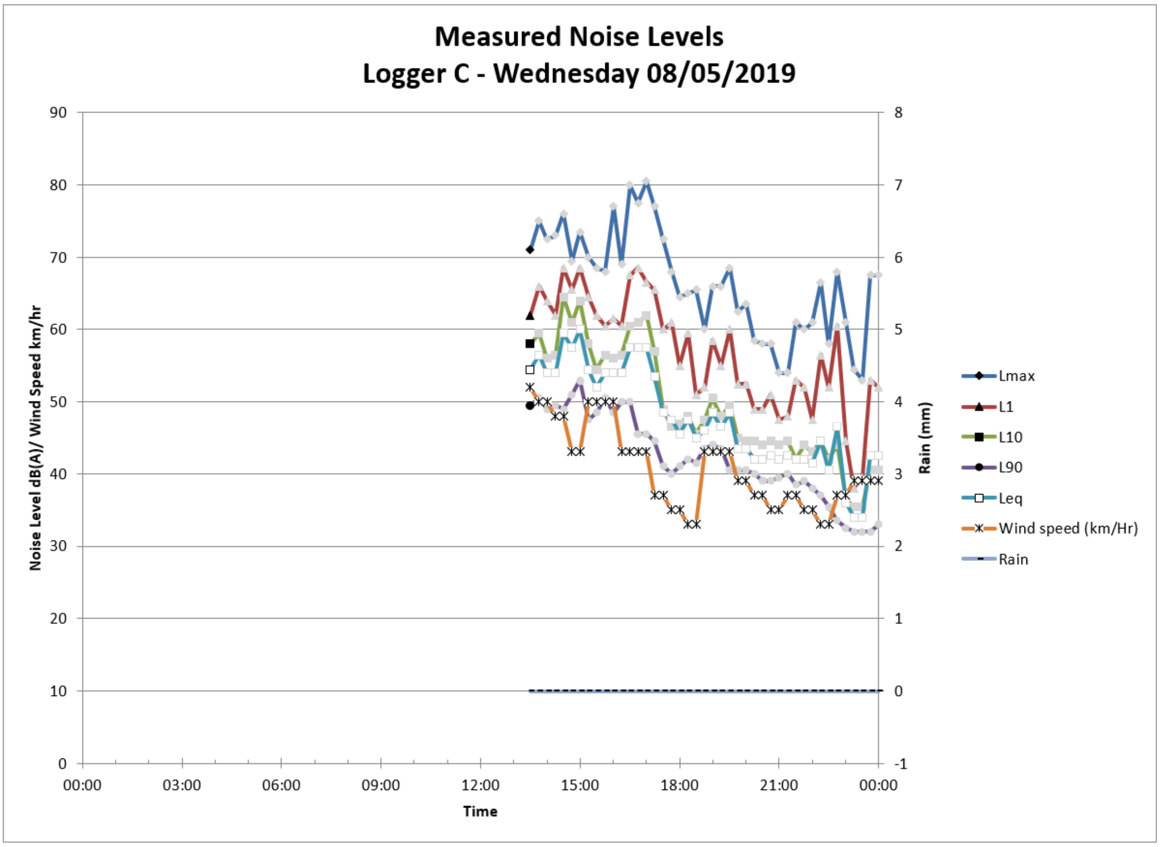
Measured Noise Levels
Logger B - Friday 17/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

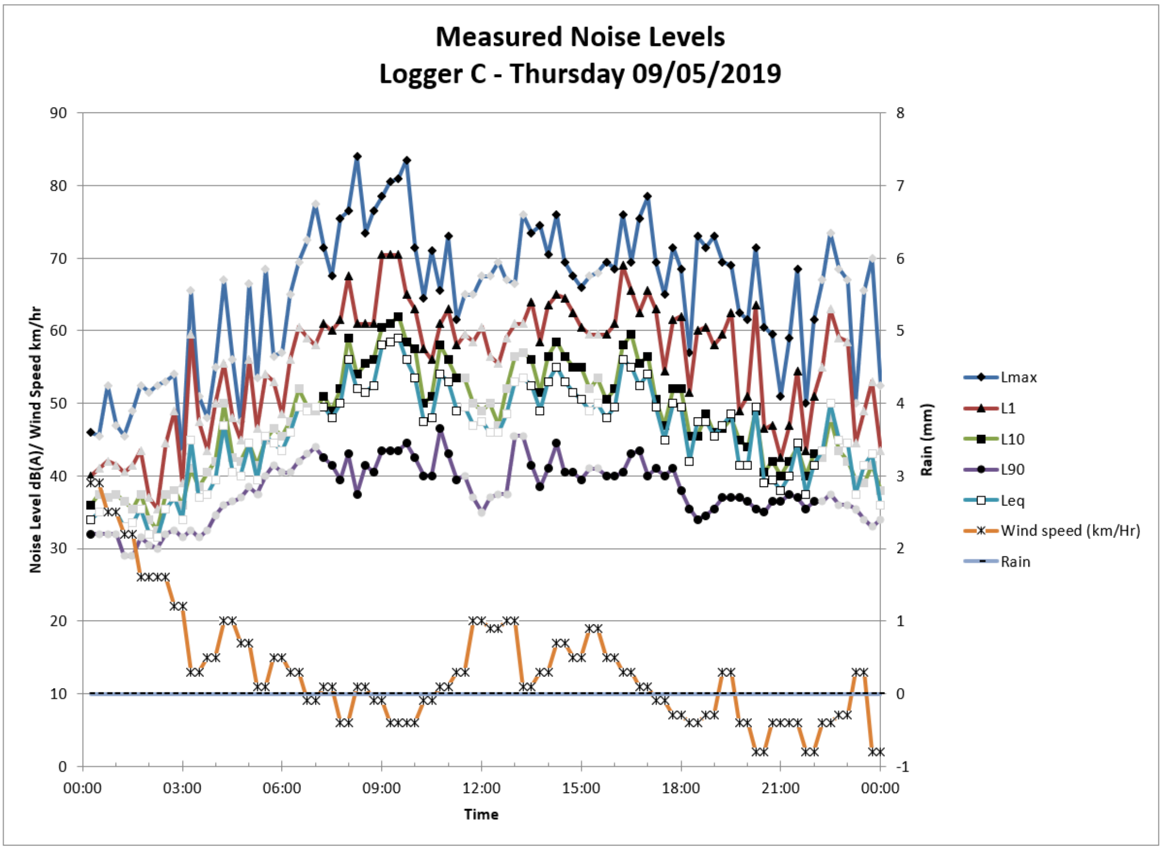


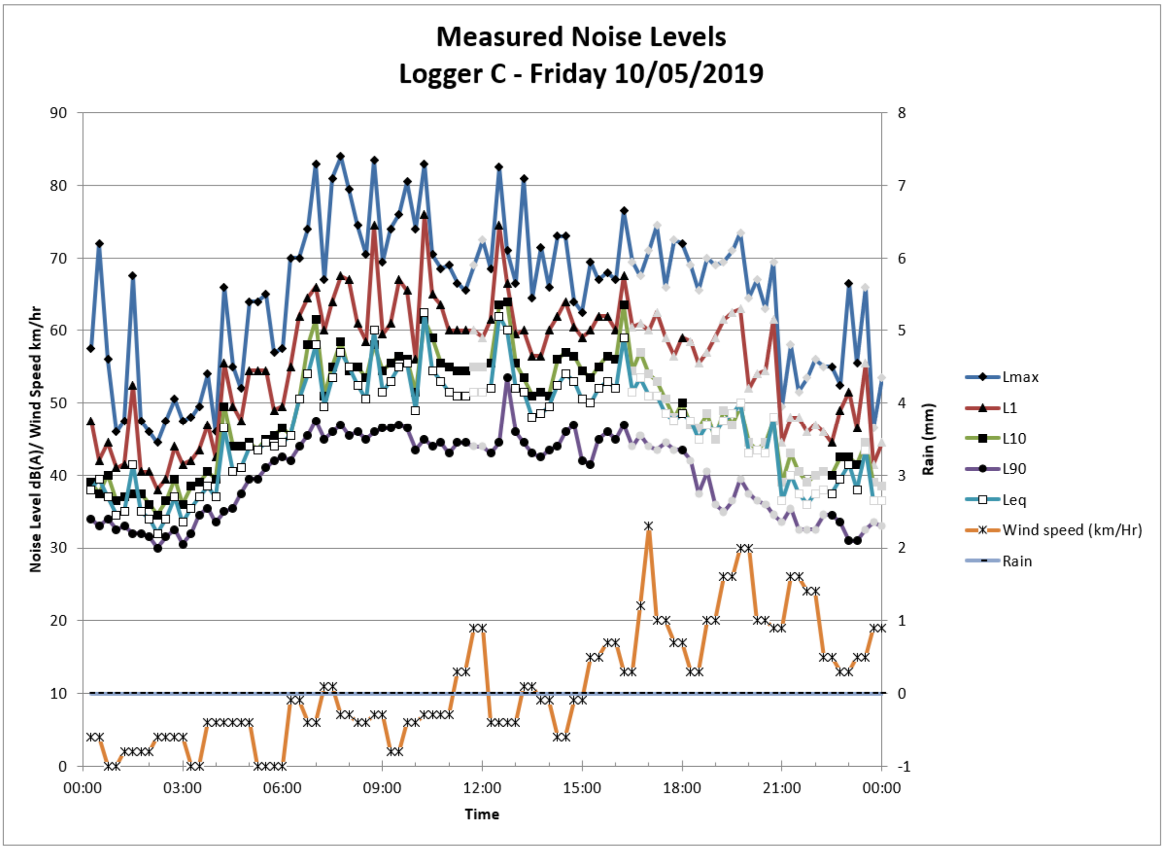
Measured Noise Levels
Logger B - Saturday 18/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

Table 3: Logger C Results

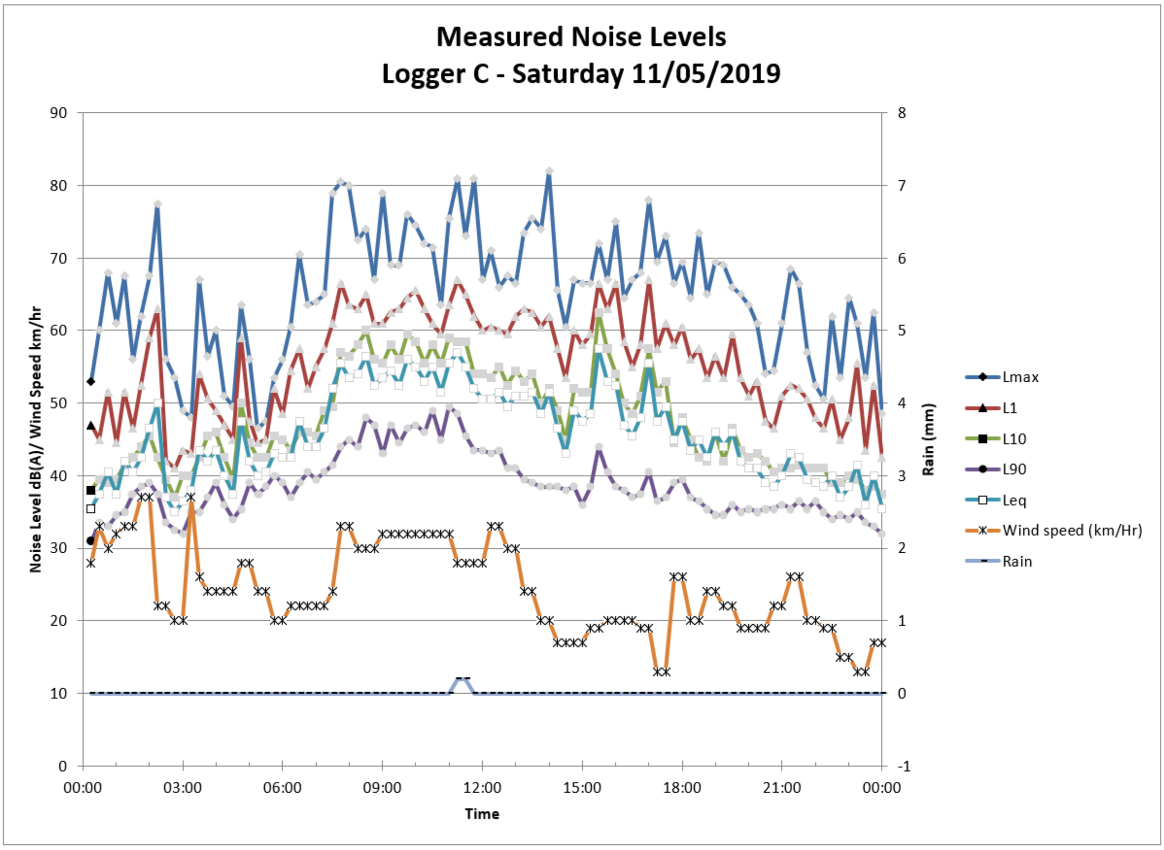
	Average L1			Average L10			ABL (L90)			Leq		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
8/05/2019	-	-	-	-	-	-	-	-	-	-	-	-
9/05/2019	63	53	-	55	44	-	40	35	-	53	45	-
10/05/2019	63	-	48	56	-	42	43	-	31	55	-	46
11/05/2019	-	-	-	-	-	-	-	-	-	-	-	-
12/05/2019	-	49	-	-	41	-	-	32	-	-	41	-
13/05/2019	-	52	48	-	42	41	-	32	31	-	43	43
14/05/2019	-	54	48	-	43	40	-	32	30	-	45	43
15/05/2019	60	55	46	52	43	39	35	32	30	51	45	42
16/05/2019	60	54	47	52	44	38	37	35	29	51	44	42
17/05/2019	62	53	48	53	43	41	36	33	31	53	43	44
18/05/2019	61	52	50	52	41	39	34	31	29	51	48	44
19/05/2019	63	57	47	54	47	39	35	35	29	54	49	42
20/05/2019	63	59	53	54	49	46	35	35	30	55	50	50
21/05/2019	64	57	54	56	48	46	44	36	31	54	50	51
22/05/2019	64	64	54	55	53	46	35	44	29	55	53	51
Average	62	55	49	54	45	42	37	34	30	53	46	45
Median	63	54	48	54	43	41	**36**	**34**	**30**	54	45	44
Logarithmic Average	62	57	50	54	46	43	39	36	30	**54**	**48**	**47**


Measured Noise Levels
Logger C - Wednesday 08/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

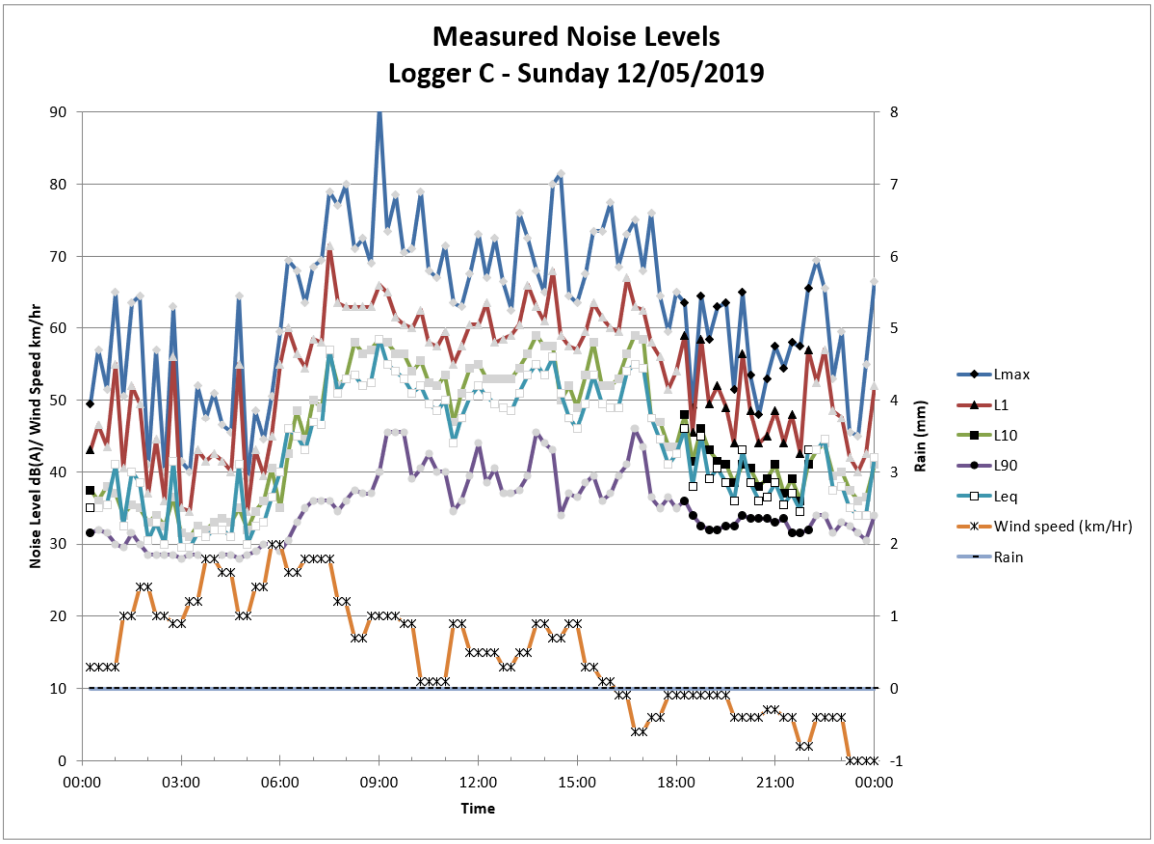

Measured Noise Levels
Logger C - Thursday 09/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



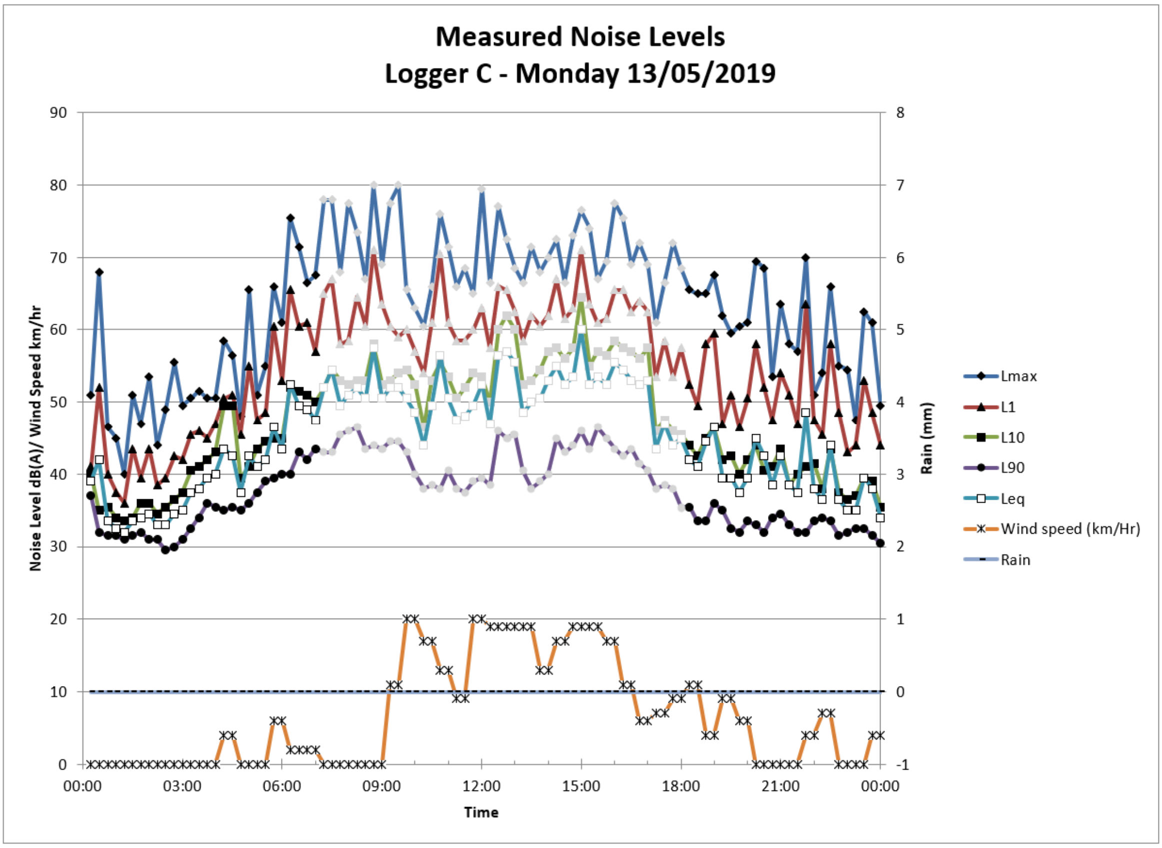
Measured Noise Levels
Logger C - Friday 10/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



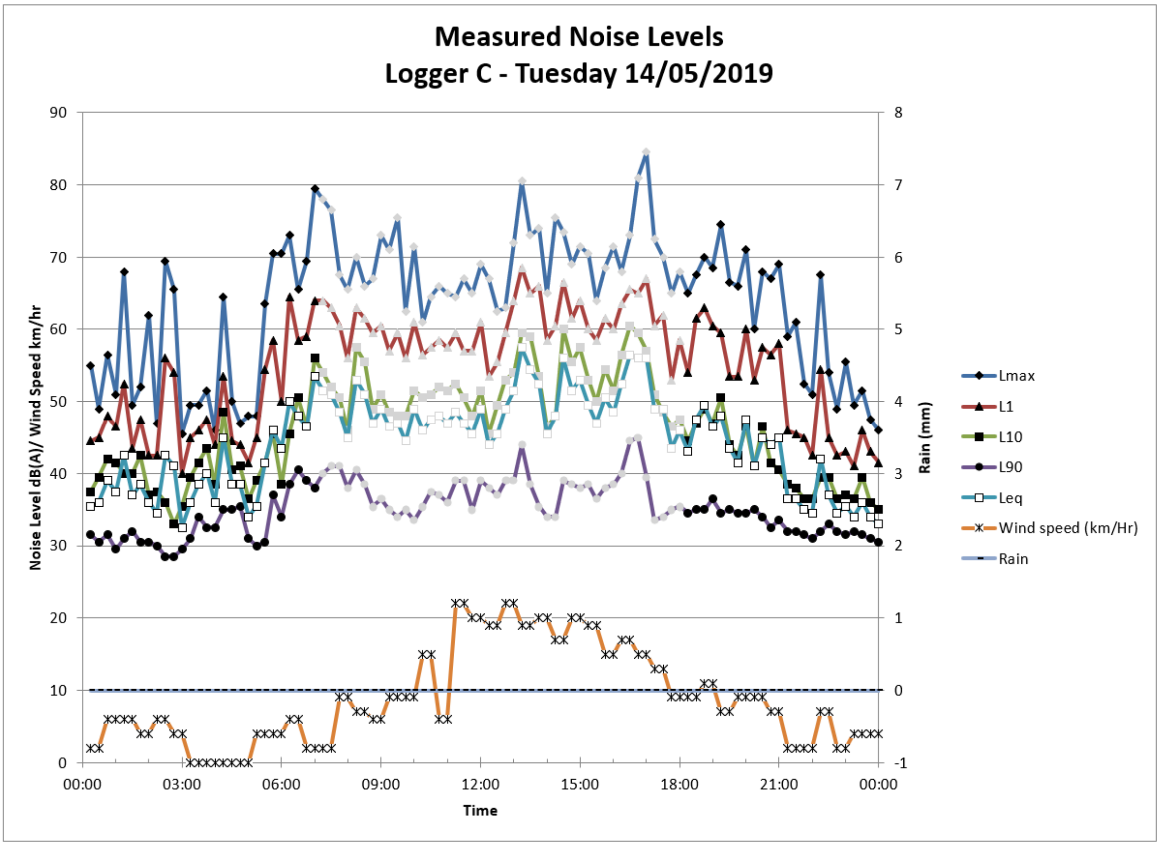
Measured Noise Levels
Logger C - Saturday 11/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

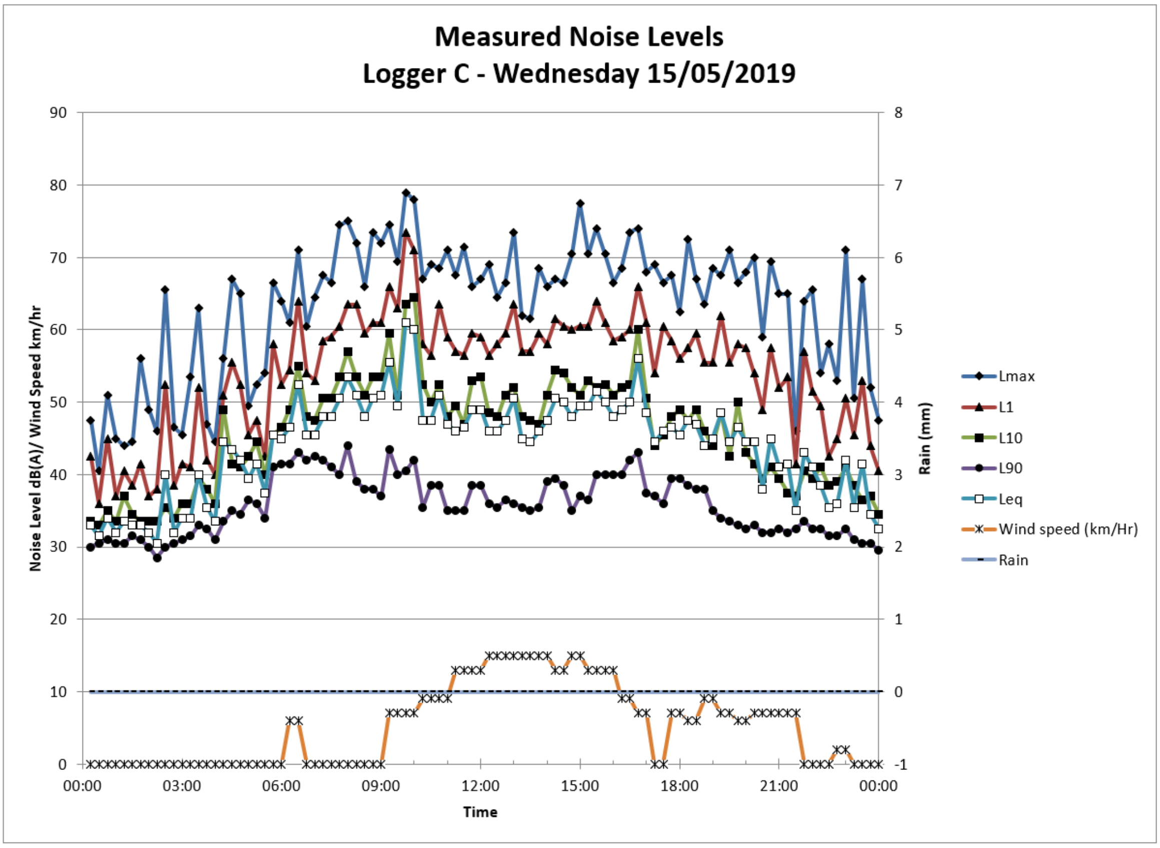


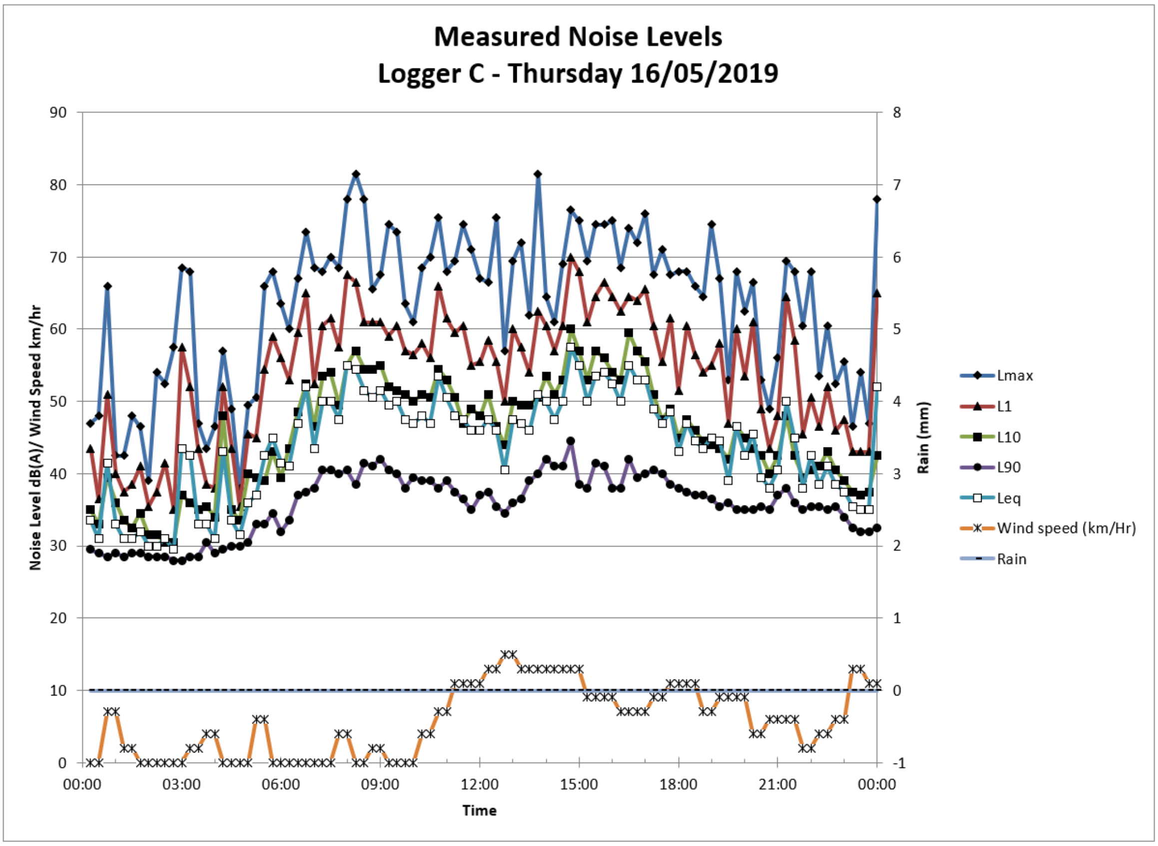
Measured Noise Levels
Logger C - Sunday 12/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



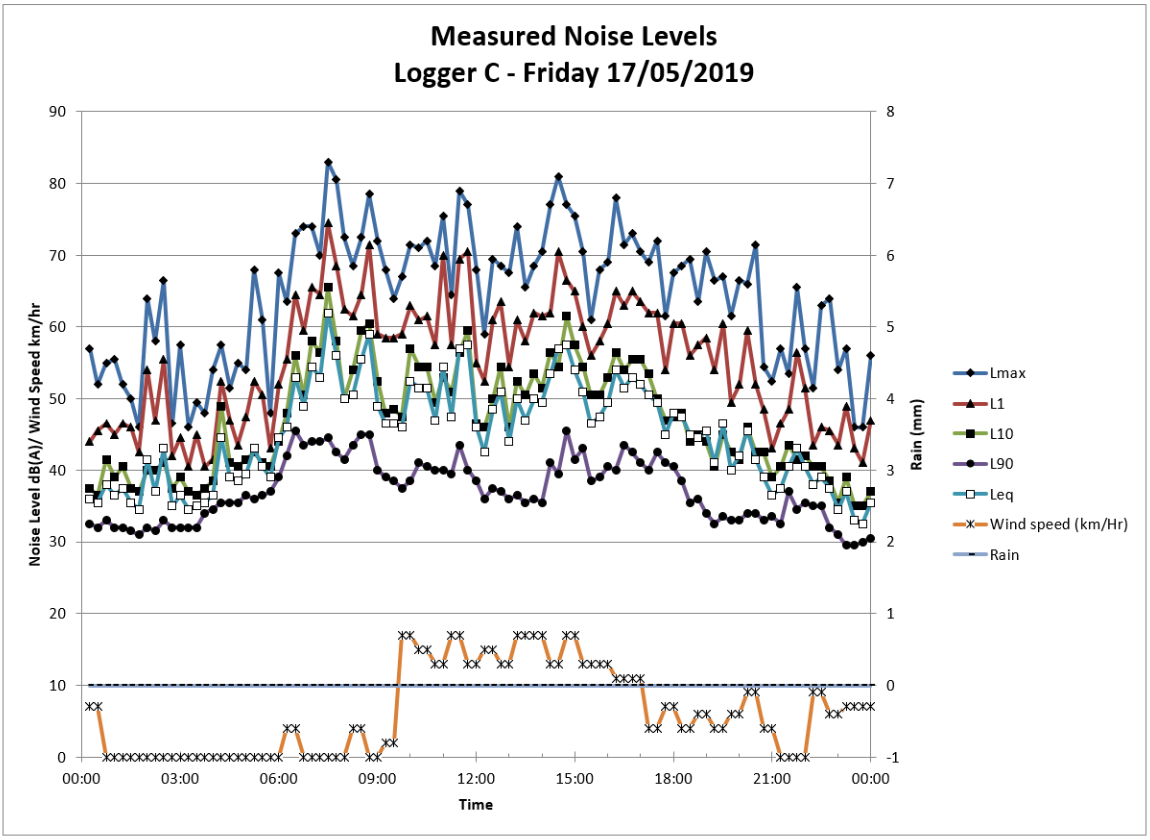
Measured Noise Levels
Logger C - Monday 13/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Logger C - Tuesday 14/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
0
10
20
30
40
50
60
70
80
90
-1
0
1
2
3
4
5
6
7
8
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

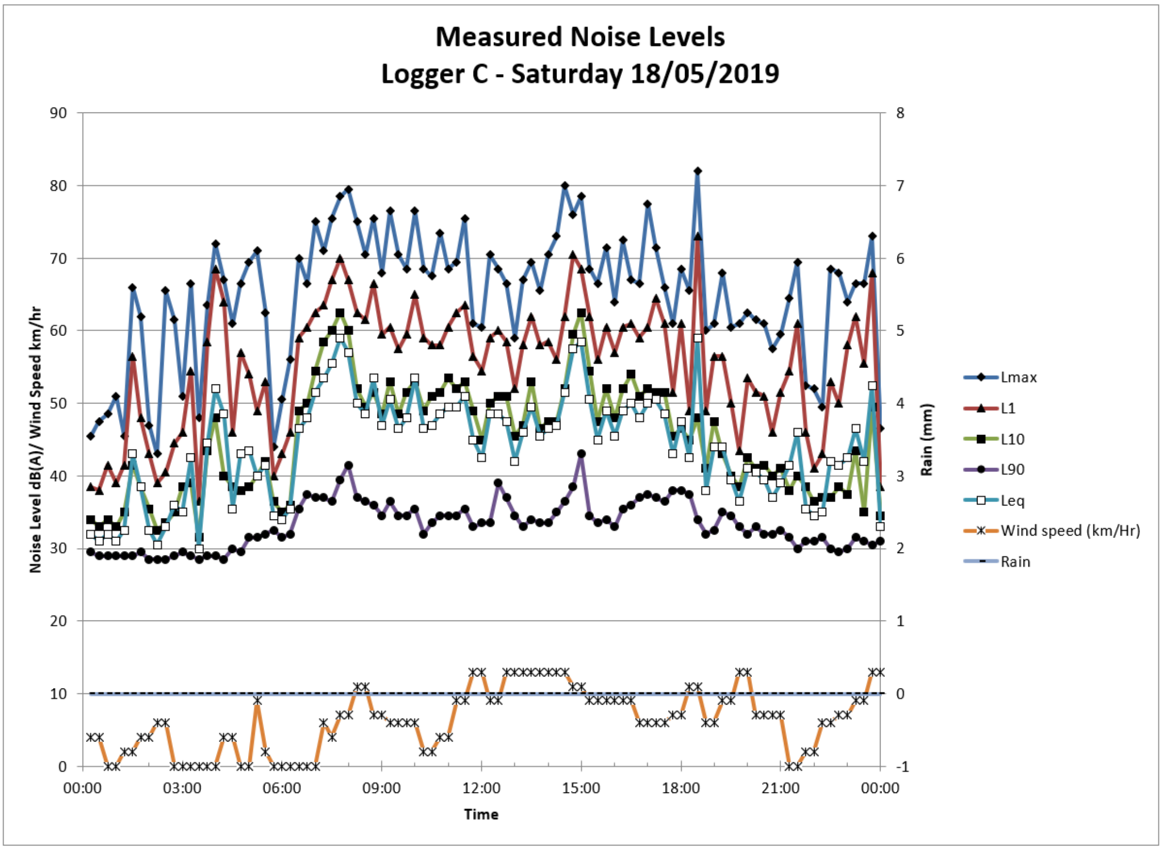

Measured Noise Levels
Logger C - Wednesday 15/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
0
10
20
30
40
50
60
70
80
90
-1
0
1
2
3
4
5
6
7
8
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



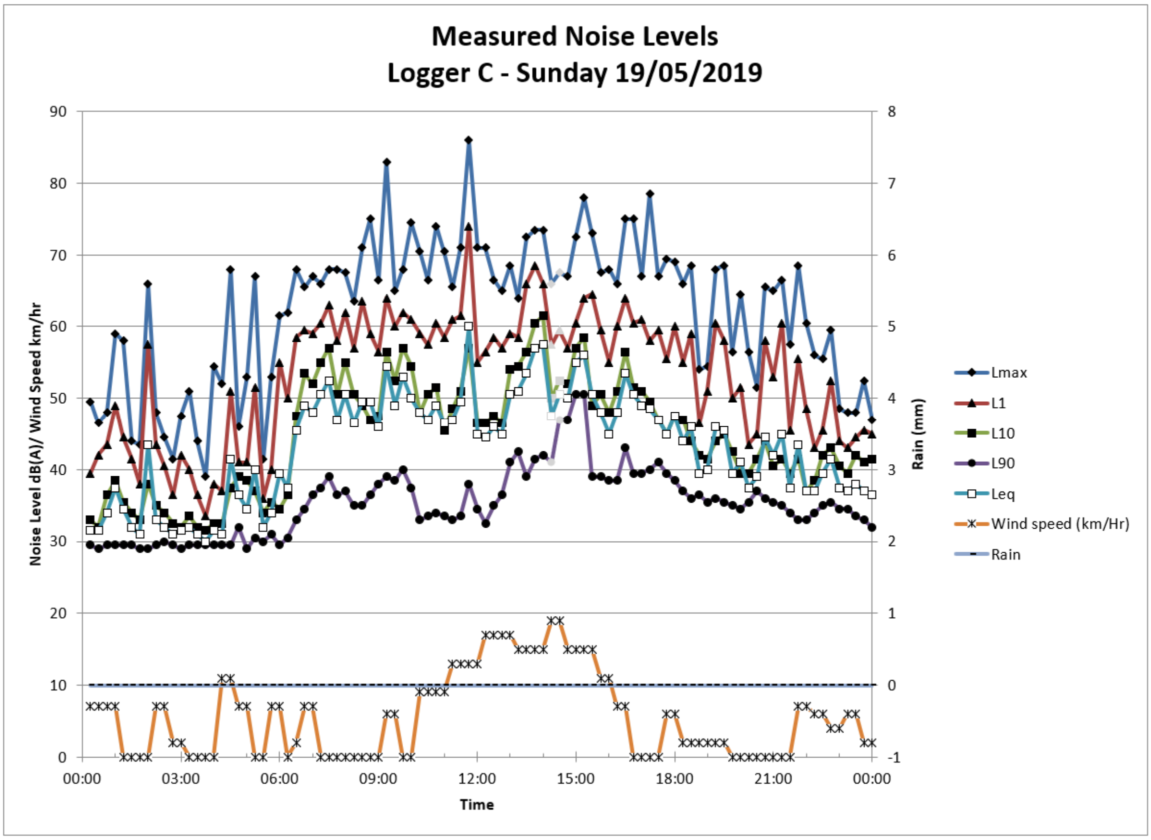
Measured Noise Levels
Logger C - Thursday 16/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



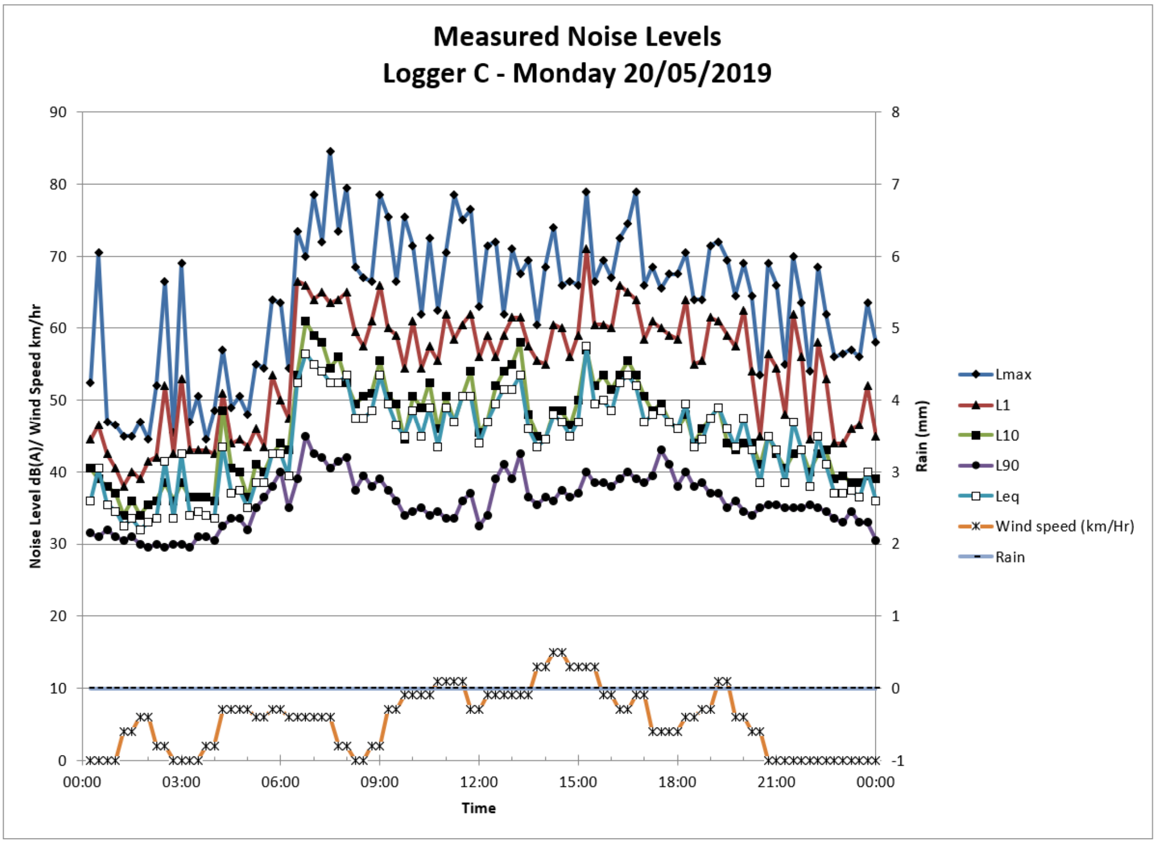
Measured Noise Levels
Logger C - Friday 17/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

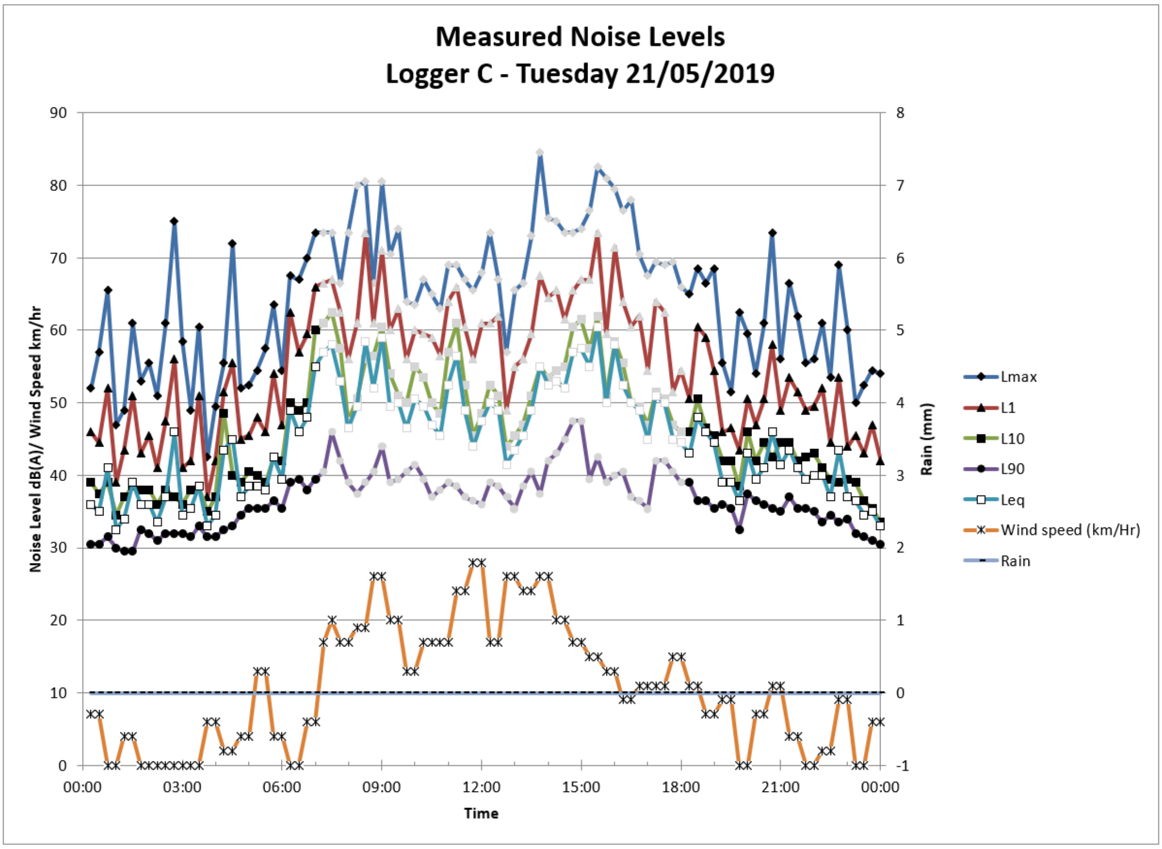


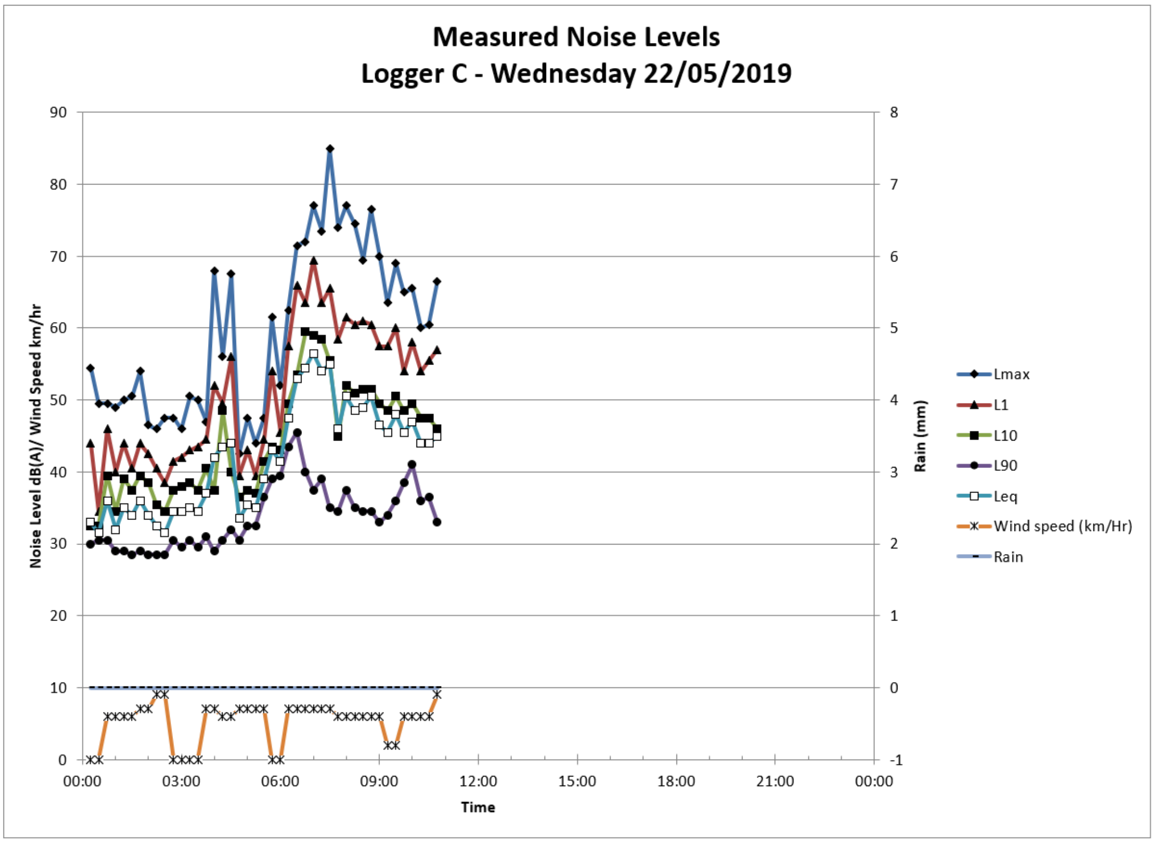
Measured Noise Levels
Logger C - Saturday 18/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



Measured Noise Levels
Logger C - Sunday 19/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Logger C - Monday 20/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

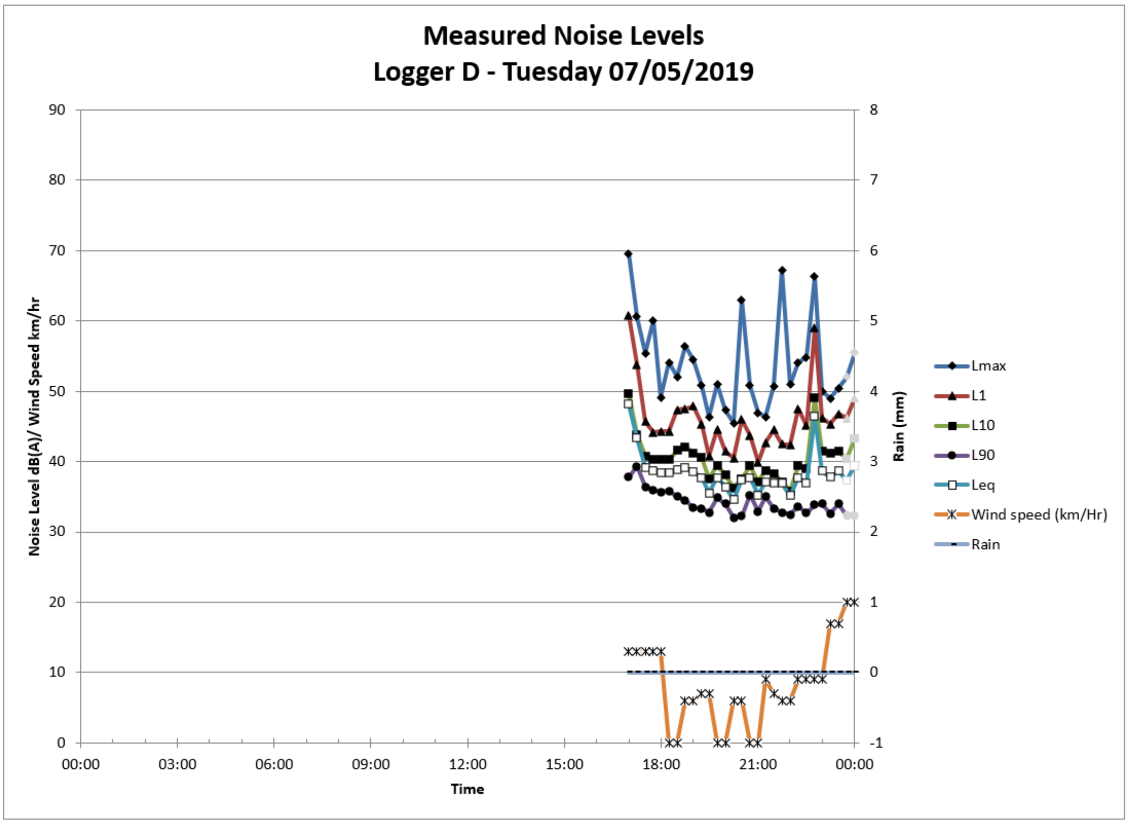

Measured Noise Levels
Logger C - Tuesday 21/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

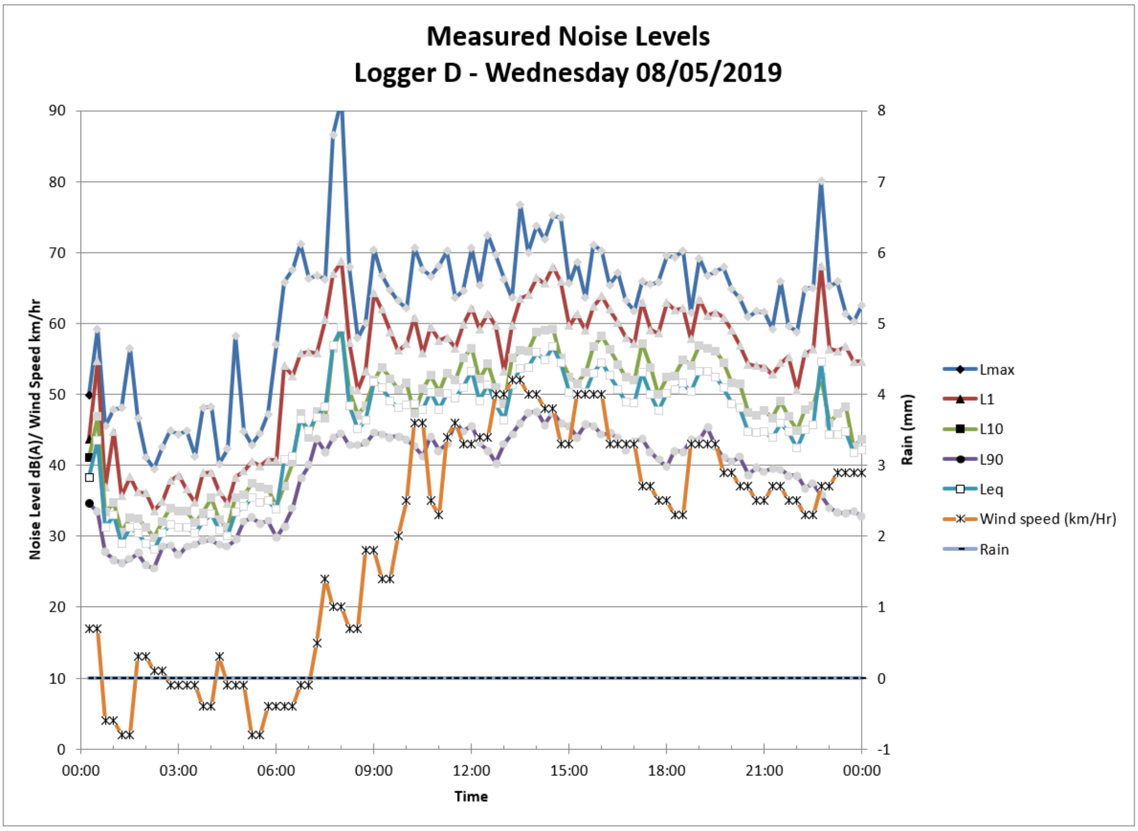


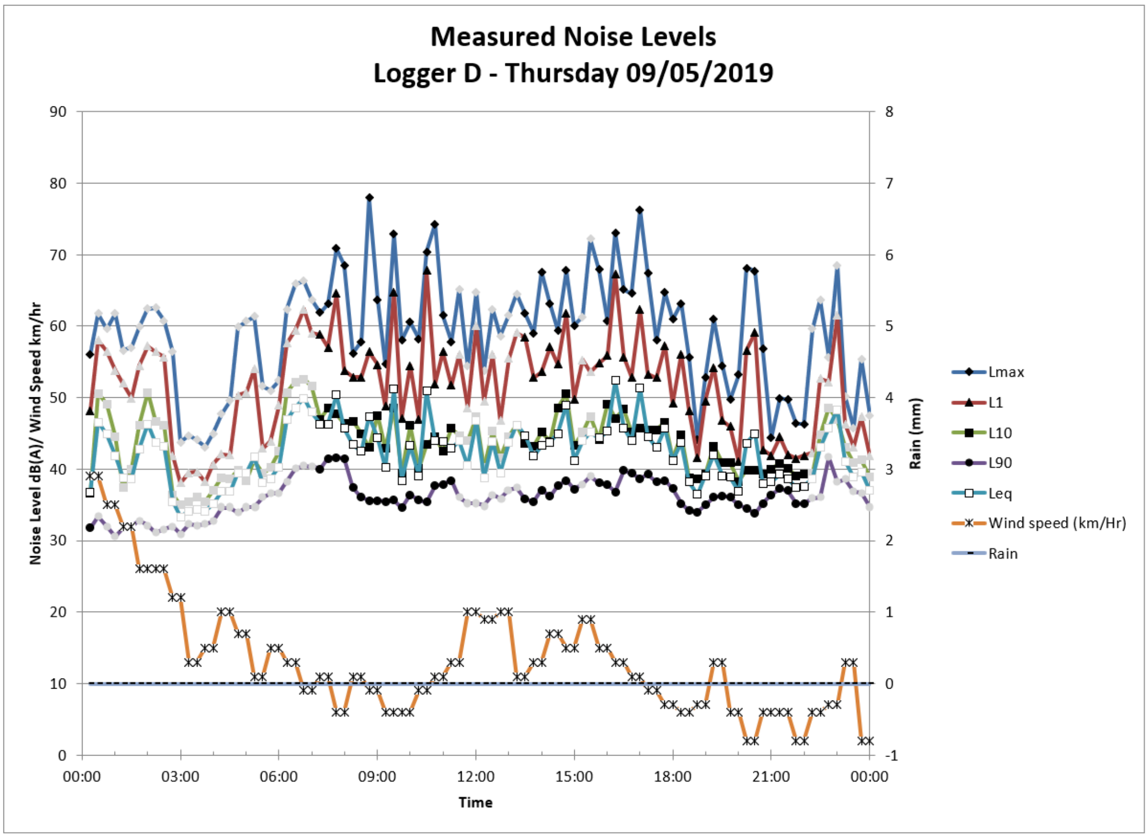
Measured Noise Levels
Logger C - Wednesday 22/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

Table 4: Logger D Results

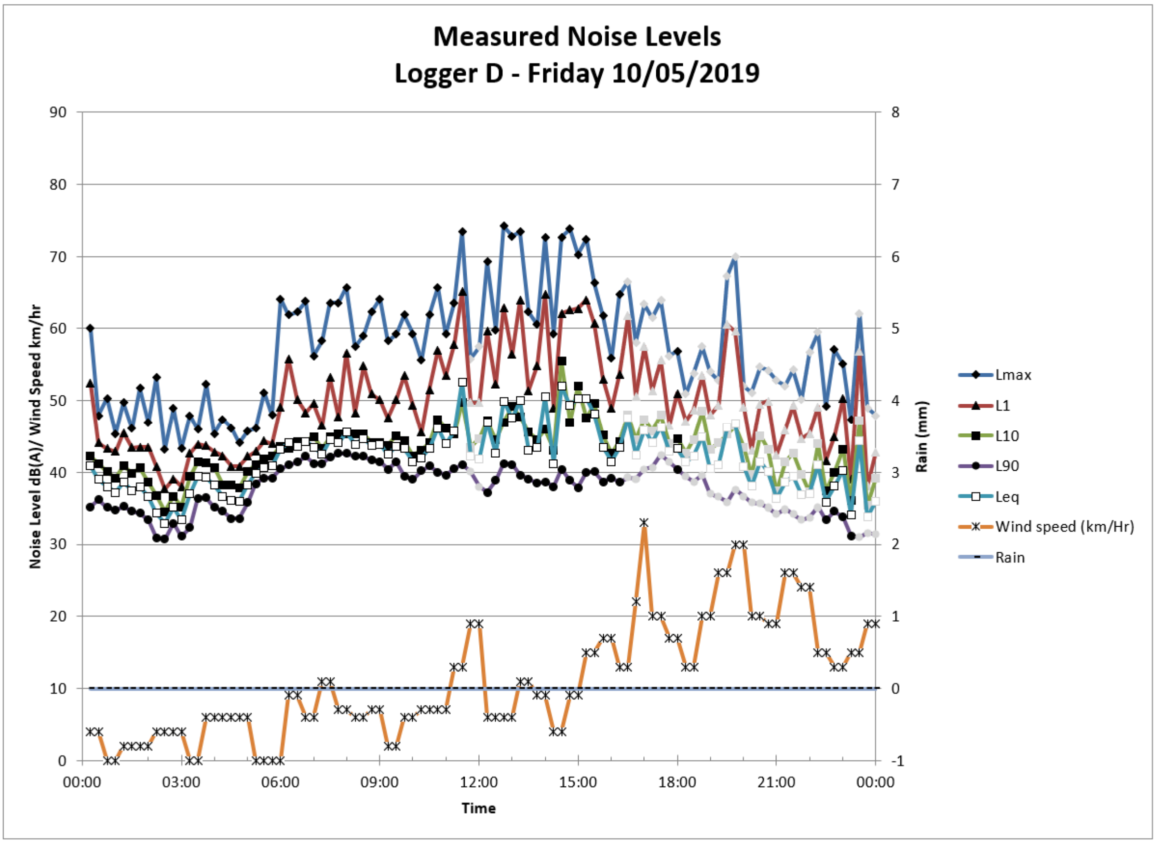
	Average L1			Average L10			ABL (L90)			Leq		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
7/05/2019	50	44	48	43	39	42	36	32	33	43	37	41
8/05/2019	-	-	-	-	-	-	-	-	-	-	-	-
9/05/2019	56	47	-	45	40	-	36	34	-	46	40	-
10/05/2019	55	-	44	46	-	40	39	-	31	47	-	40
11/05/2019	-	-	-	-	-	-	-	-	-	-	-	-
12/05/2019	-	44	-	-	39	-	-	34	-	-	39	-
13/05/2019	-	46	43	-	39	38	-	33	31	-	39	39
14/05/2019	-	44	43	-	39	38	-	33	30	-	38	39
15/05/2019	53	45	44	44	41	39	33	35	31	44	41	40
16/05/2019	53	47	43	45	41	38	33	35	30	45	41	38
17/05/2019	54	44	42	45	40	38	35	33	32	46	38	38
18/05/2019	55	44	43	45	39	37	30	34	30	47	38	39
19/05/2019	54	43	41	45	39	37	32	33	31	46	38	36
20/05/2019	54	54	43	44	45	38	33	35	30	45	44	38
21/05/2019	66	53	46	57	46	40	48	32	29	55	49	44
22/05/2019	60	54	51	51	46	44	32	33	29	53	50	50
23/05/2019	59	59	51	51	50	44	33	38	31	52	51	49
Average	56	48	45	56	48	45	35	3 4	31	48	42	41
Median	55	46	43	55	46	43	**33**	34	31	46	40	39
Logarithmic Average	58	51	46	58	51	46	39	34	31	49	45	43


Measured Noise Levels
Logger D - Tuesday 07/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

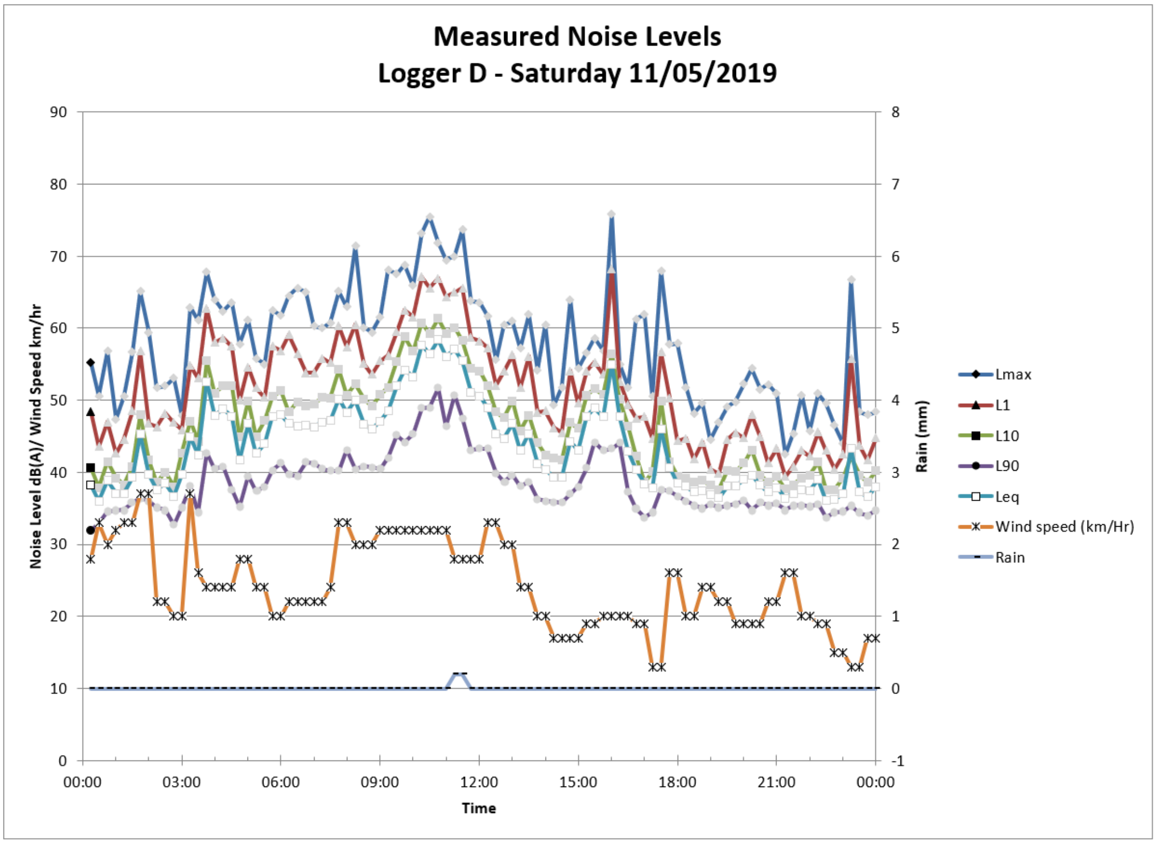

Measured Noise Levels
Logger D - Wednesday 08/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

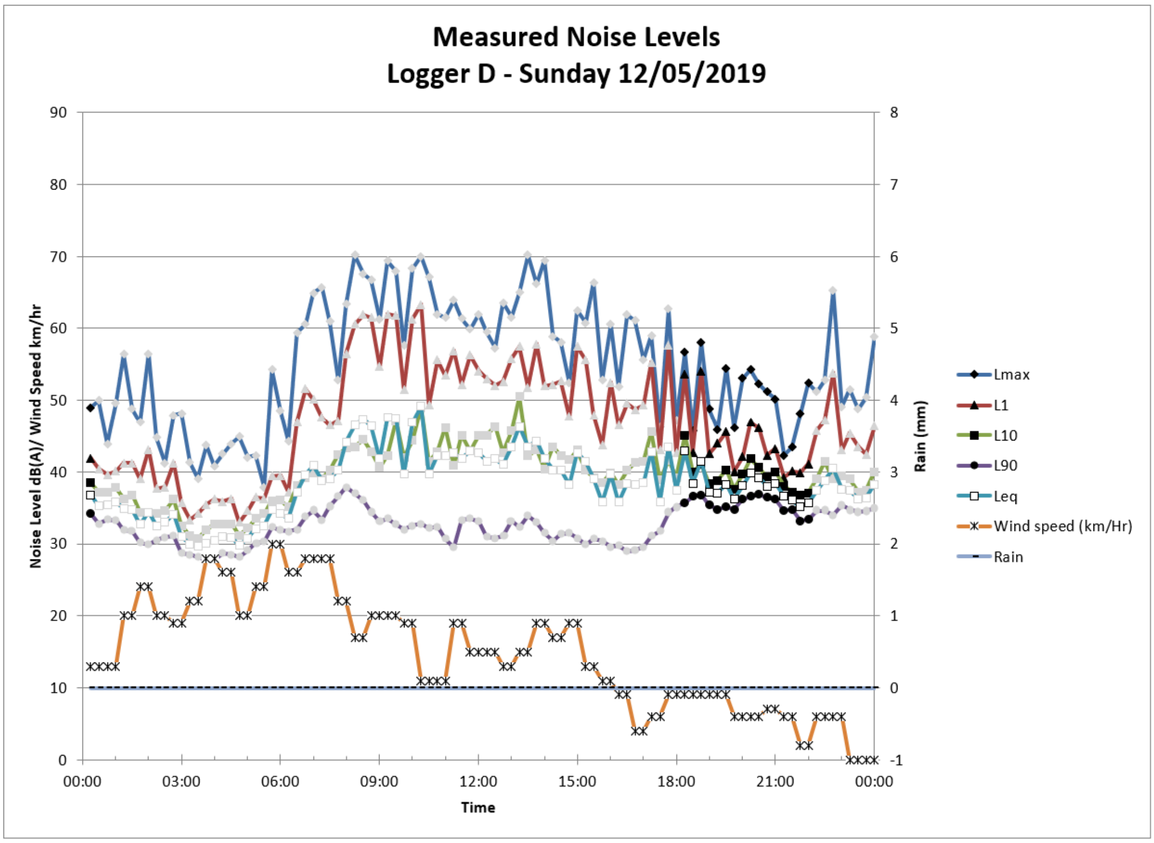


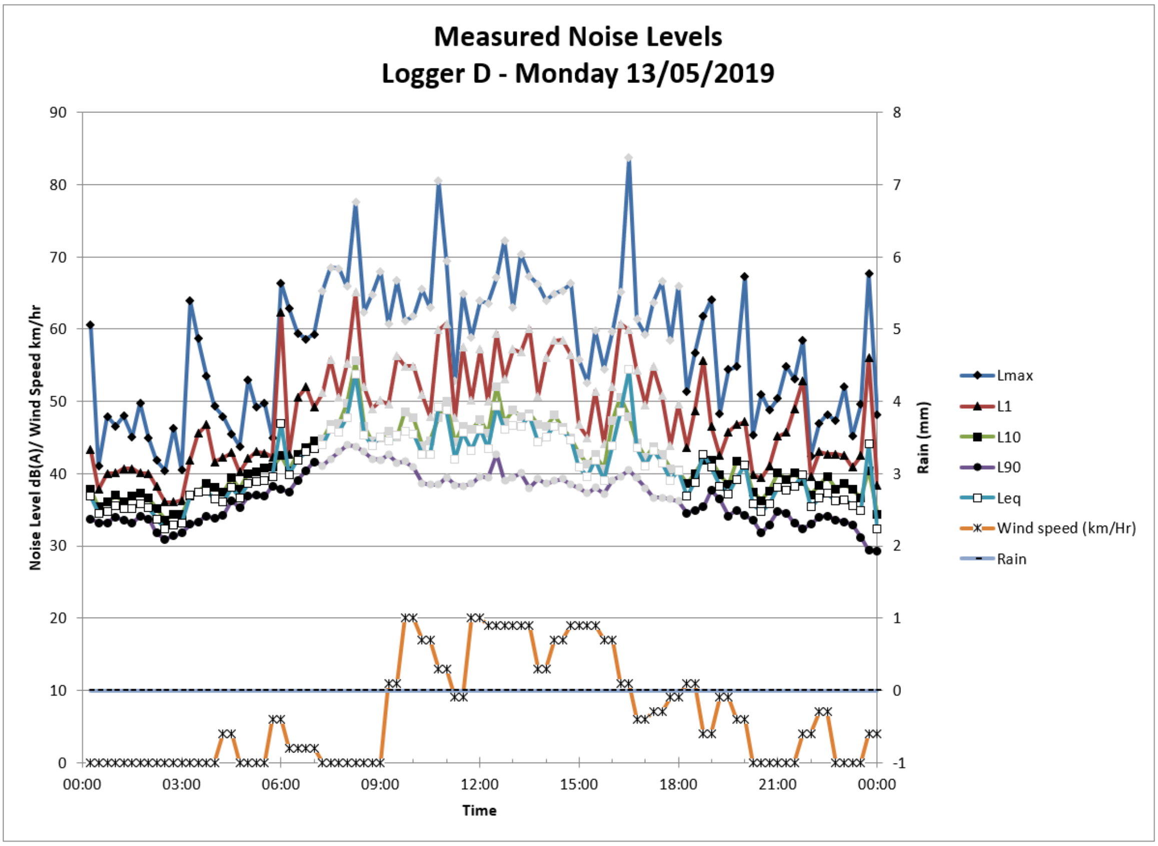
Measured Noise Levels
Logger D - Thursday 09/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



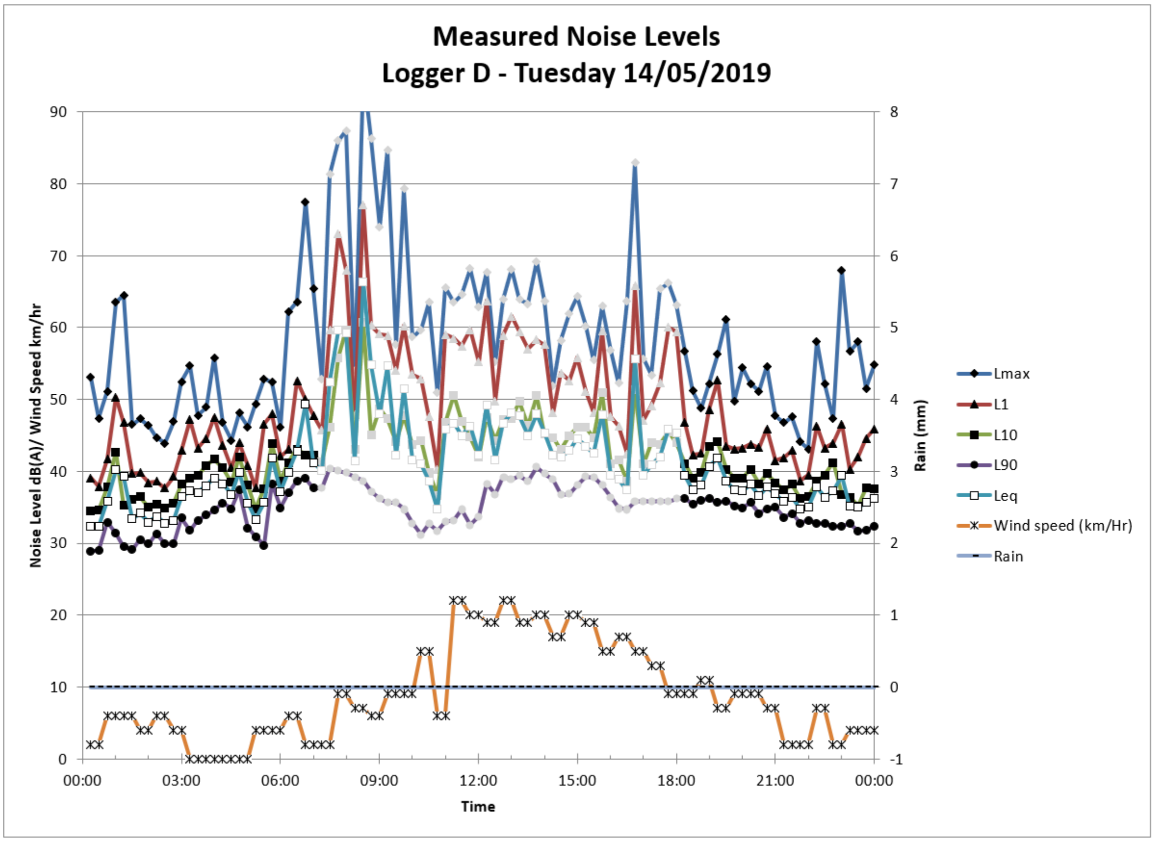
Measured Noise Levels
Logger D - Friday 10/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Logger D - Saturday 11/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00

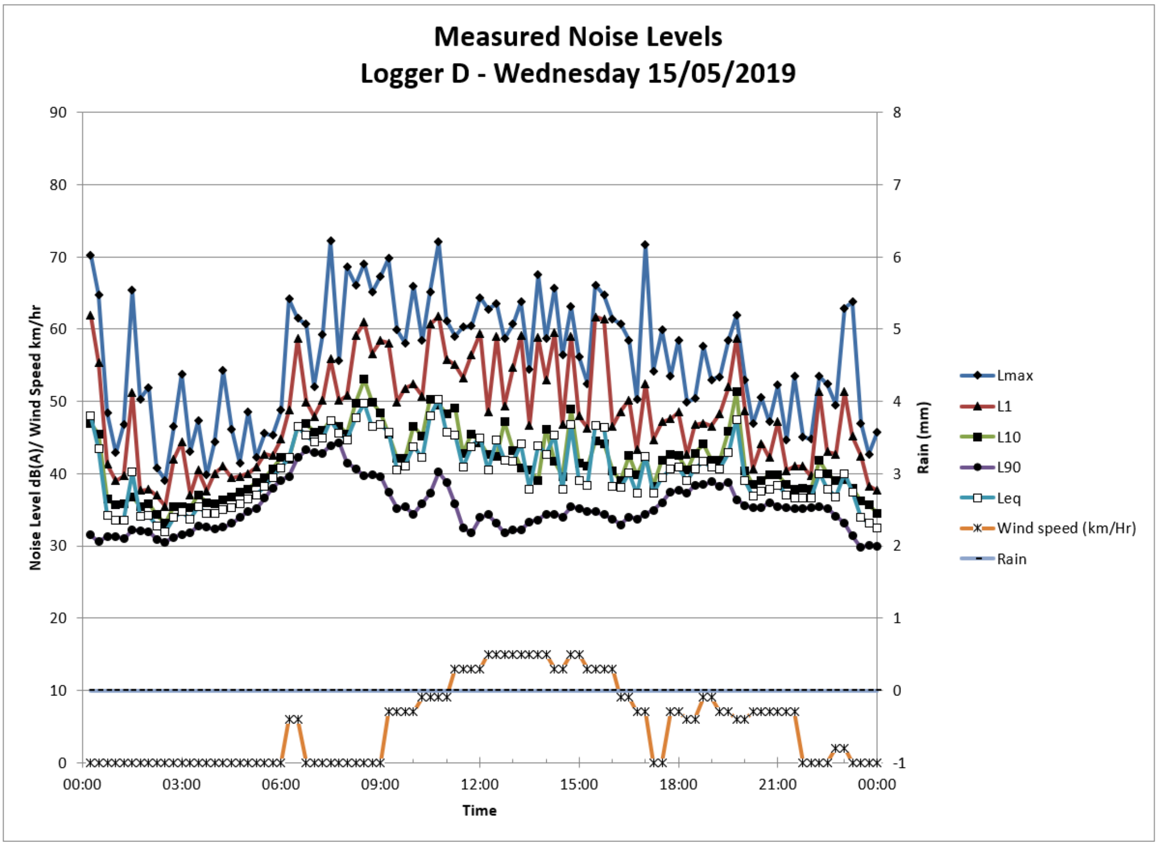

Measured Noise Levels
Logger D - Sunday 12/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00

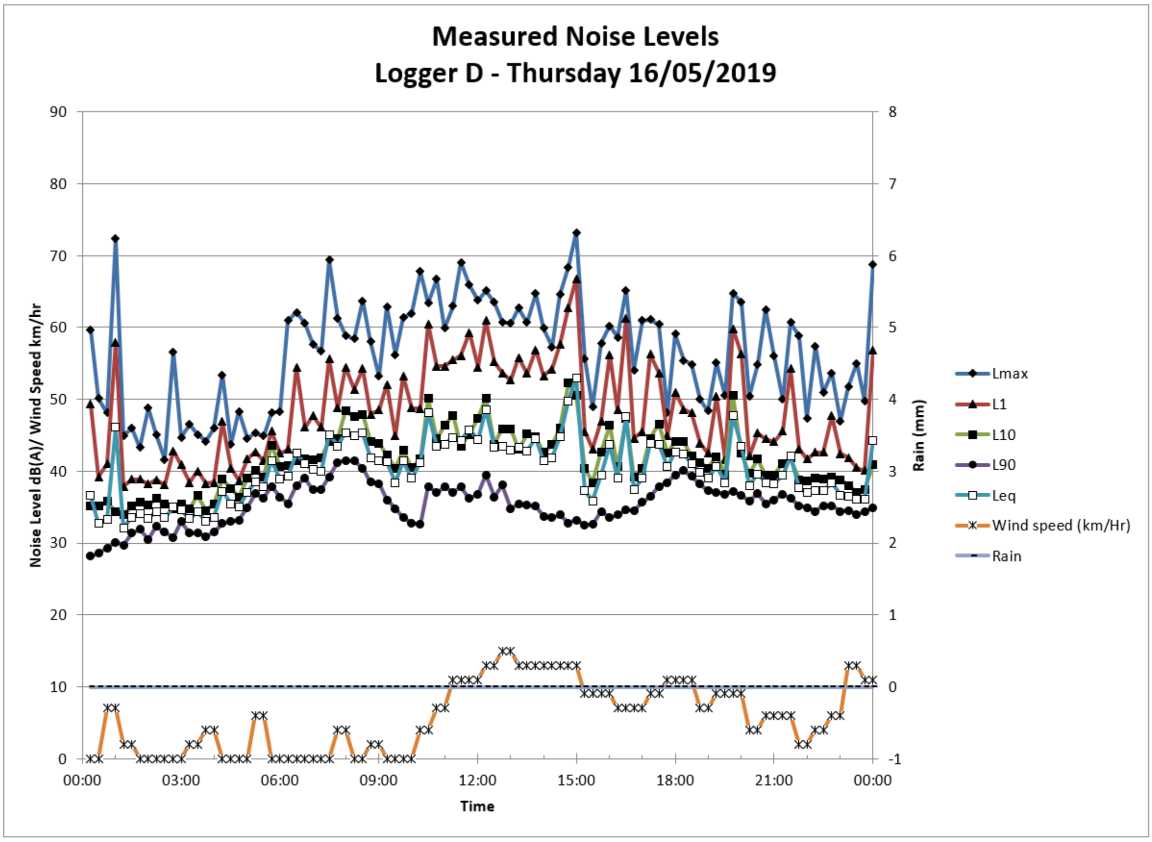


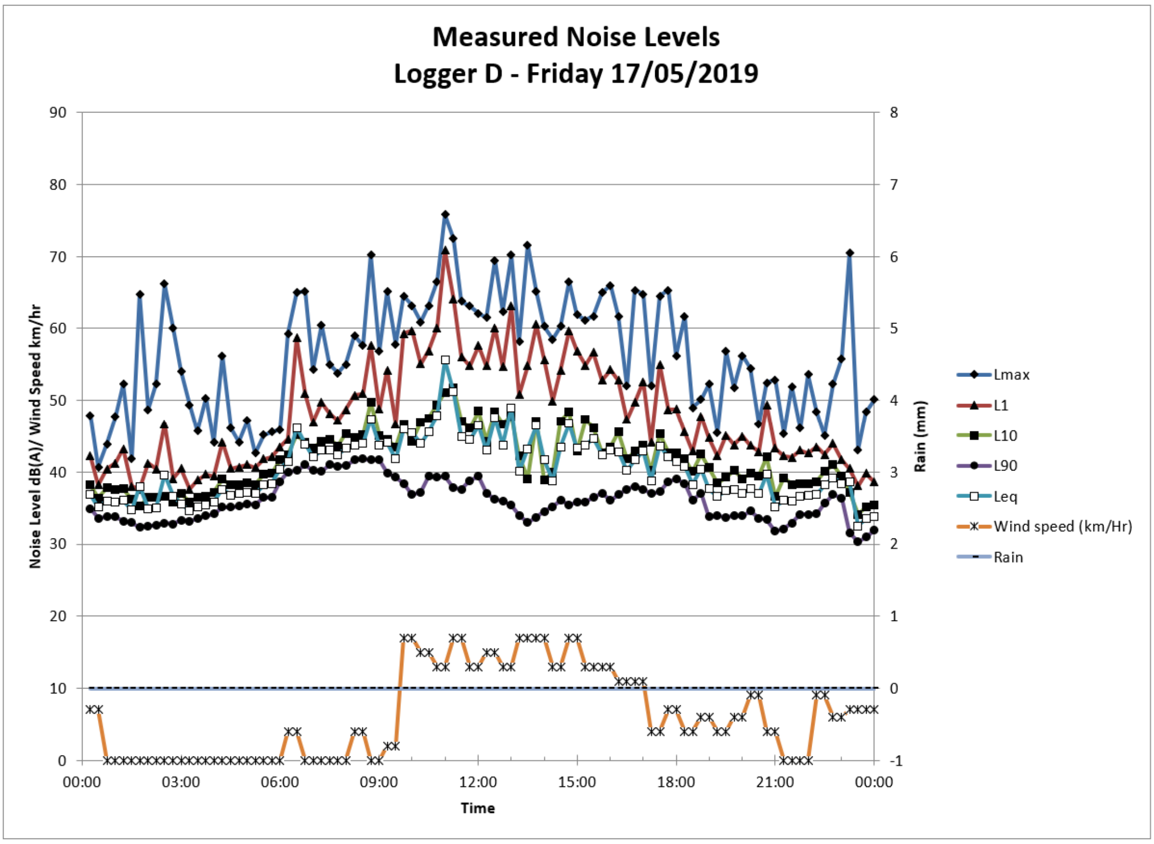
Measured Noise Levels
Logger D - Monday 13/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



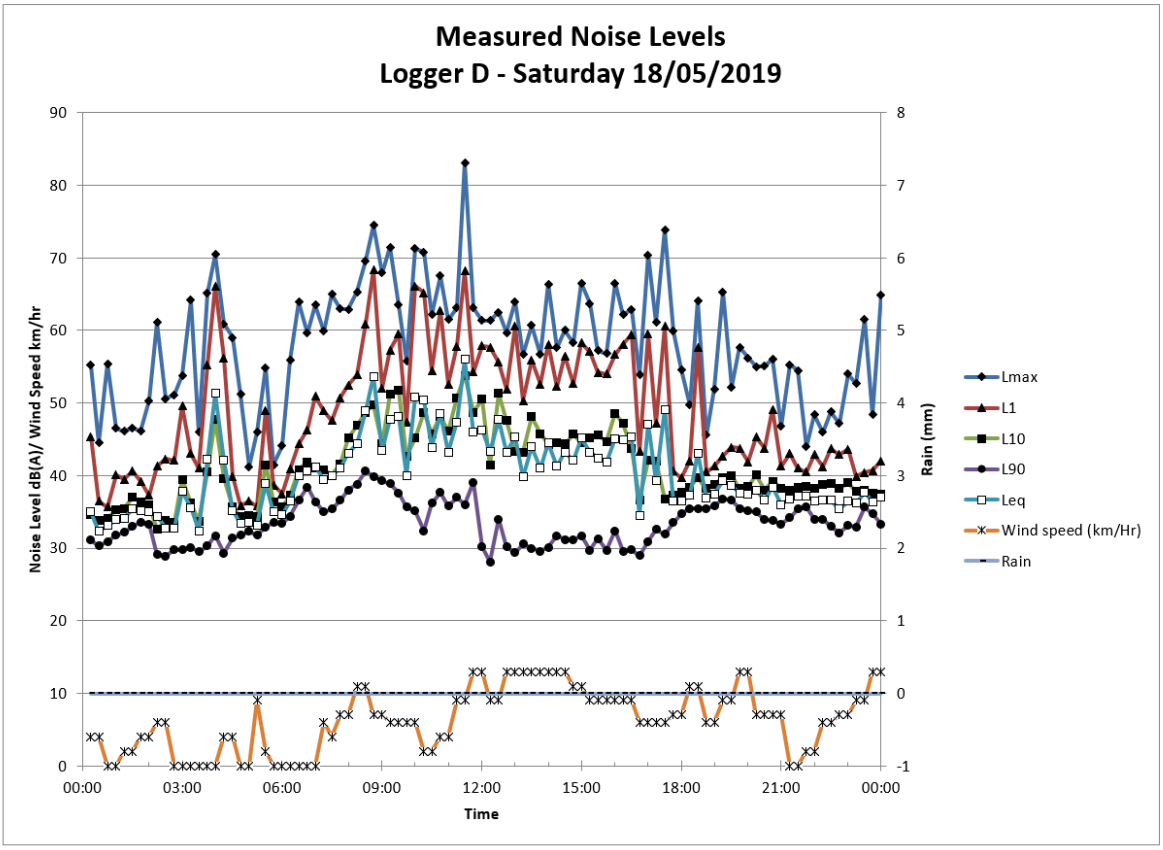
Measured Noise Levels
Logger D - Tuesday 14/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Logger D - Wednesday 15/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

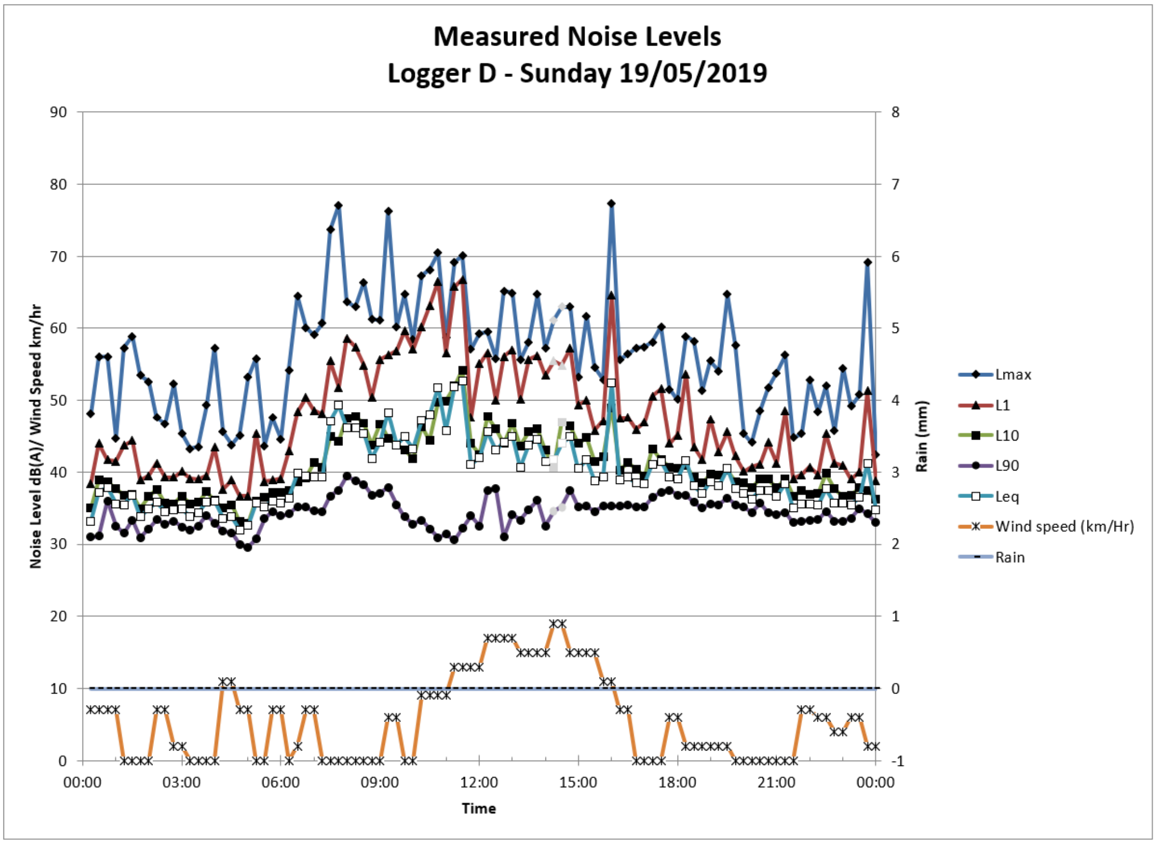

Measured Noise Levels
Logger D - Thursday 16/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



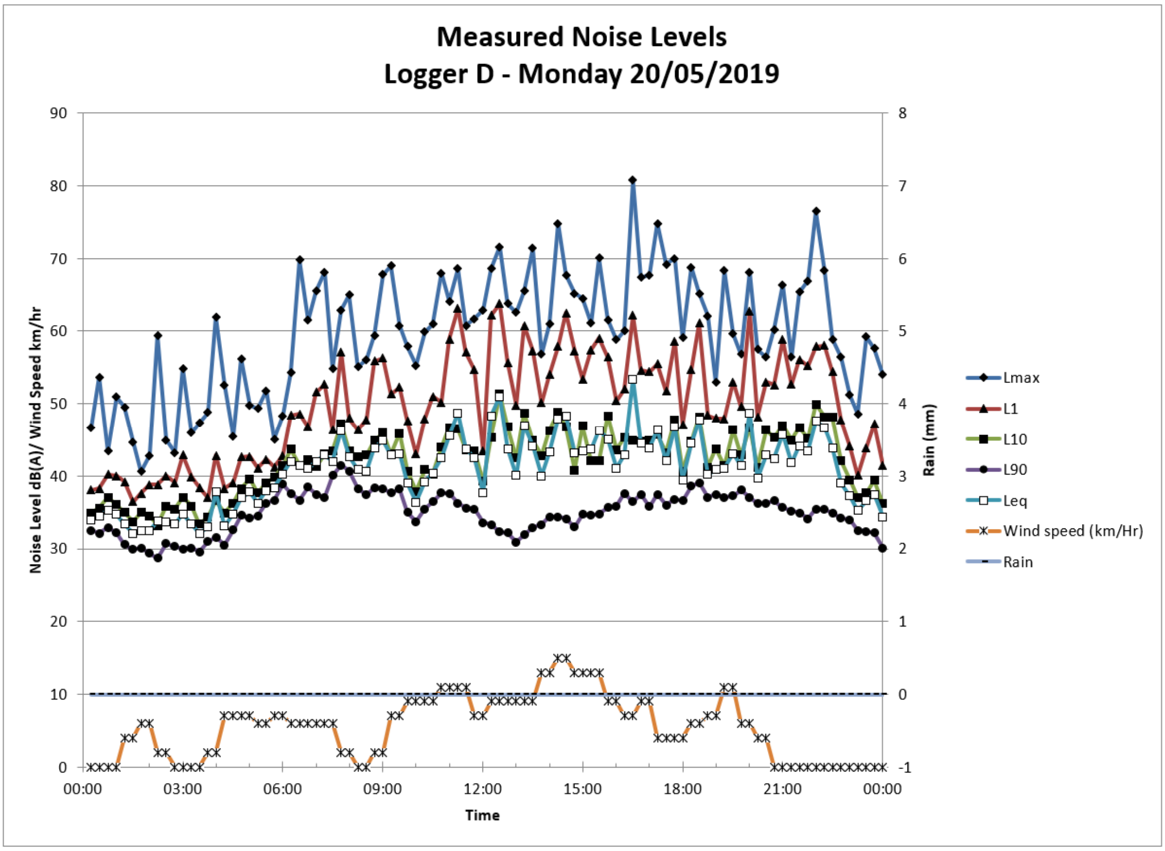
Measured Noise Levels
Logger D - Friday 17/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



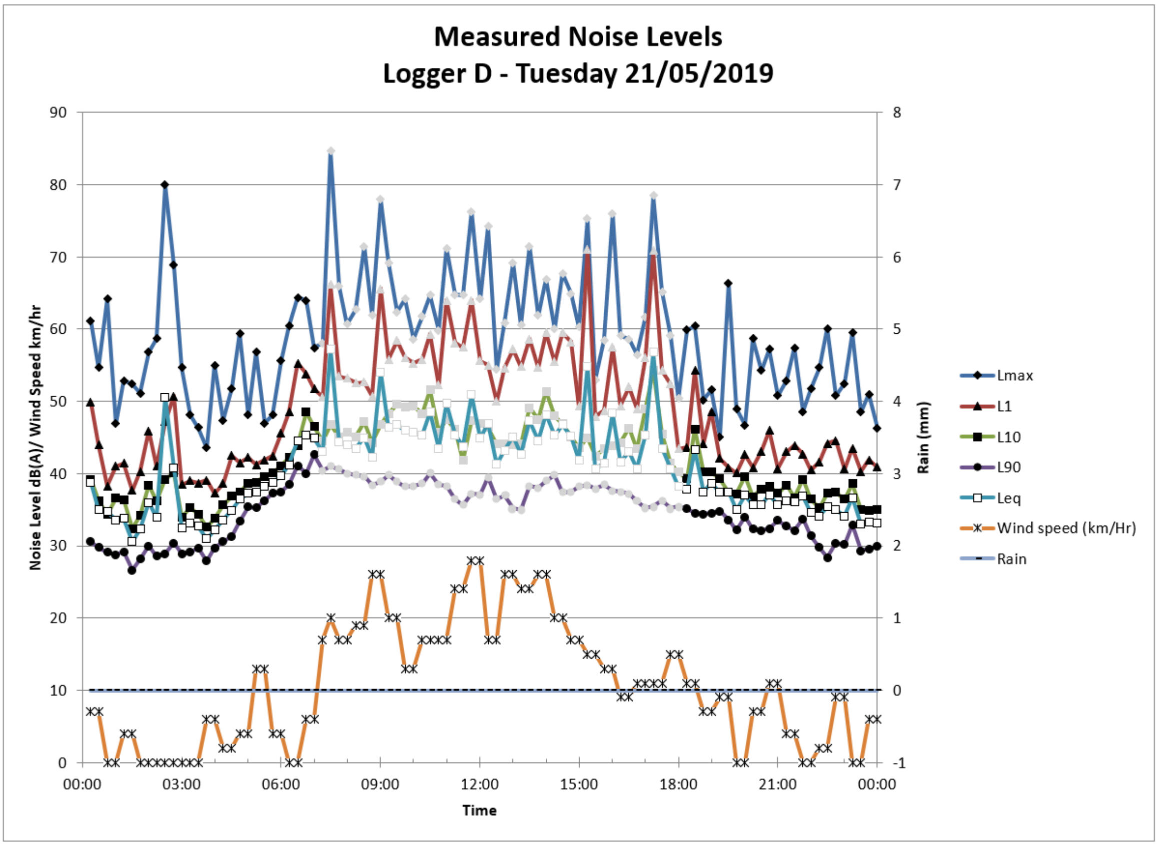
Measured Noise Levels
Logger D - Saturday 18/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



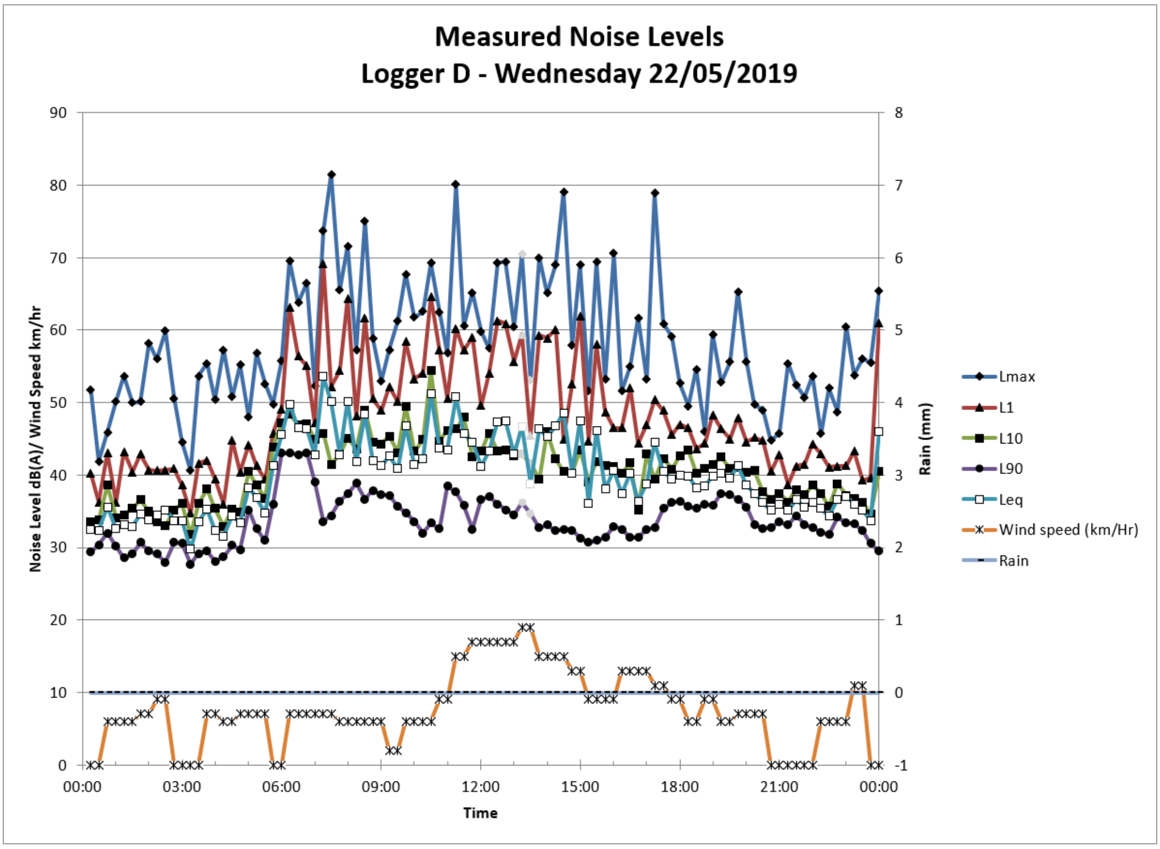
Measured Noise Levels
Logger D - Sunday 19/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



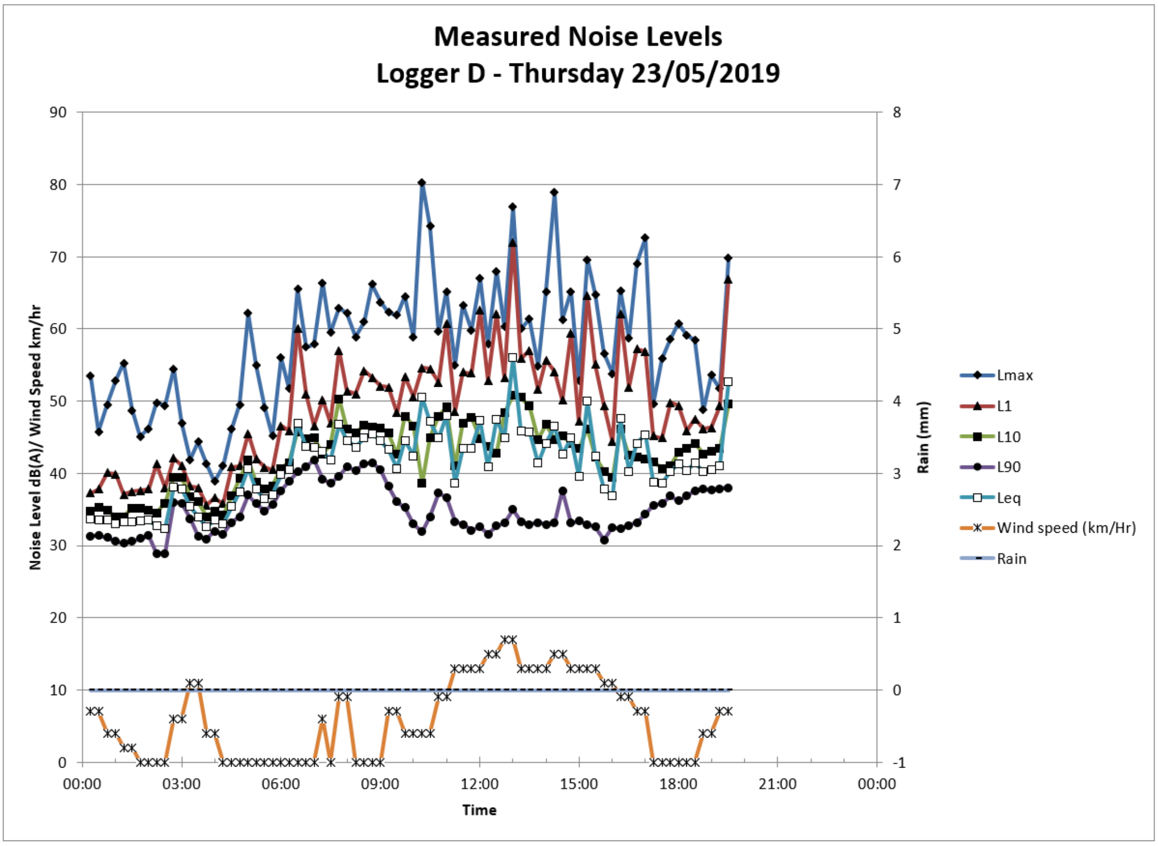
Measured Noise Levels
Logger D - Monday 20/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



Measured Noise Levels
Logger D - Tuesday 21/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



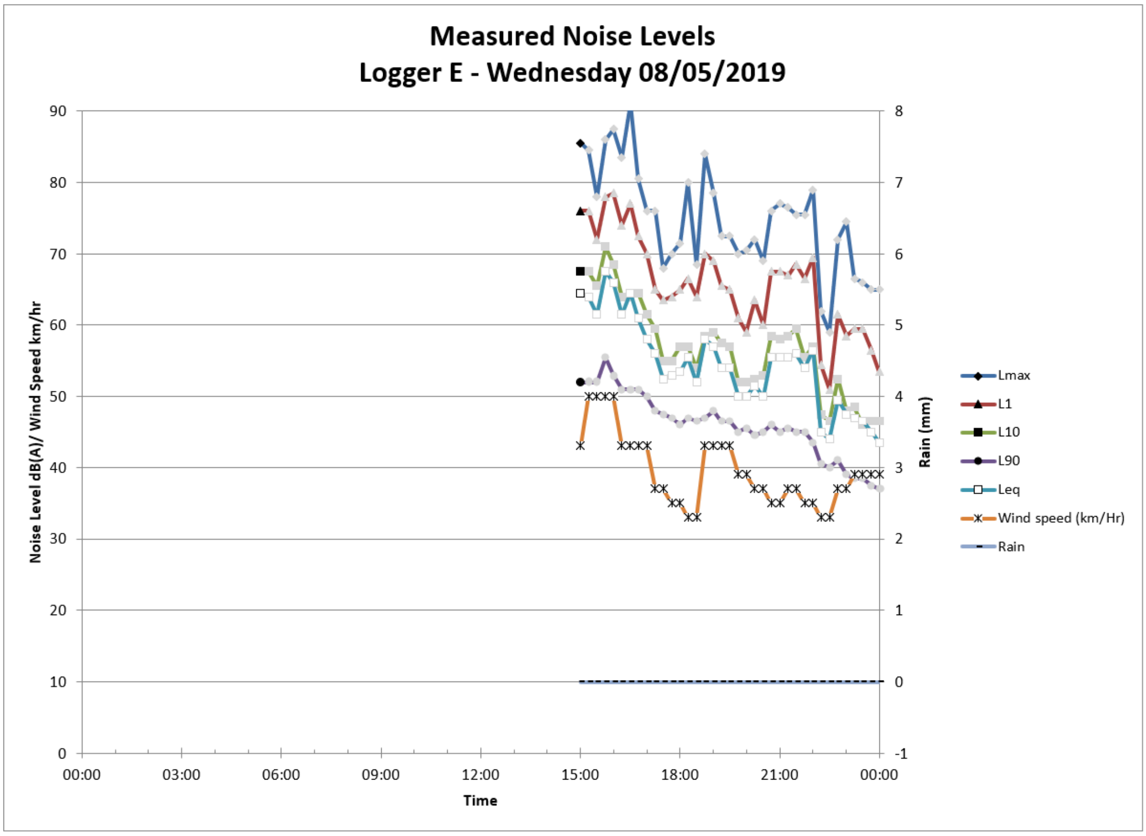
Measured Noise Levels
Logger D - Wednesday 22/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



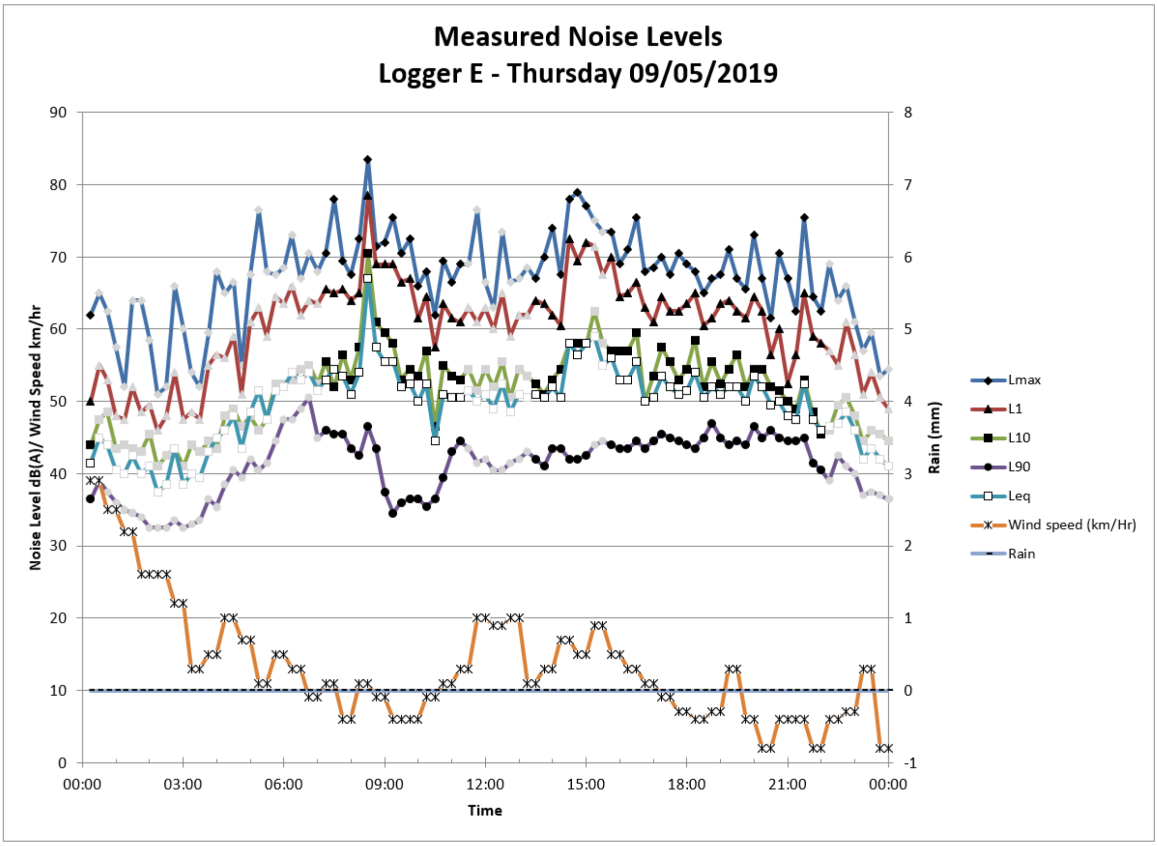
Measured Noise Levels
Logger D - Thursday 23/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

Table 5: Logger E Results

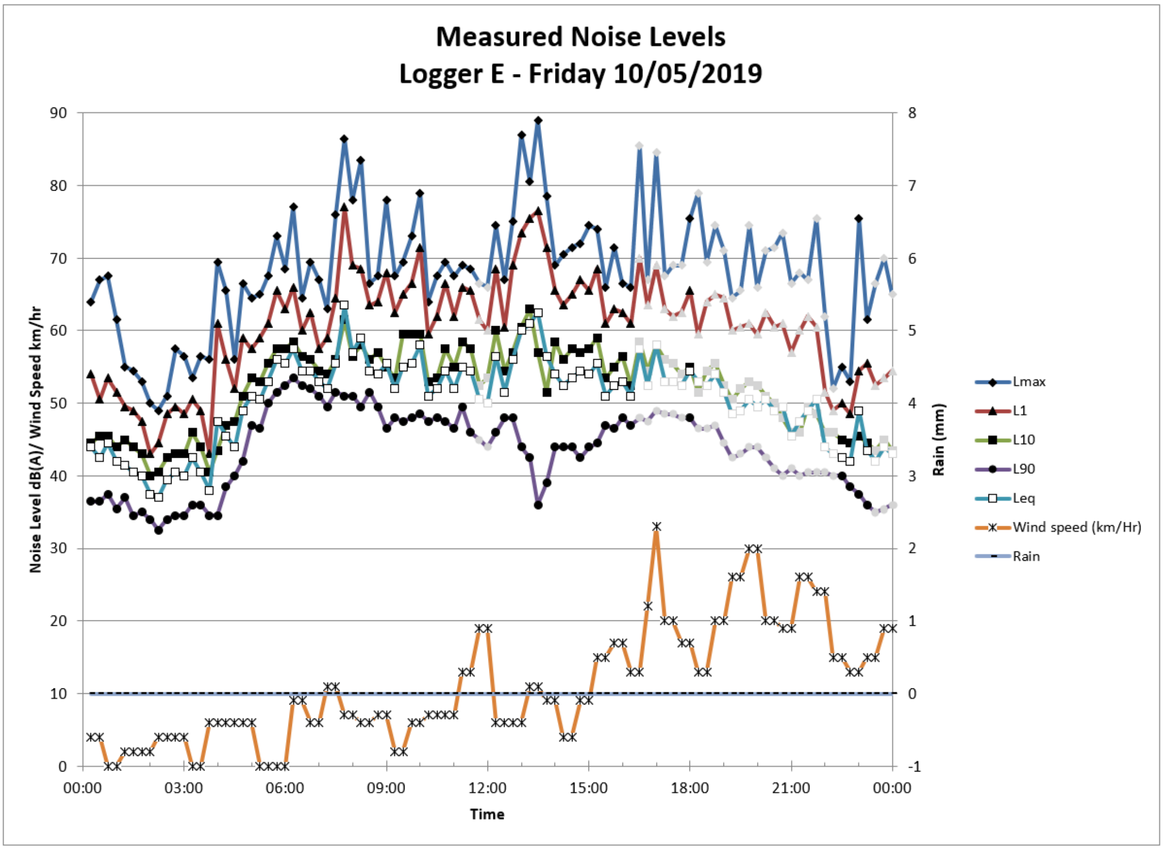
	Average L1			Average L10			ABL (L90)			Leq		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
8/05/2019	-	-	-	-	-	-	-	-	-	-	-	-
9/05/2019	65	61	-	56	53	-	37	43	-	56	51	-
10/05/2019	66	-	54	57	-	48	43	-	35	56	-	50
11/05/2019	-	-	-	-	-	-	-	-	-	-	-	-
12/05/2019	-	59	-	-	50	-	-	42	-	-	49	-
13/05/2019	-	59	53	-	51	48	-	40	34	-	49	48
14/05/2019	-	61	54	-	52	47	-	42	33	-	52	48
15/05/2019	62	61	54	53	51	48	33	40	34	51	51	48
16/05/2019	64	60	54	55	52	47	32	43	33	54	50	47
17/05/2019	64	59	56	55	50	50	37	41	35	54	49	52
18/05/2019	64	59	52	55	50	45	31	42	33	54	49	45
19/05/2019	64	59	52	55	51	44	33	42	33	54	51	44
20/05/2019	65	61	56	56	51	48	39	41	34	56	51	50
21/05/2019	64	61	57	56	52	50	44	42	35	54	52	51
22/05/2019	64	64	57	55	53	50	32	44	34	54	53	51
Average	64	60	54	55	51	48	36	42	34	54	51	49
Median	64	60	54	55	51	48	**35**	**42**	**34**	54	51	48
Log Average	65	61	55	55	51	48	38	42	34	**55**	**51**	**49**

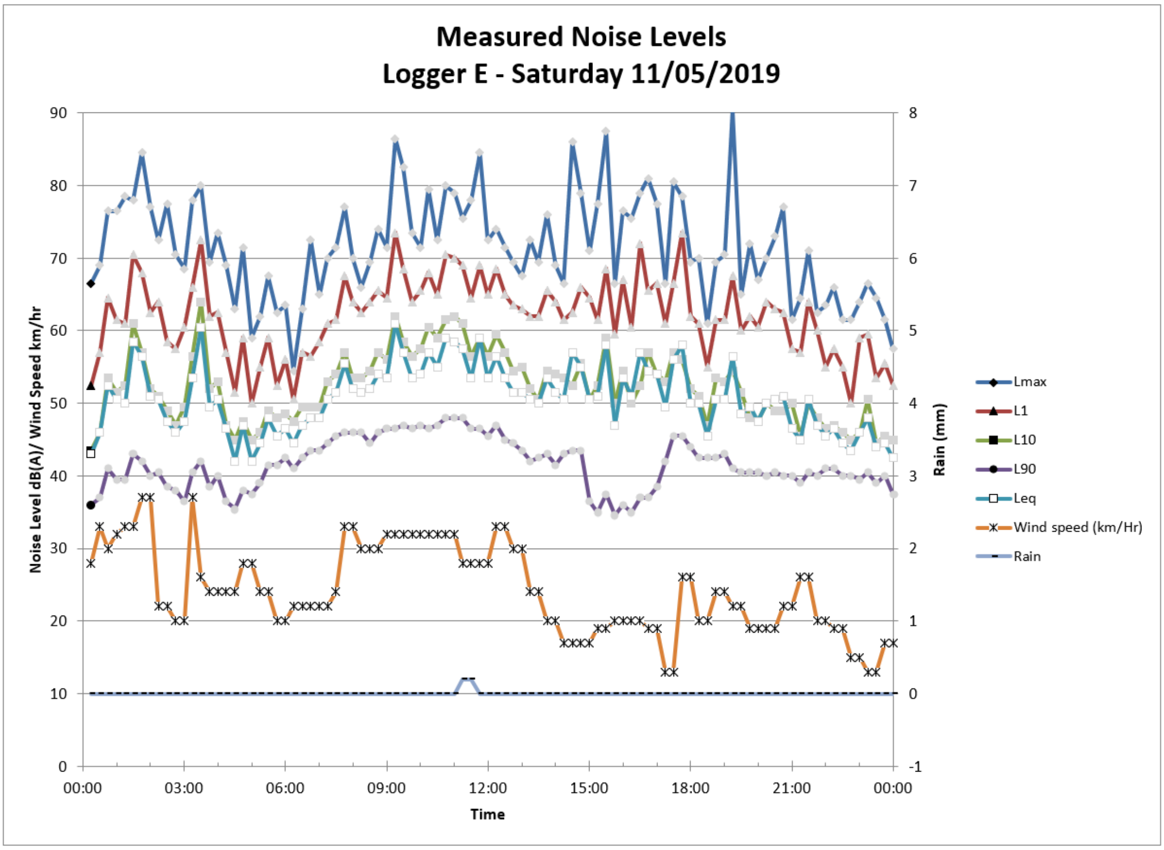


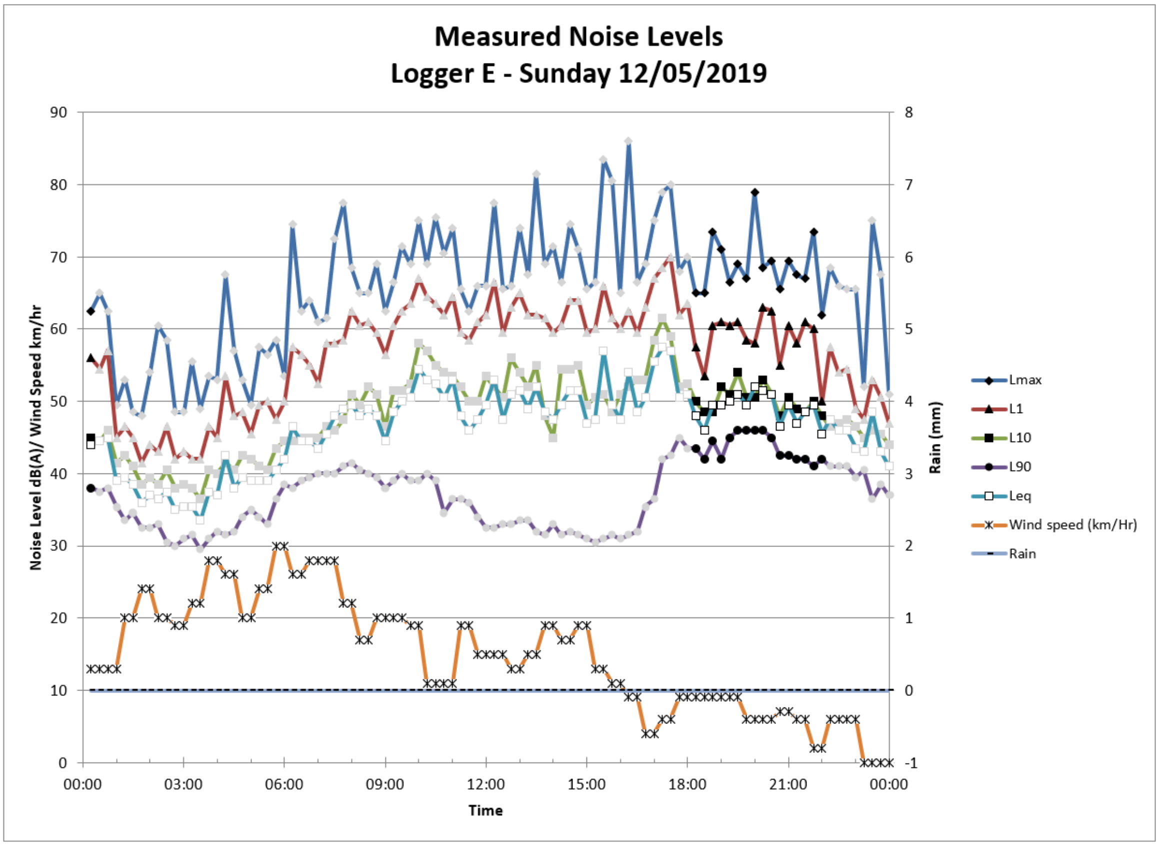
Measured Noise Levels
Logger E - Wednesday 08/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

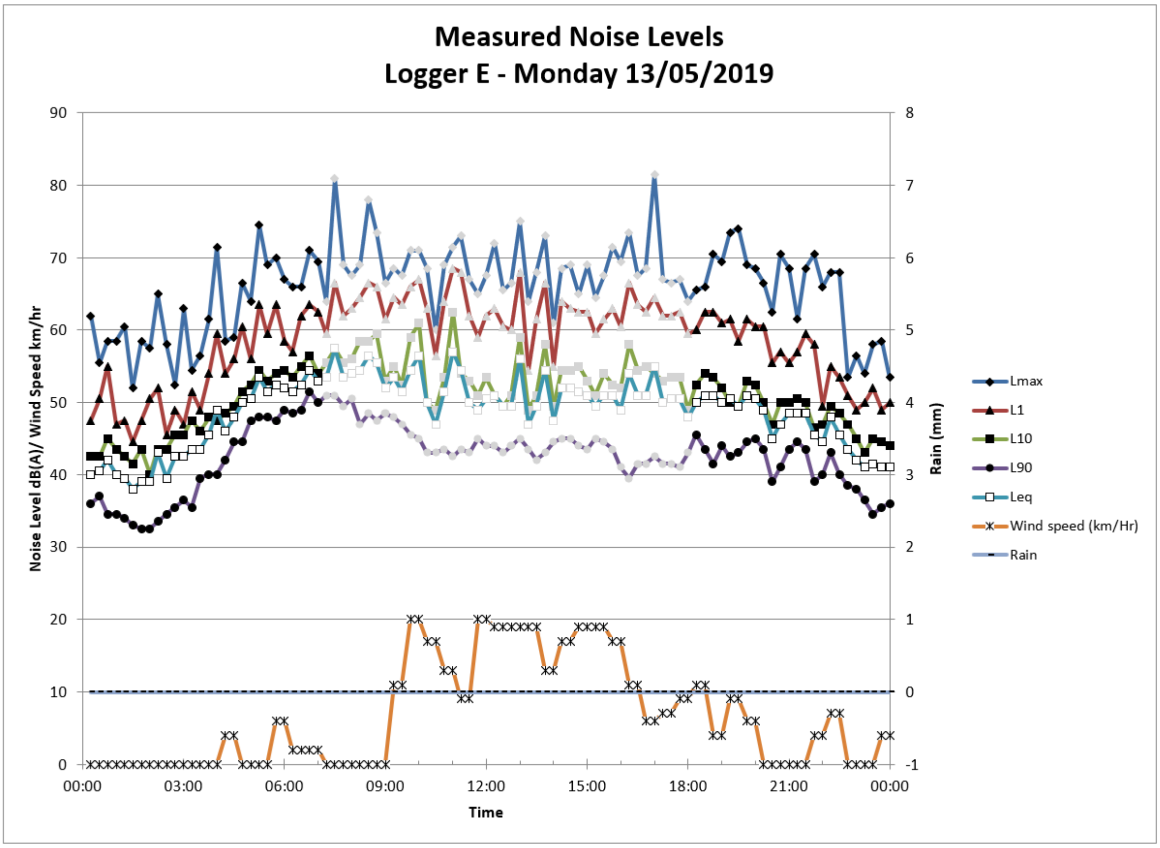


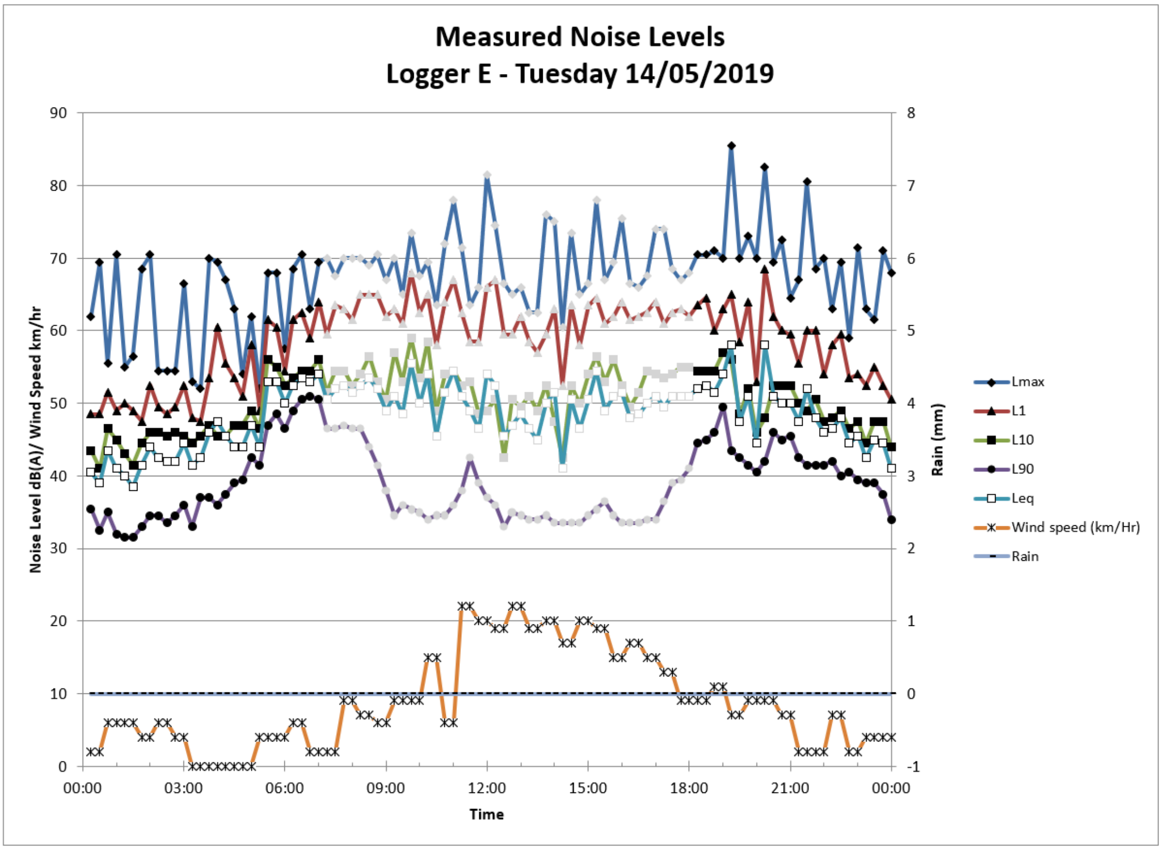
Measured Noise Levels
Logger E - Thursday 09/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Logger E - Friday 10/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

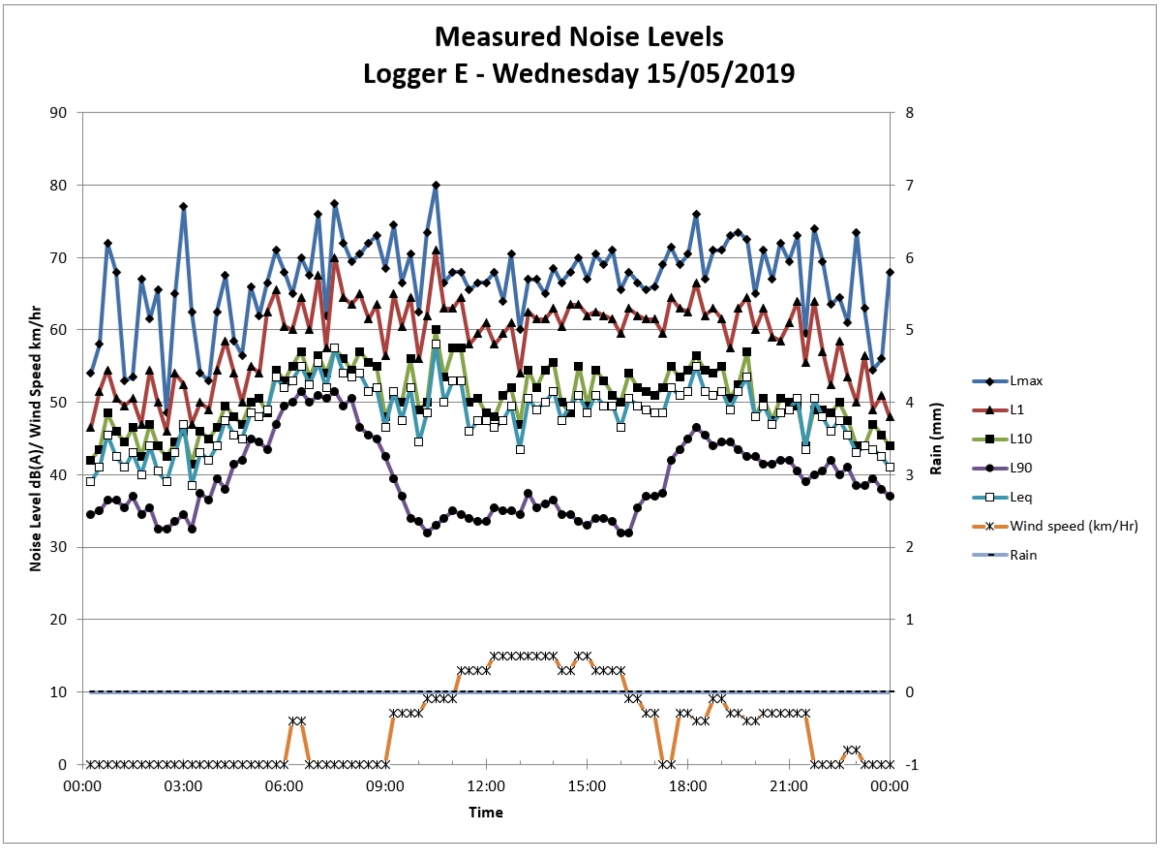

Measured Noise Levels
Logger E - Saturday 11/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Logger E - Sunday 12/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

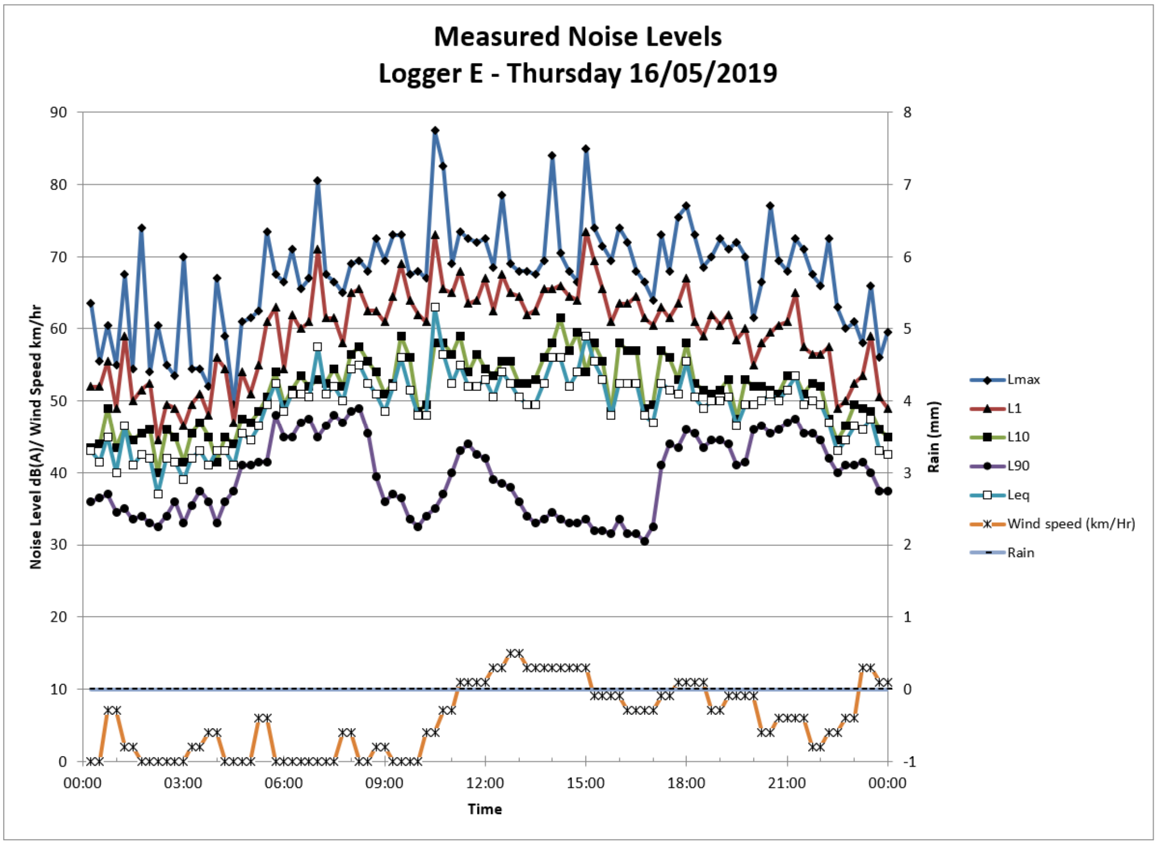

Measured Noise Levels
Logger E - Monday 13/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

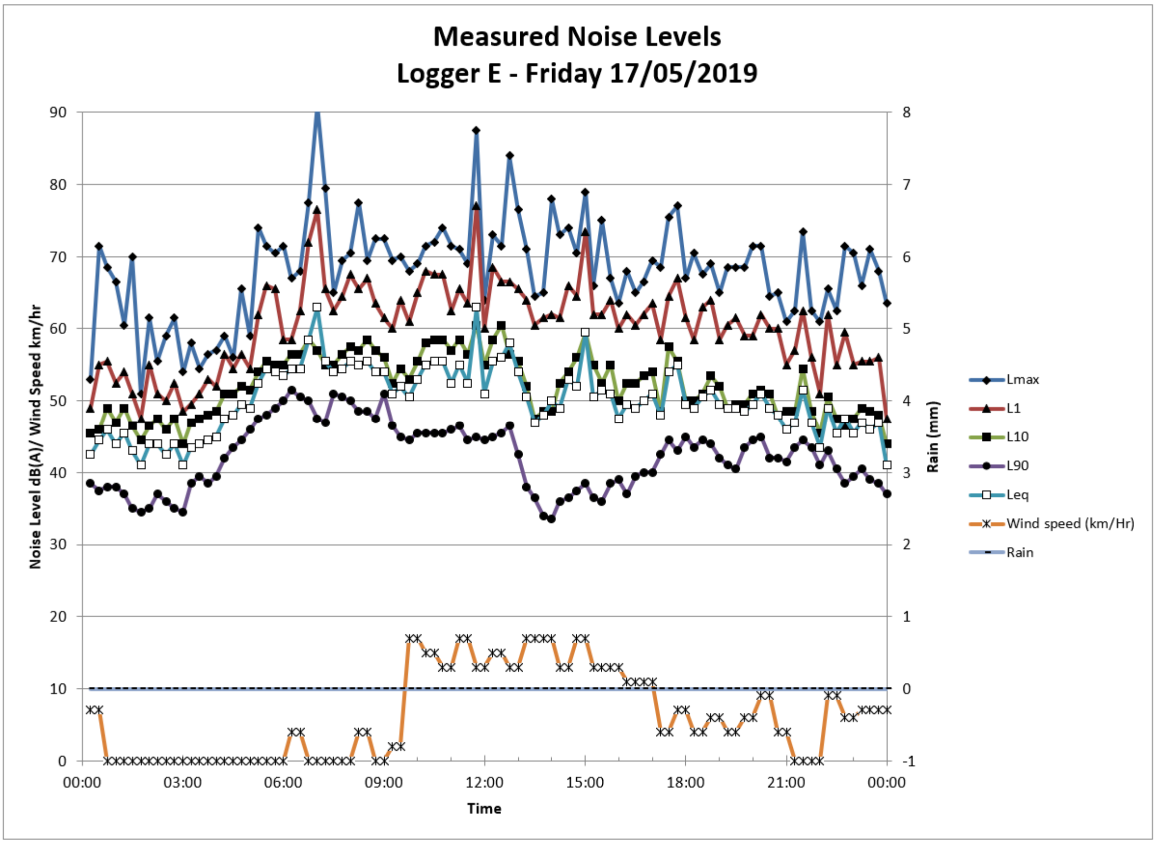


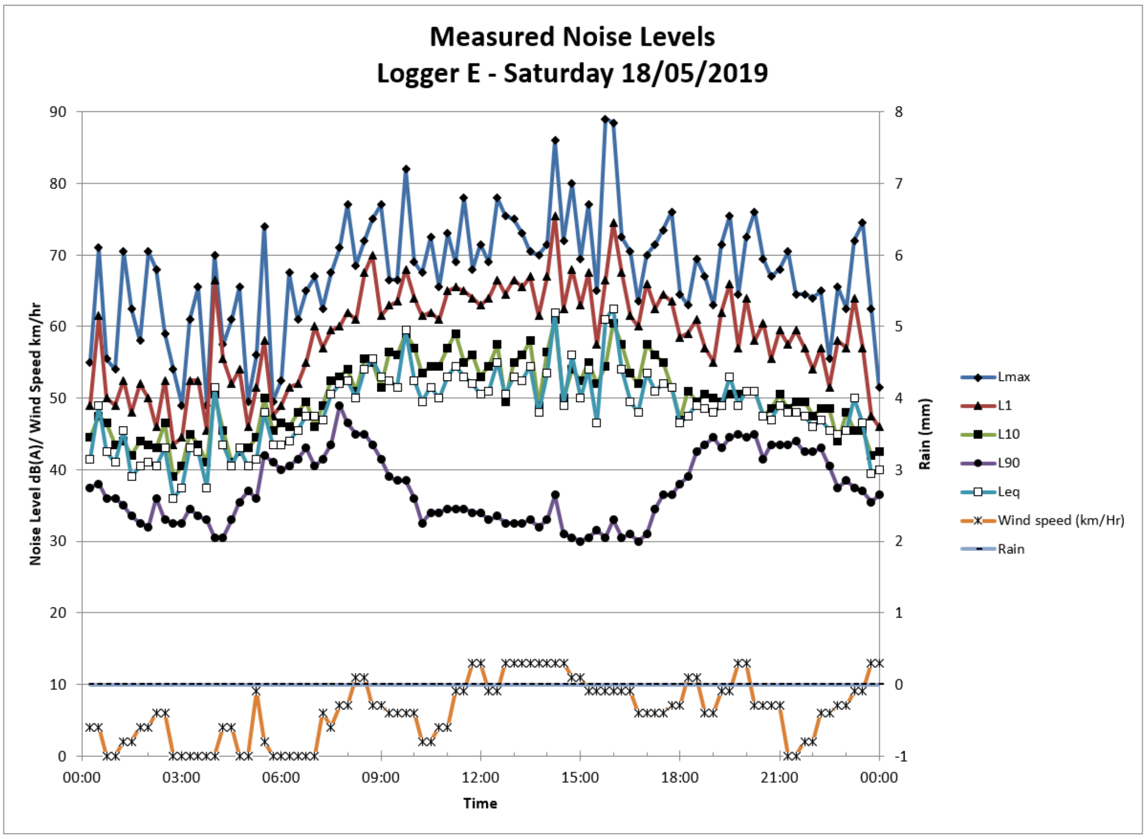
Measured Noise Levels
Logger E - Tuesday 14/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



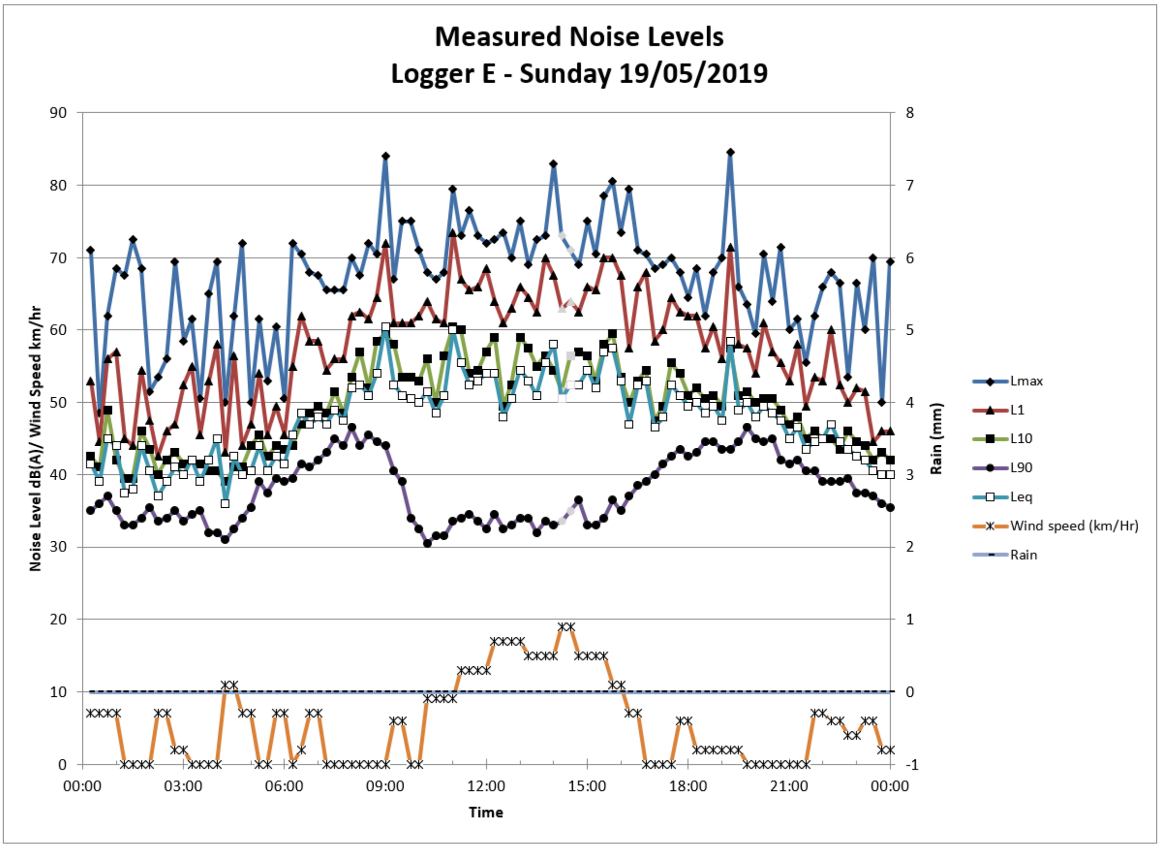
Measured Noise Levels
Logger E - Wednesday 15/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Logger E - Thursday 16/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00

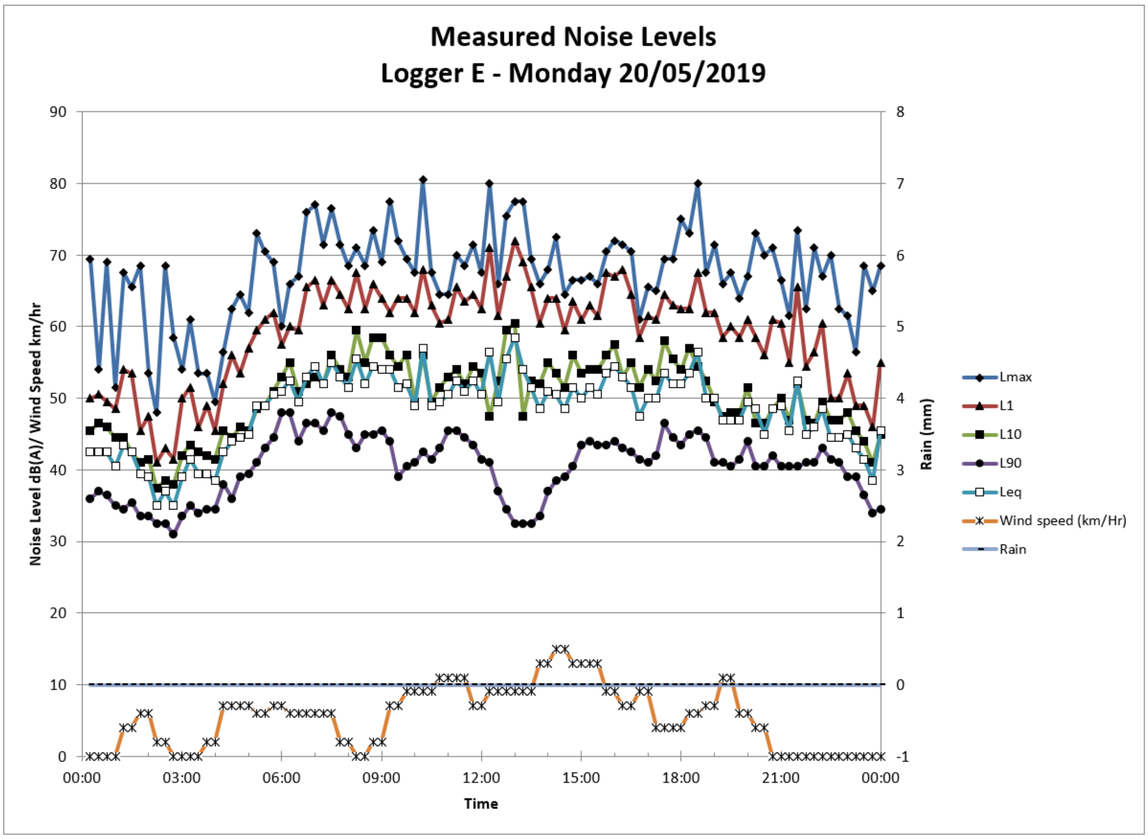

Measured Noise Levels
Logger E - Friday 17/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
1
0
-1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00



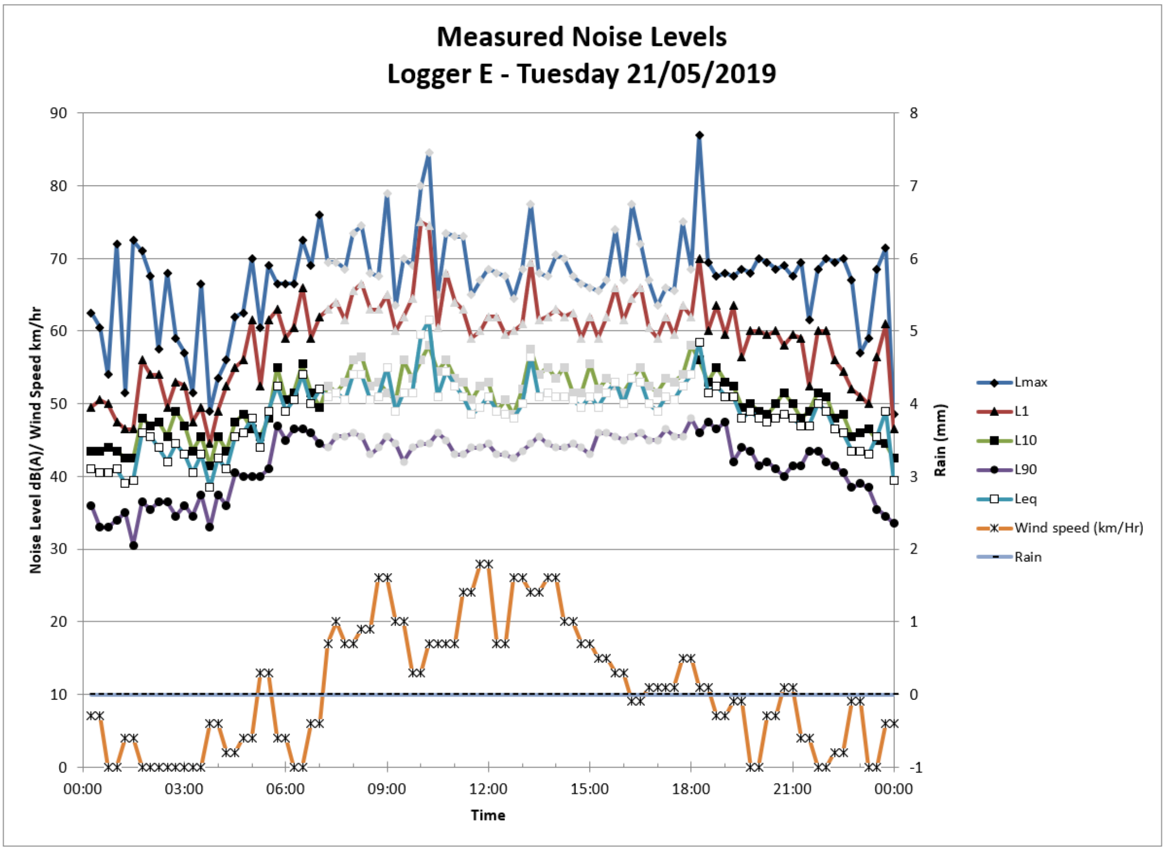
Measured Noise Levels
Logger E - Saturday 18/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



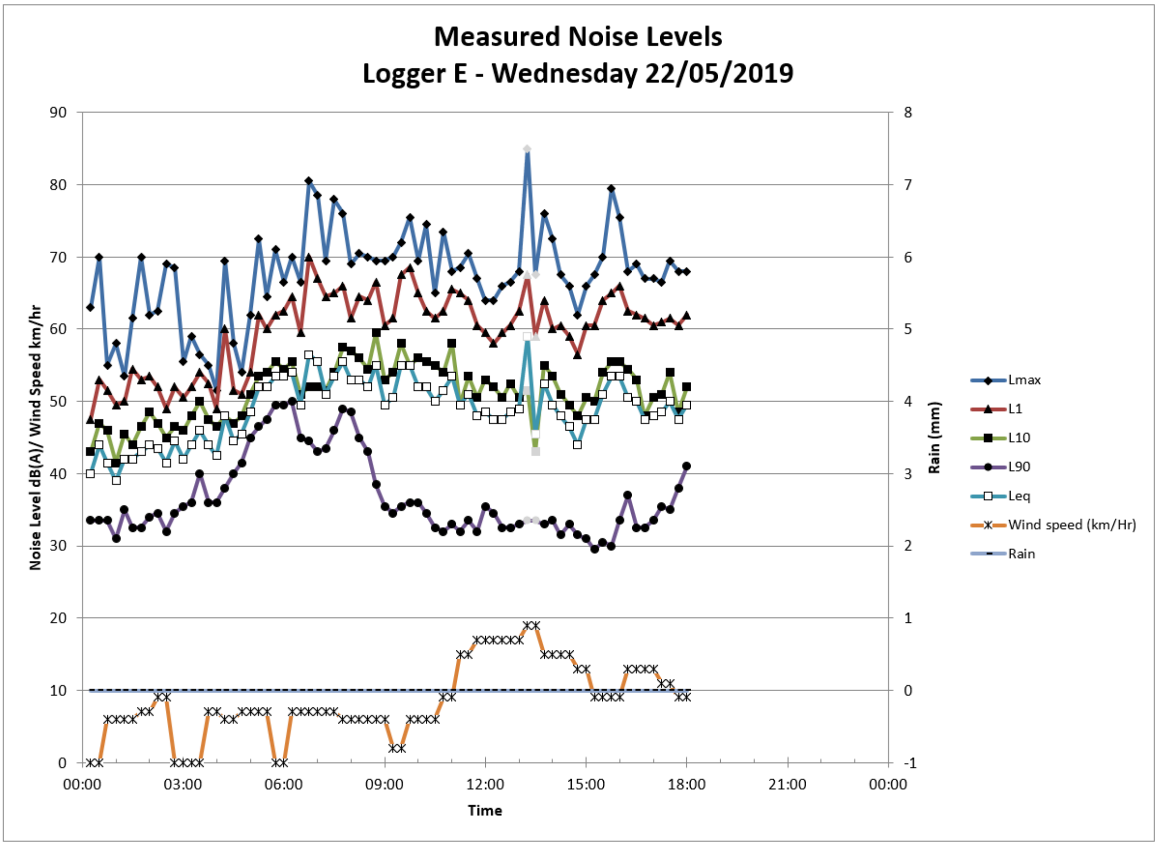
Measured Noise Levels
Logger E - Sunday 19/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



Measured Noise Levels
Logger E - Monday 20/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

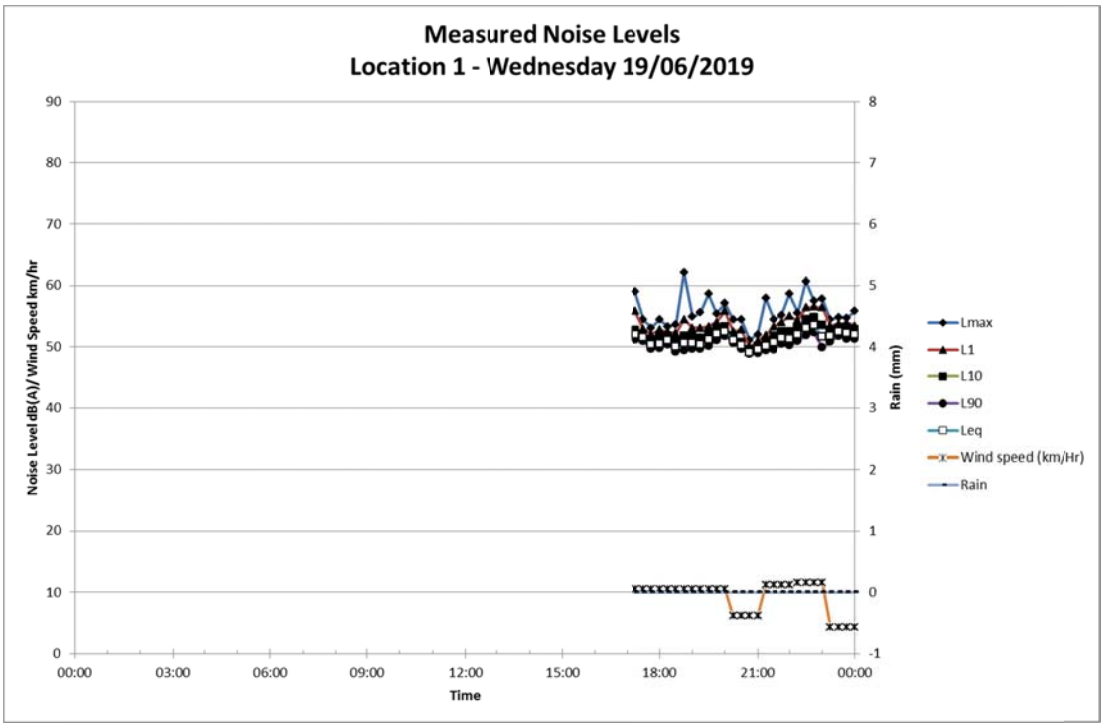


Measured Noise Levels
Logger E - Tuesday 21/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

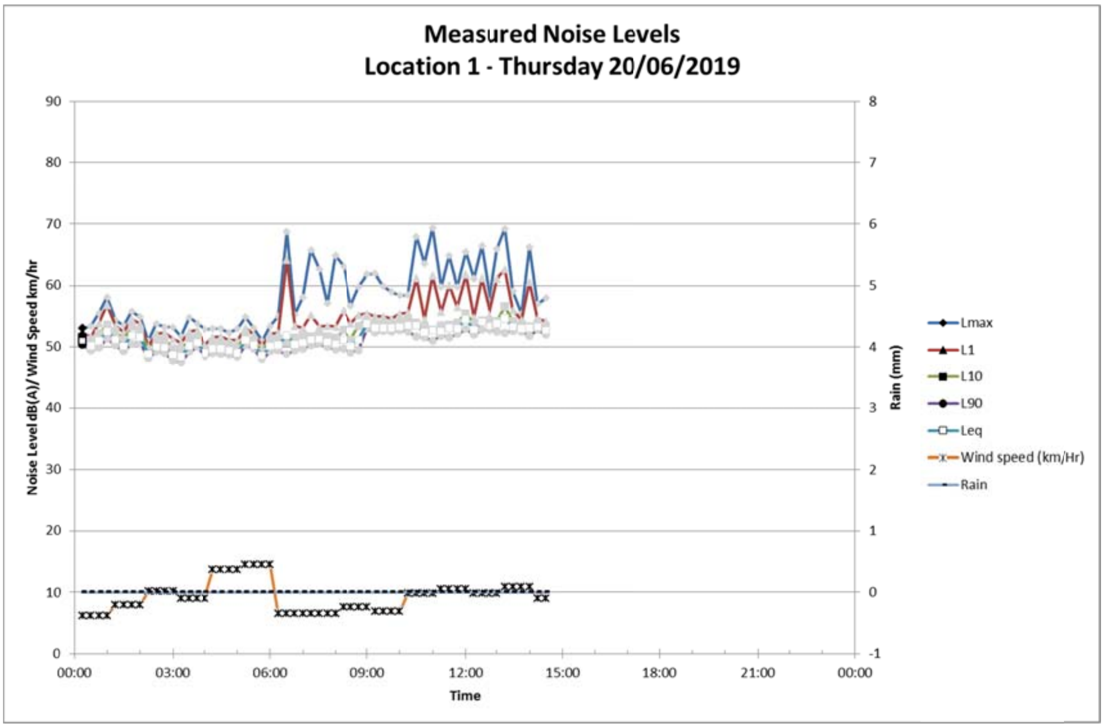


Measured Noise Levels
Logger E - Wednesday 22/05/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

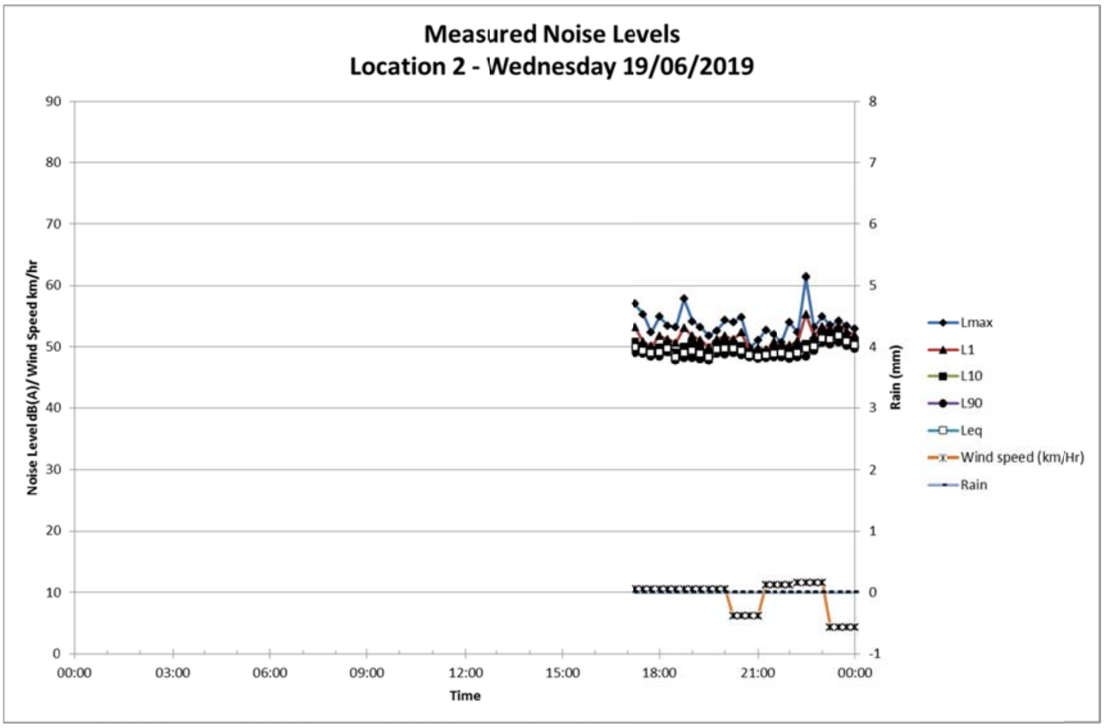
Attachment 6: Tallawarra A – Continuous Operations Noise Graphs 19-20/06/2019



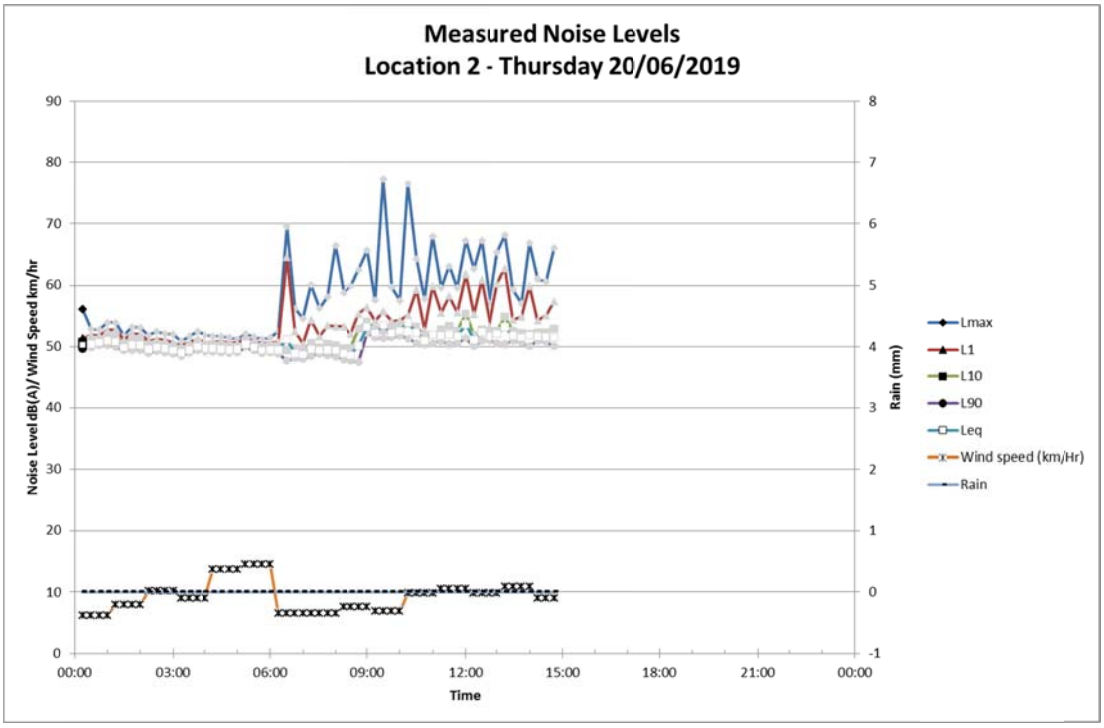
Measured Noise Levels
Location 1 - Wednesday 19/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



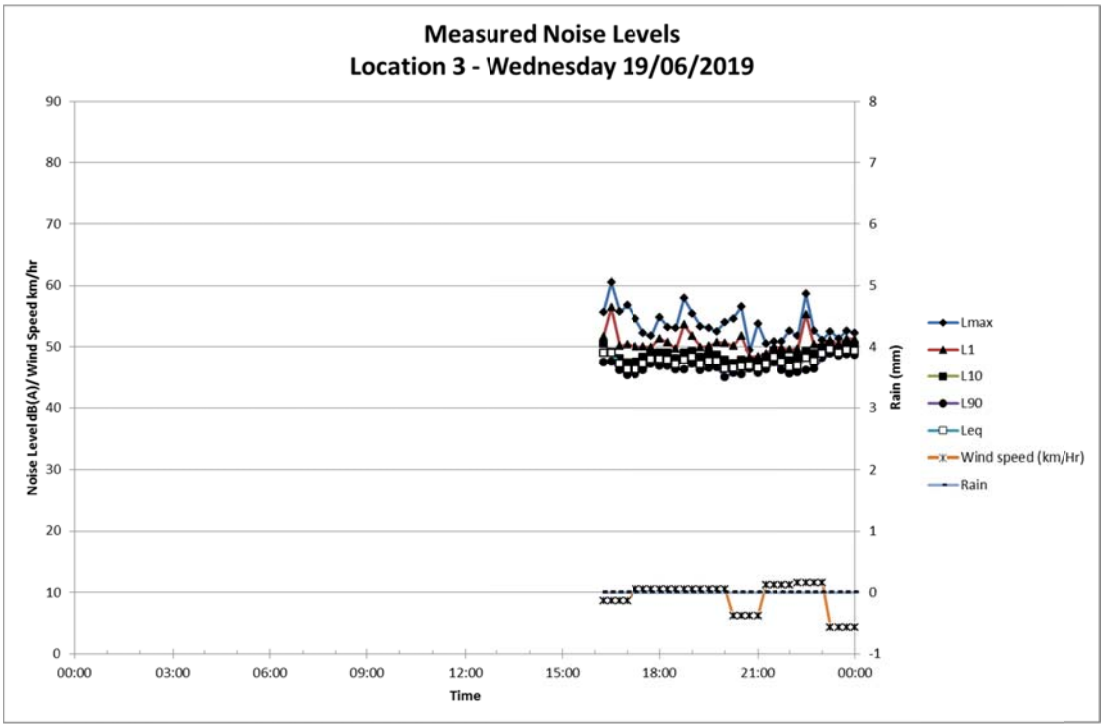
Measured Noise Levels
Location 1 - Thursday 20/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



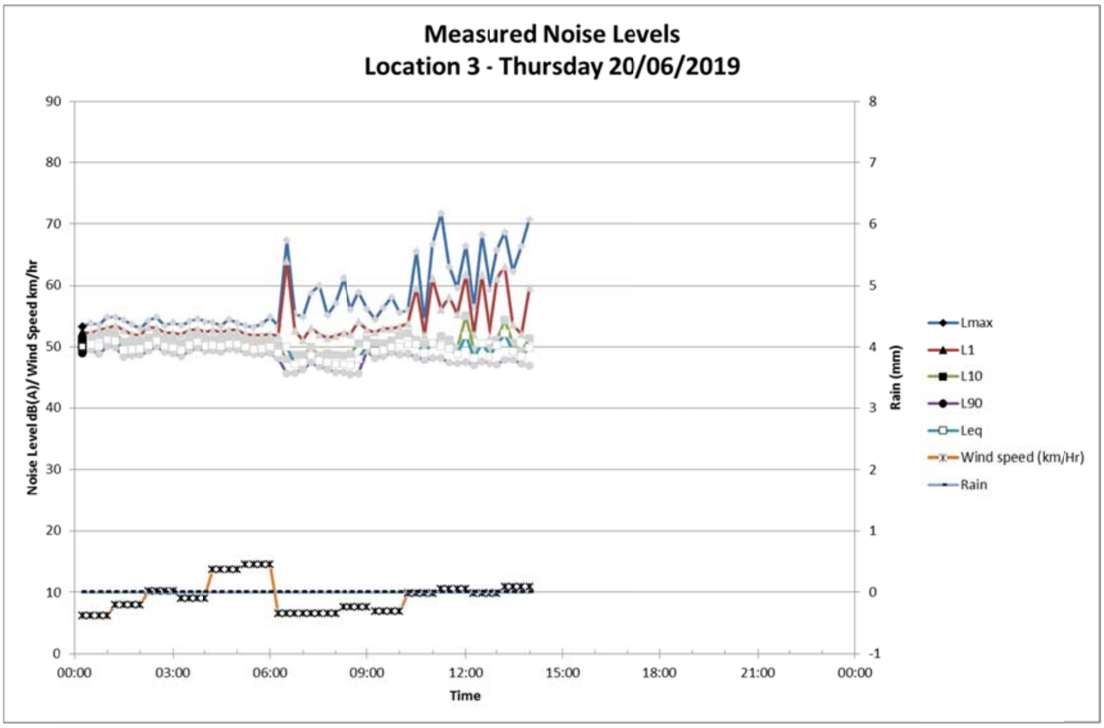
Measured Noise Levels
Location 2 - Wednesday 19/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



Measured Noise Levels
Location 2 - Thursday 20/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

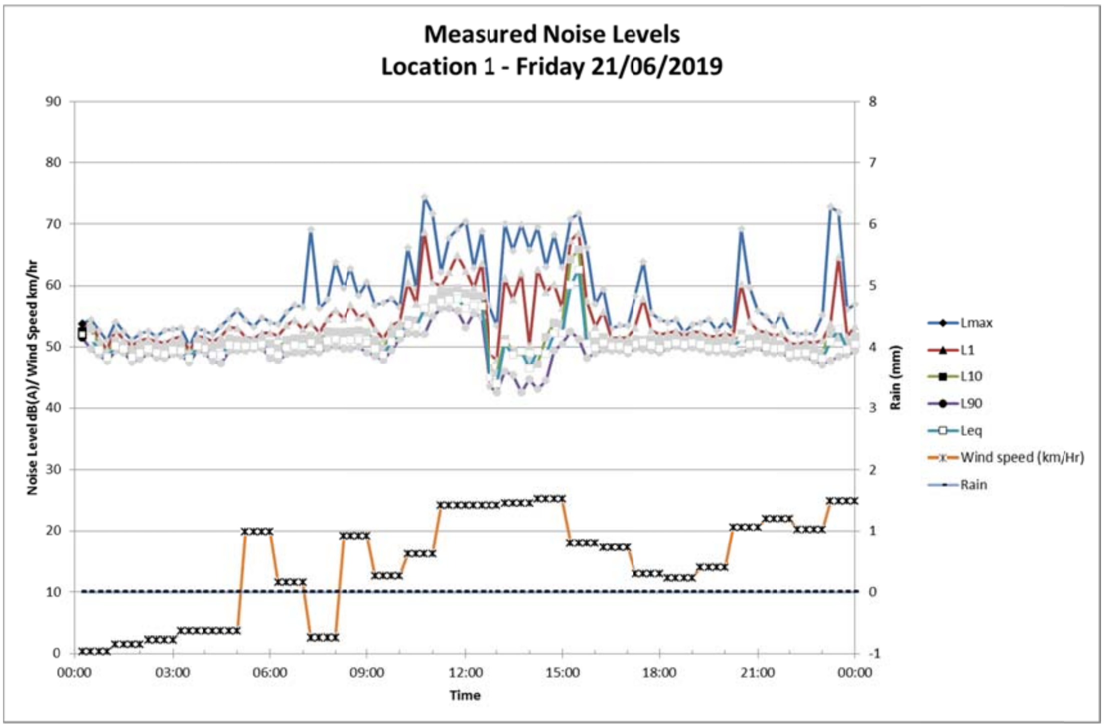


Measured Noise Levels
Location 3 - Wednesday 19/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

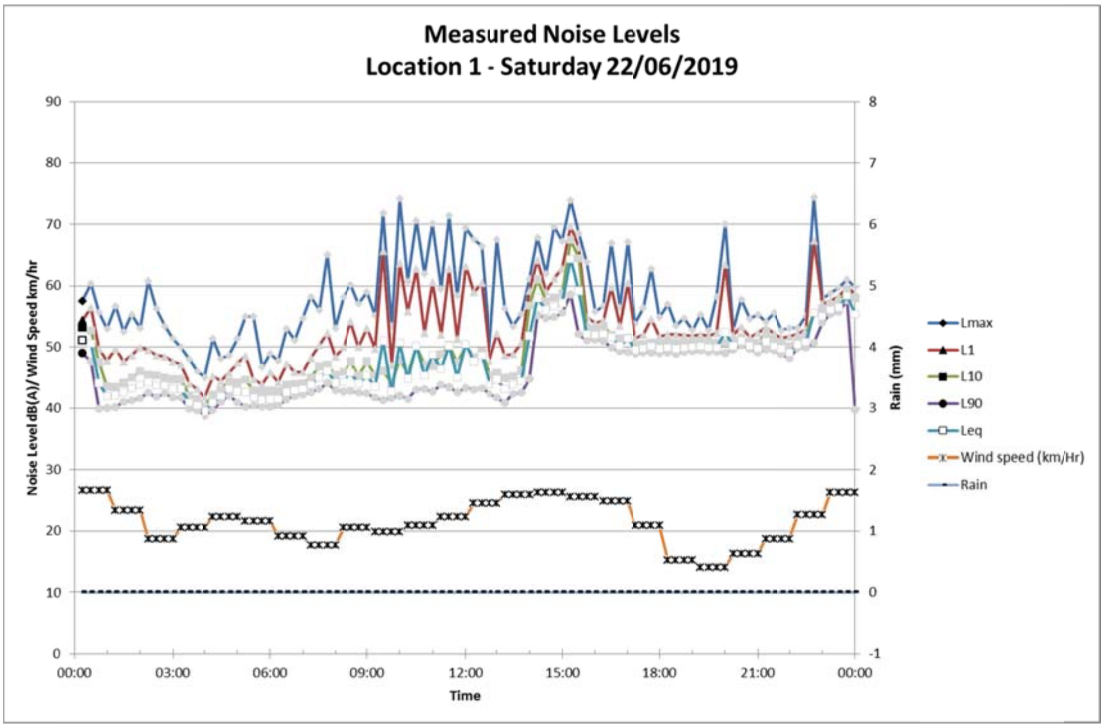


Measured Noise Levels
Location 3 - Thursday 20/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

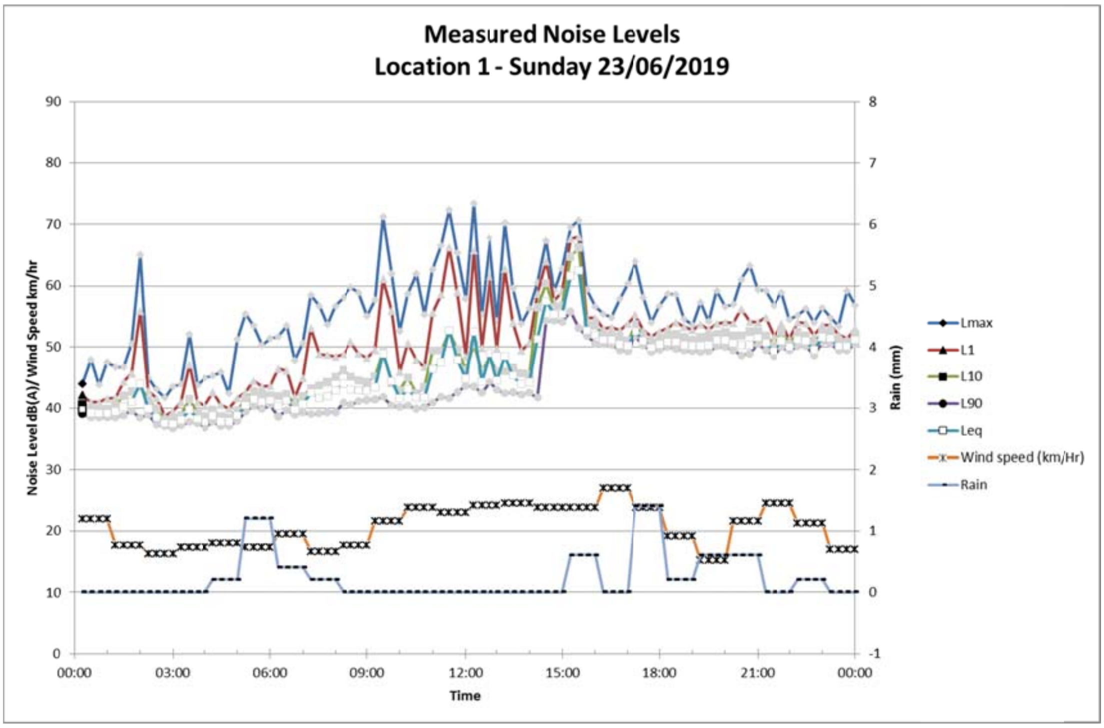
Attachment 7: Tallawarra A – Startup/Shutdown 21-27/06/2019

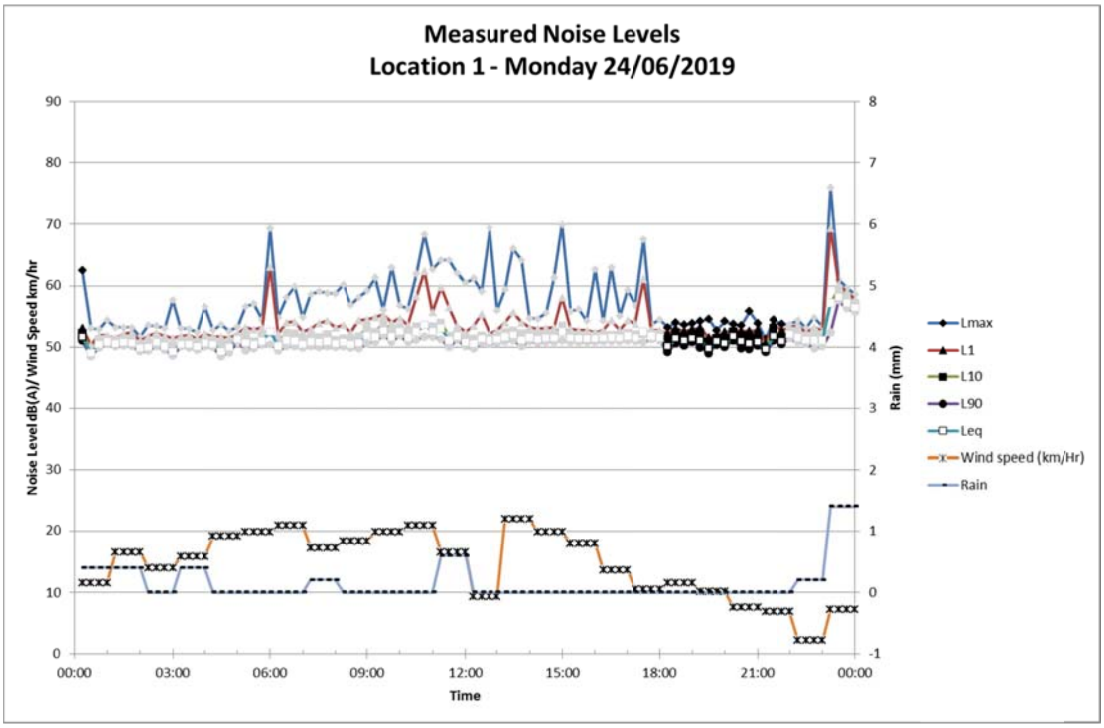


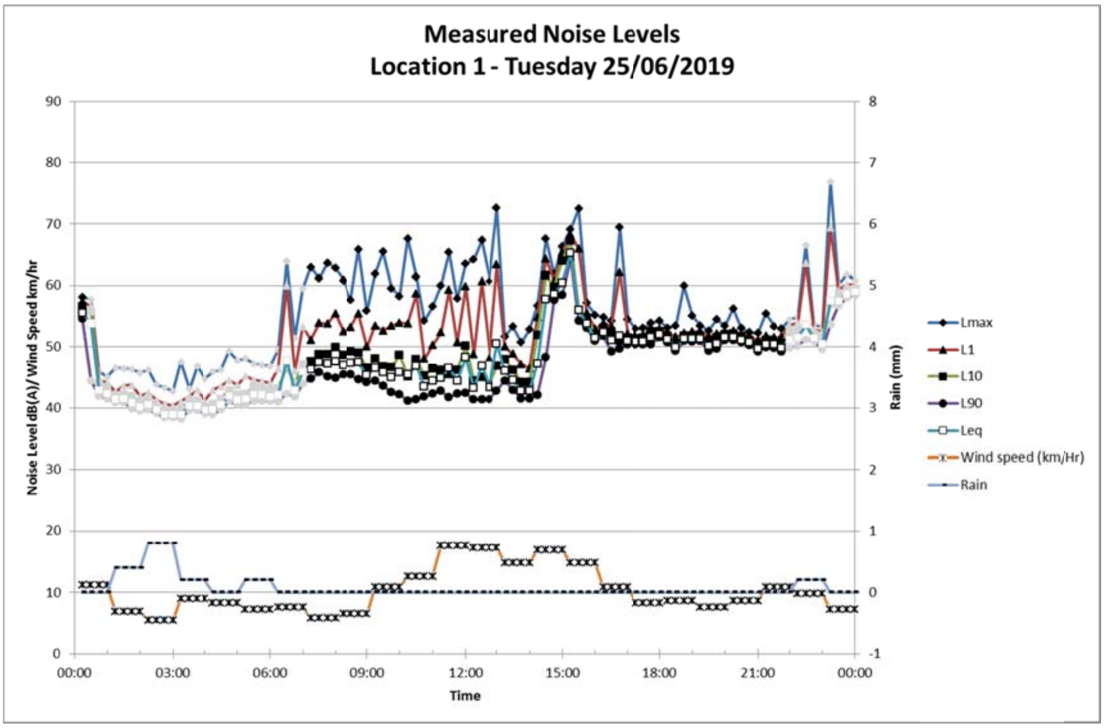
Measured Noise Levels
Location 1 - Friday 21/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



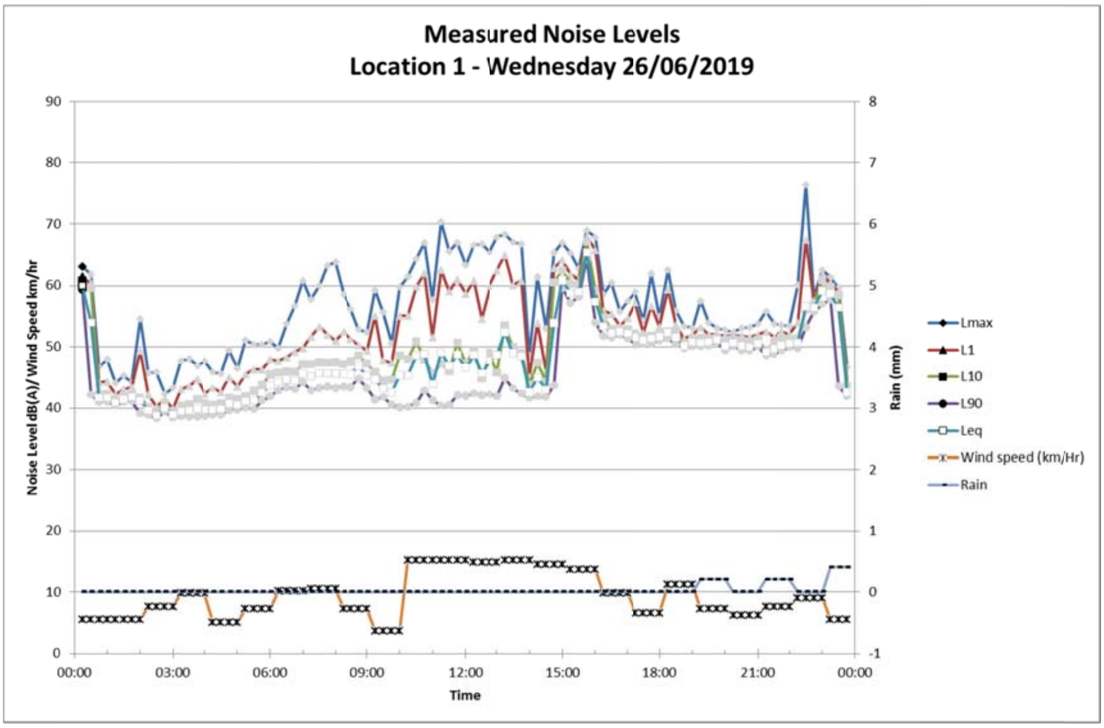
Measured Noise Levels
Location 1 - Saturday 22/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Location 1 - Sunday 23/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

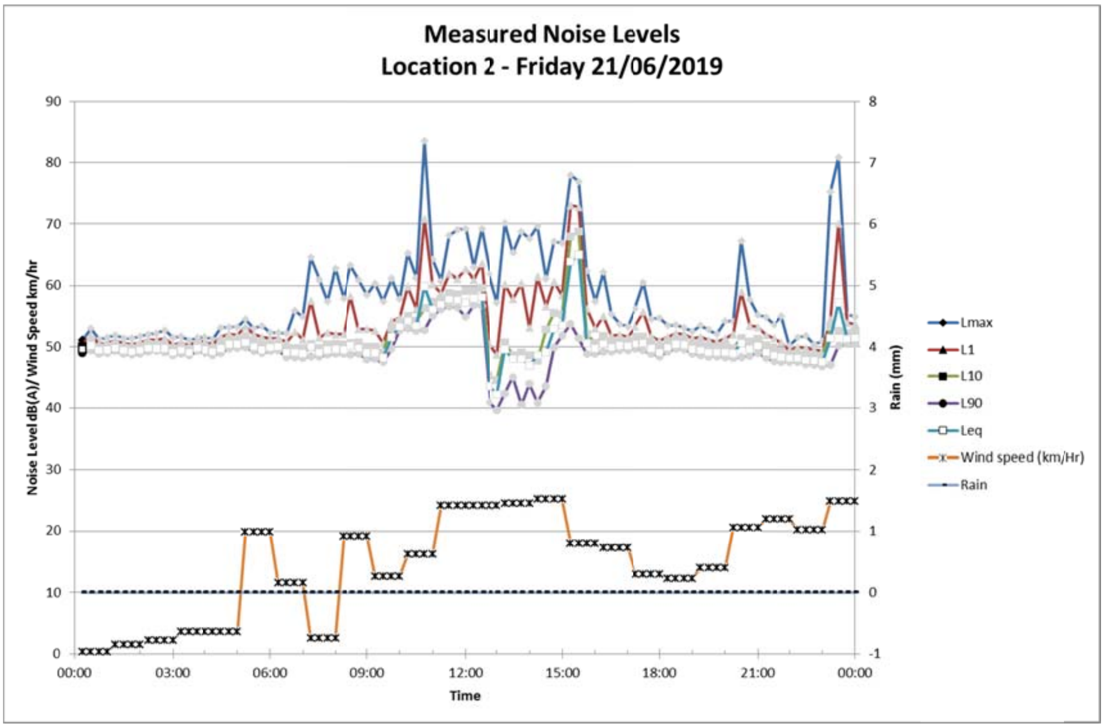

Measured Noise Levels
Location 1 - Monday 24/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

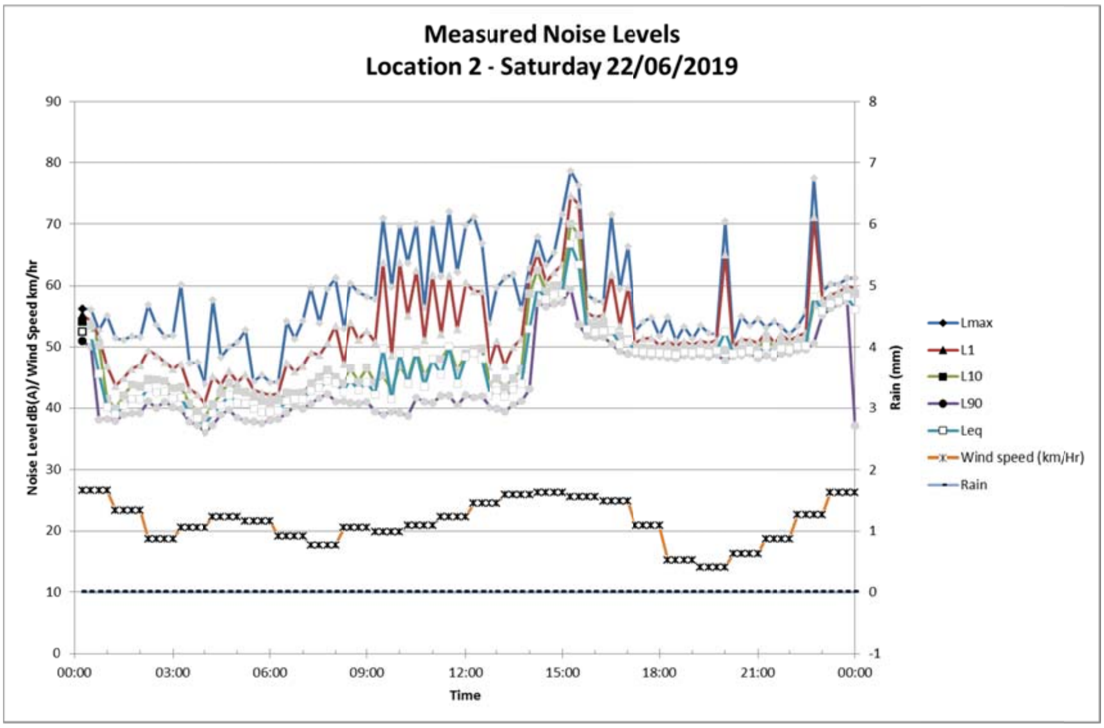


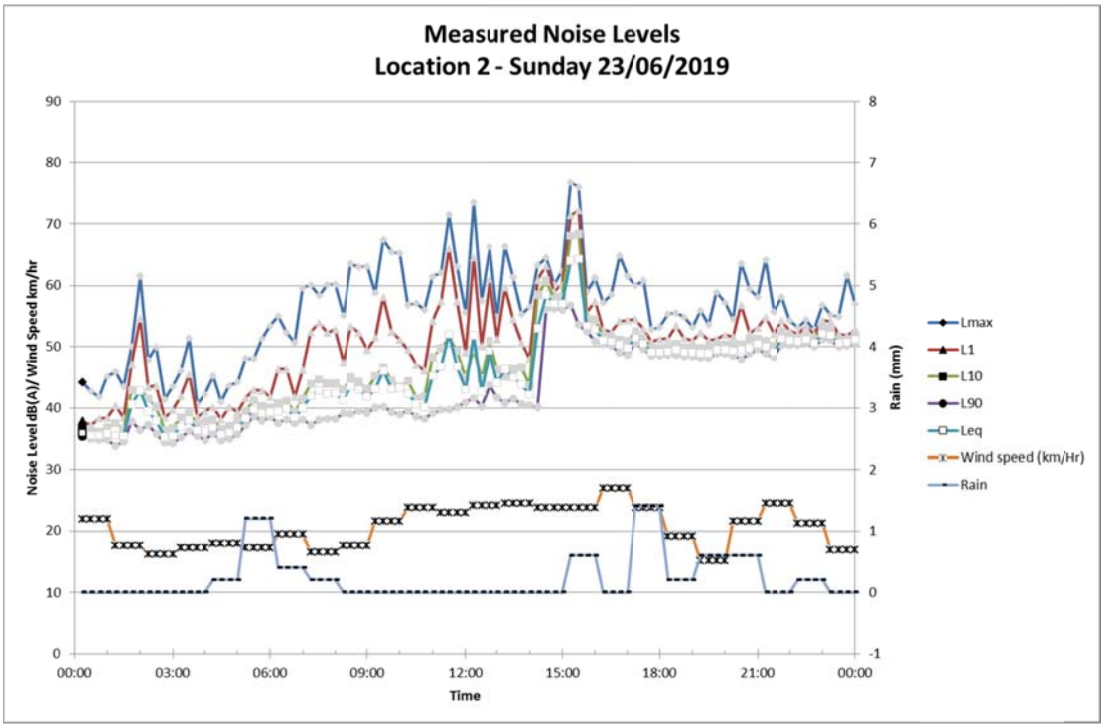
Measured Noise Levels
Location 1 - Tuesday 25/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



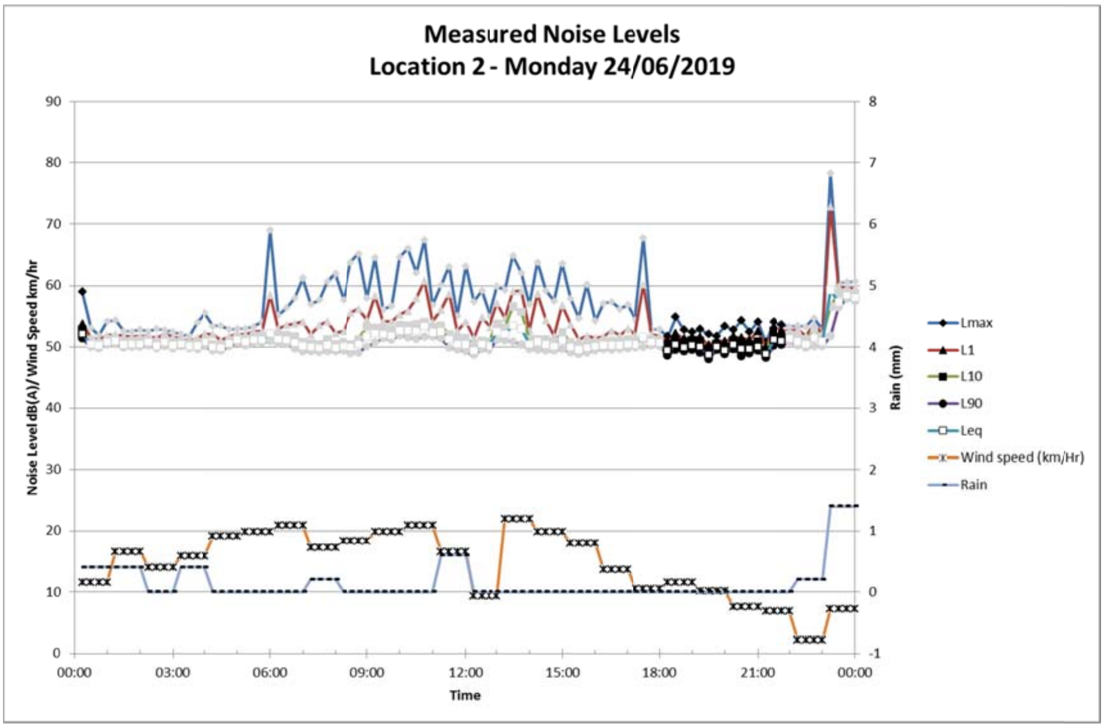
Measured Noise Levels
Location 1 - Wednesday 26/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Location 2 - Friday 21/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

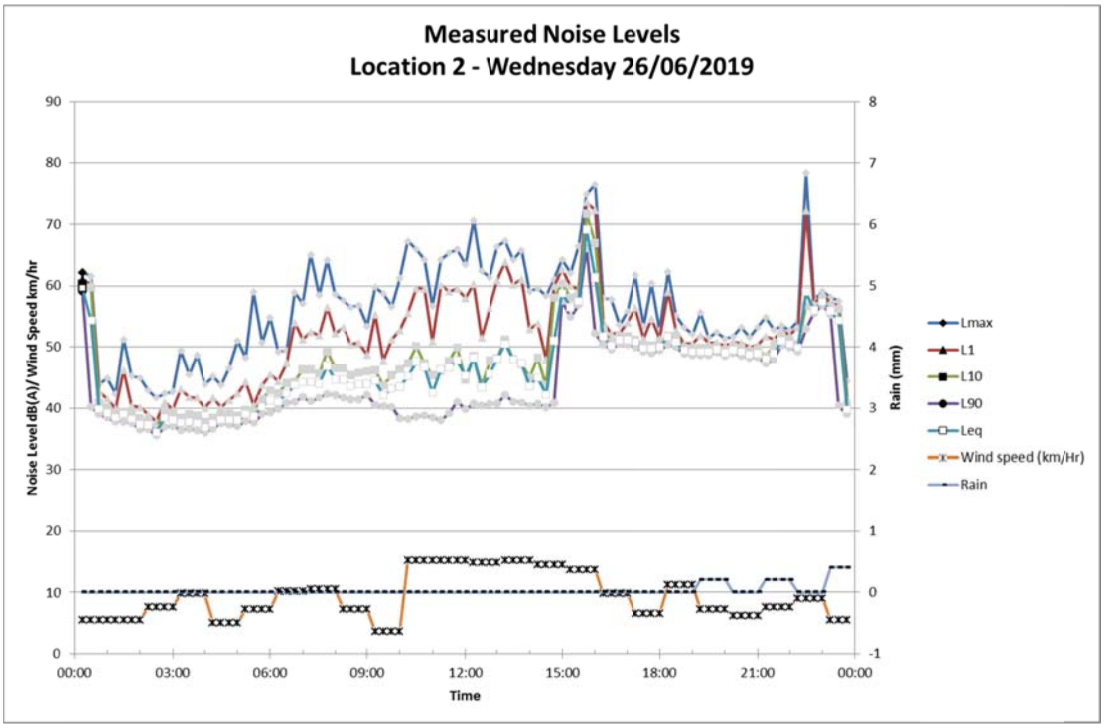

Measured Noise Levels
Location 2 - Saturday 22/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



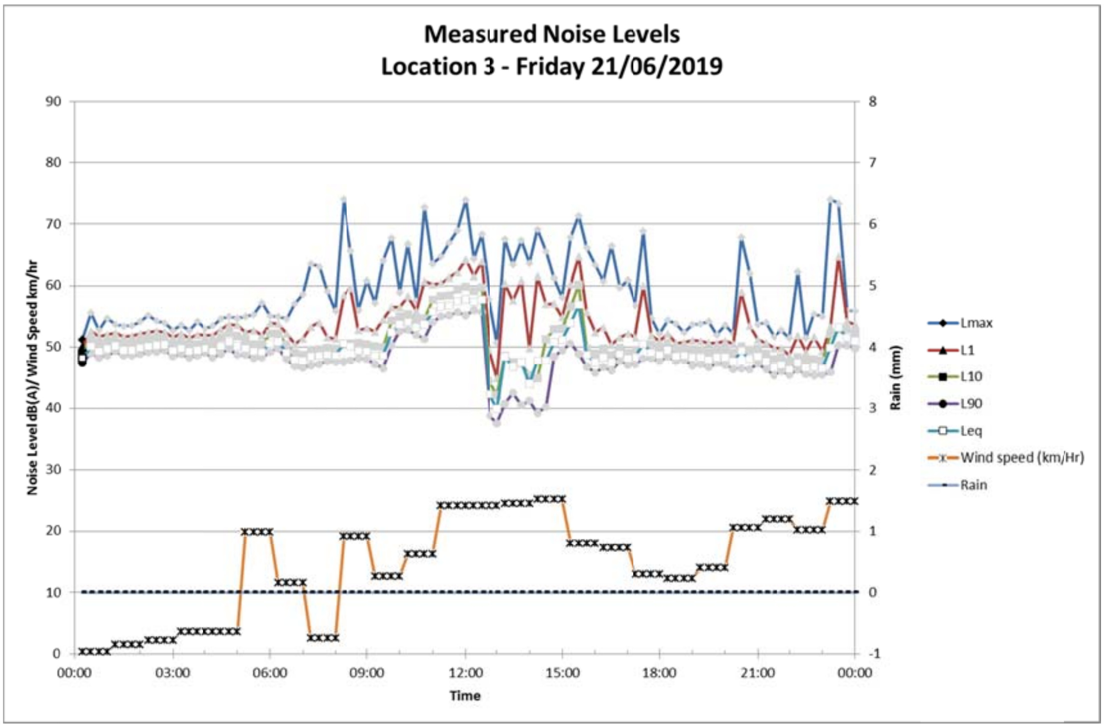
Measured Noise Levels
Location 2 - Sunday 23/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
0
10
20
30
40
50
60
70
80
90
-1
0
1
2
3
4
5
6
7
8
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



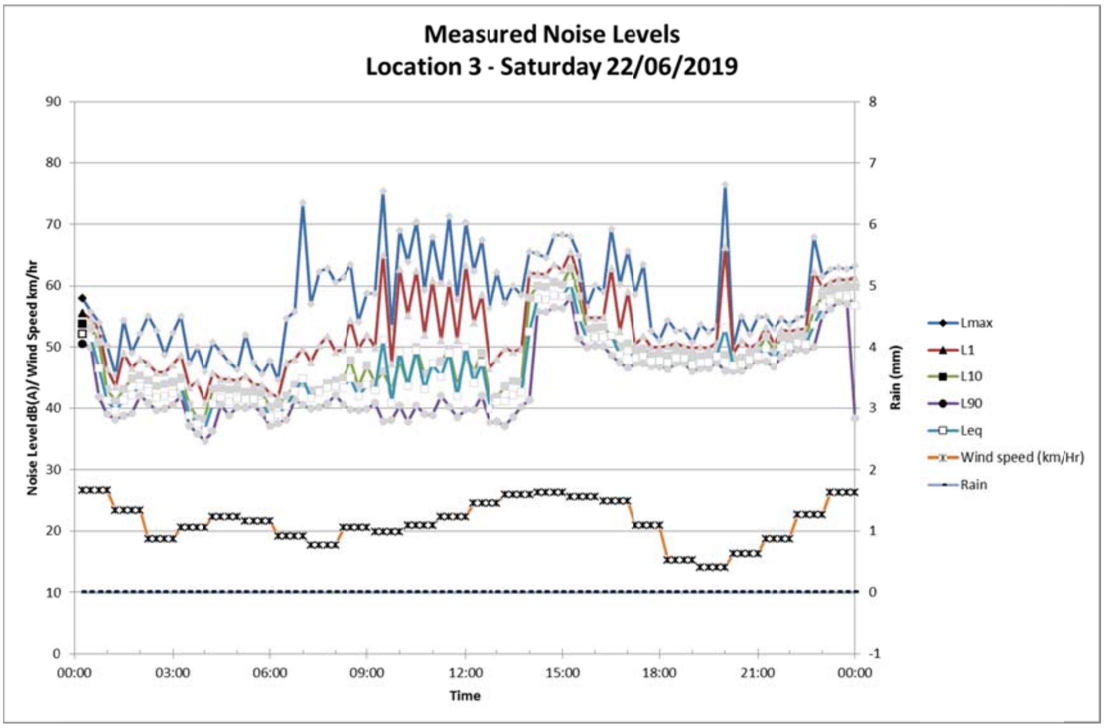
Measured Noise Levels
Location 2 - Monday 24/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
0
10
20
30
40
50
60
70
80
90
-1
0
1
2
3
4
5
6
7
8
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



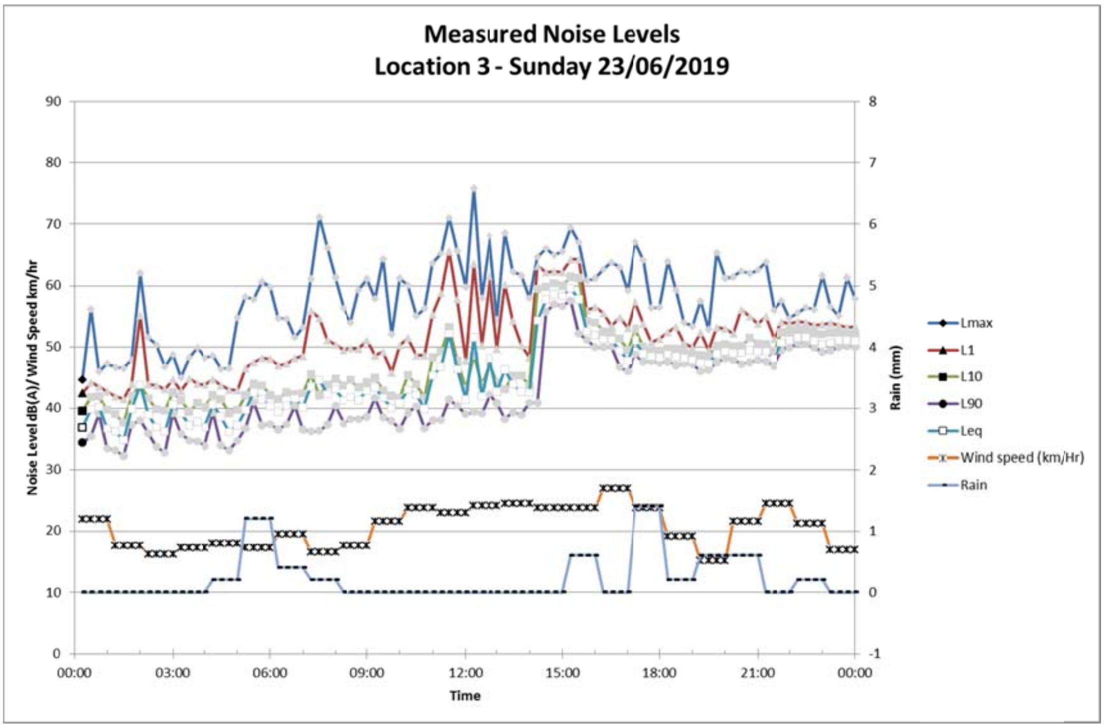
Measured Noise Levels
Location 2 - Wednesday 26/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



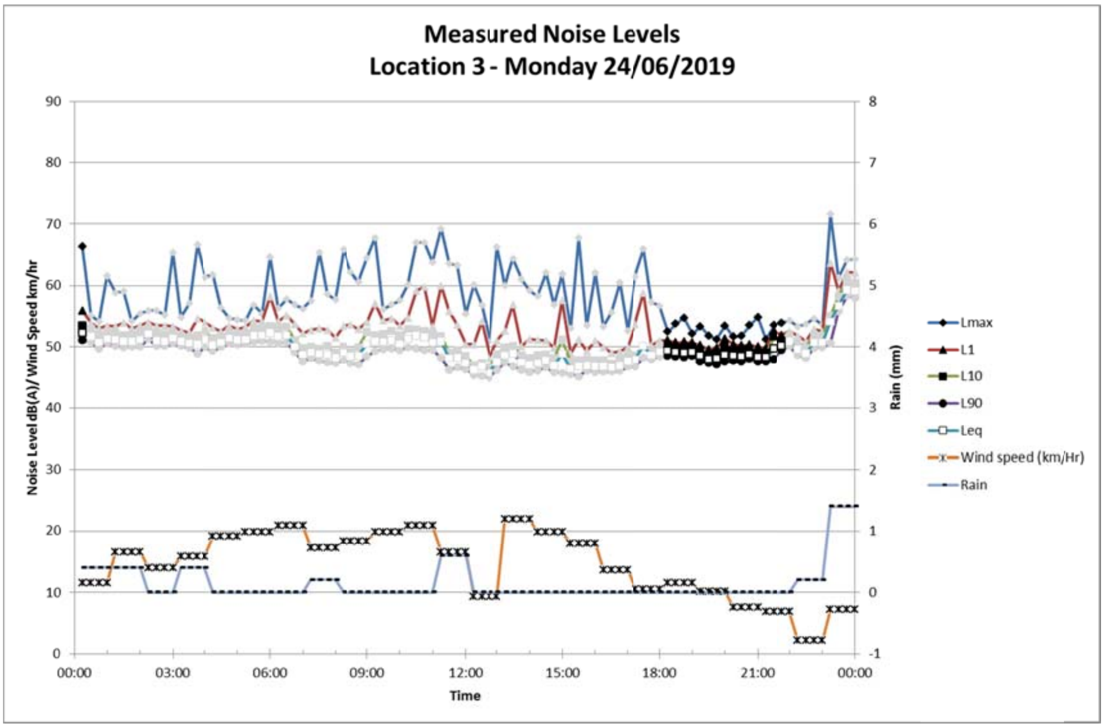
Measured Noise Levels
Location 3 - Friday 21/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

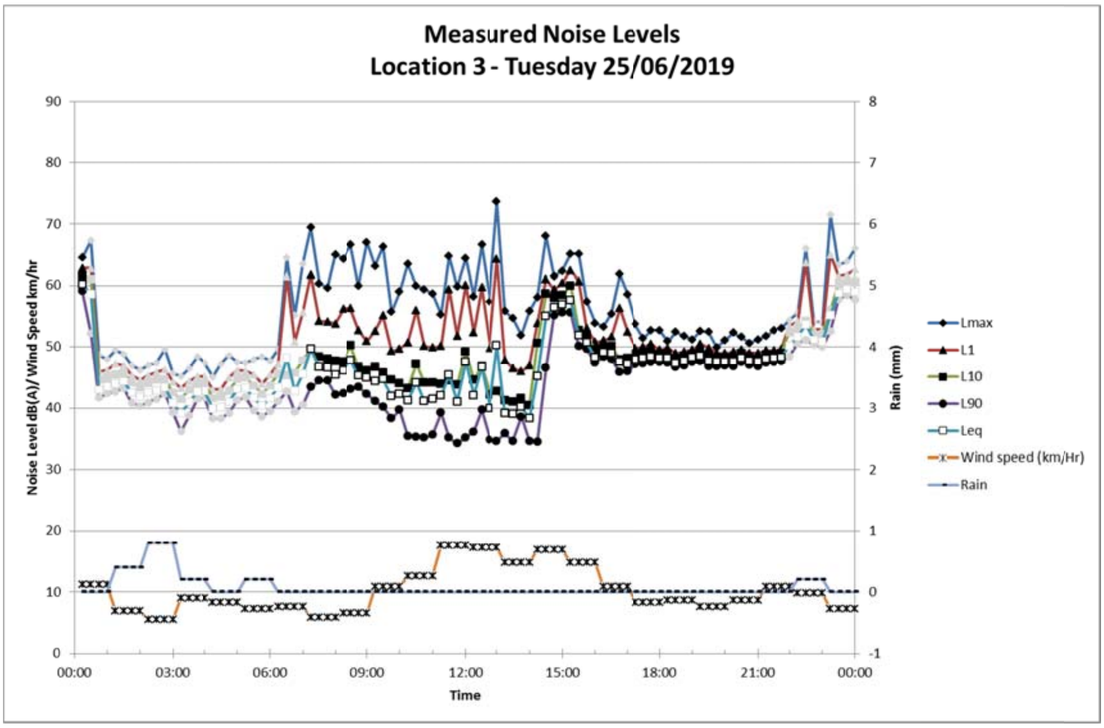


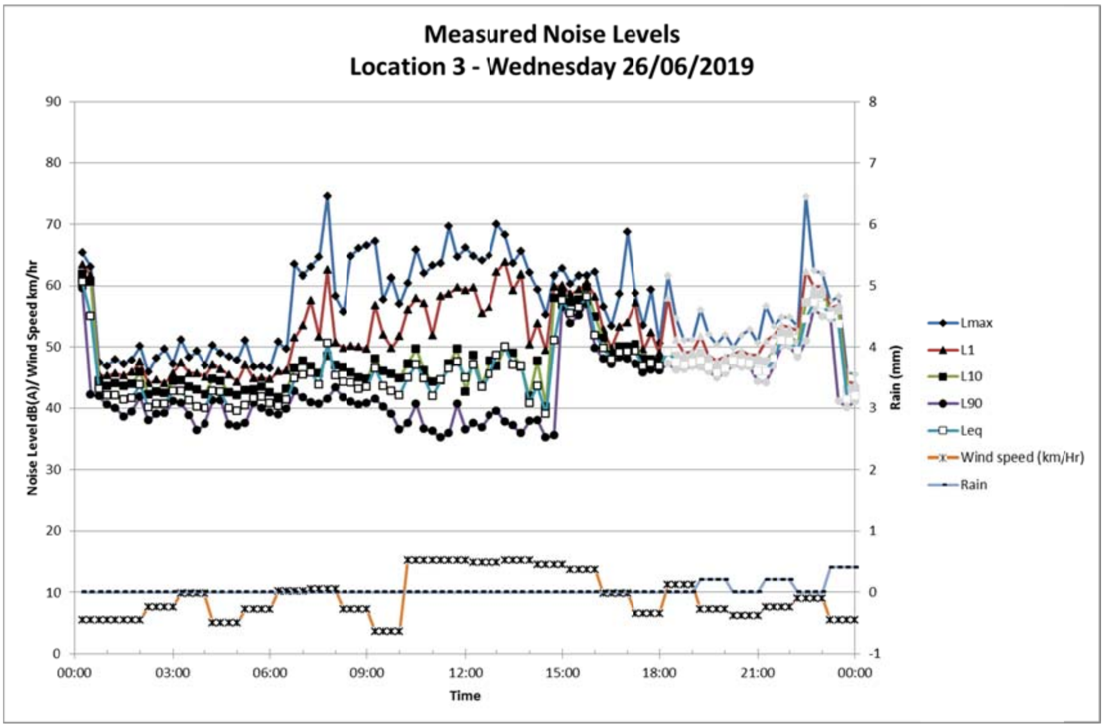
Measured Noise Levels
Location 3 - Saturday 22/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain



Measured Noise Levels
Location 3 - Sunday 23/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

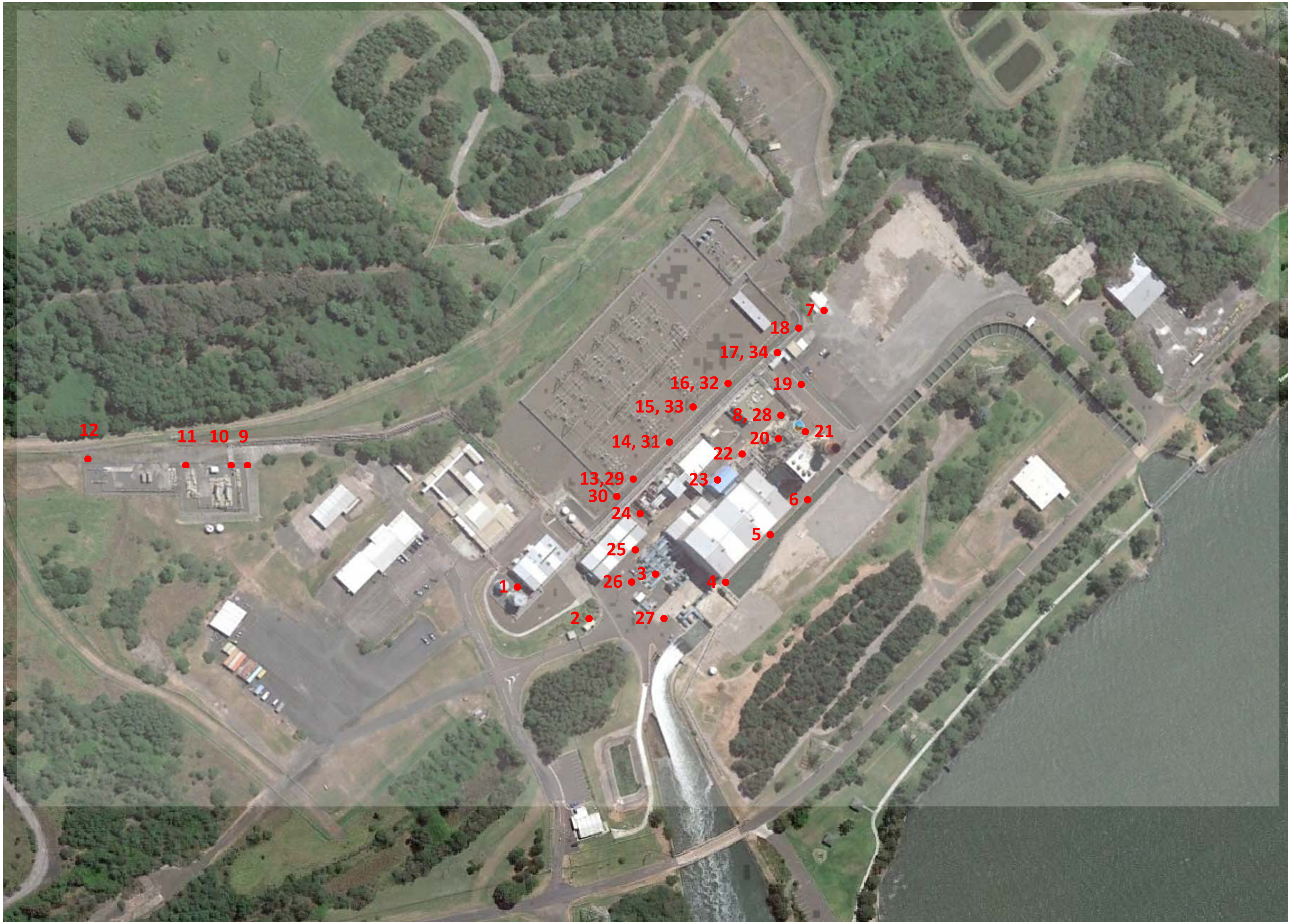

Measured Noise Levels
Location 3 - Monday 24/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain
0
10
20
30
40
50
60
70
80
90
-1
0
1
2
3
4
5
6
7
8
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00


Measured Noise Levels
Location 3 - Tuesday 25/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain
0
10
20
30
40
50
60
70
80
90
-1
0
1
2
3
4
5
6
7
8
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00



Measured Noise Levels
Location 3 - Wednesday 26/06/2019
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

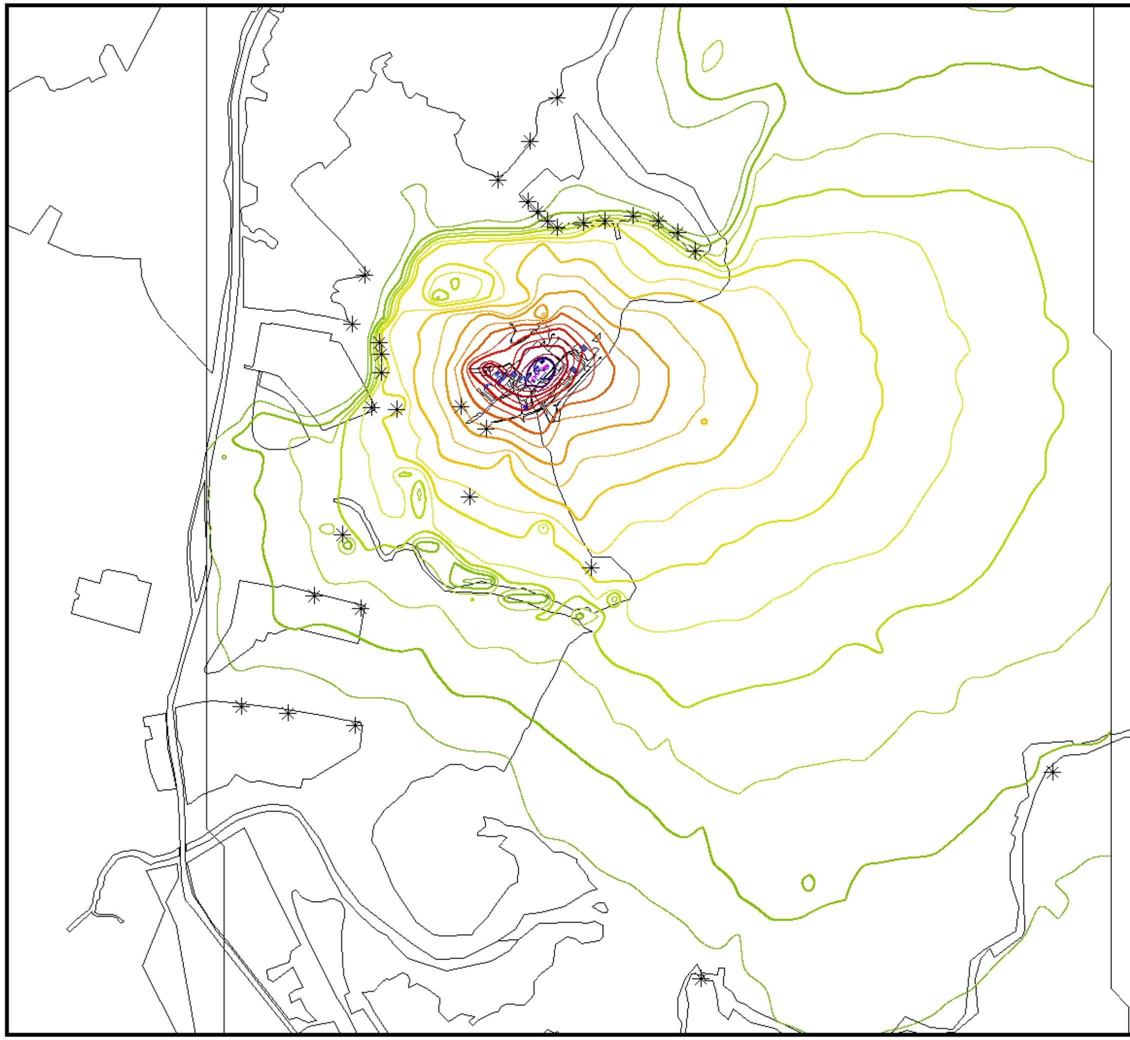
Attachment 8: Tallawarra A – Attended Measurements Results



1
2
3
4
5
6
7
8, 28
9
10
11
12
13,29
14, 31
15, 33
16, 32
17, 34
18
19
20
21
22
23
24
25
26
27
30

ID	Date	Time	Overall LAeq	Third Octave Band Centre Frequency (Hz)																																	
				20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	12500	16000	20000	Total A	Total C	Total Z
1	19/09/2019	14:59:32	75	60	63	63	63	66	58	66	61	62	62	59	60	63	69	65	69	64	65	63	67	66	62	59	54	48	46	43	39	37	35	34	75	77	79
2	19/09/2019	15:03:20	60	58	60	57	56	66	56	54	67	55	54	51	51	53	56	53	52	52	49	48	48	46	44	42	40	38	34	32	32	31	32	34	60	71	79
3	19/09/2019	15:06:02	75	61	67	64	61	73	63	66	70	66	67	69	70	71	72	69	68	70	66	64	60	59	57	56	54	53	49	46	41	38	36	35	75	81	83
4	19/09/2019	15:08:42	68	64	66	62	62	82	66	59	81	66	61	60	59	61	61	59	60	58	58	57	55	55	54	50	49	45	41	38	35	32	32	34	68	84	86
5	19/09/2019	15:12:12	75	70	69	65	64	85	69	60	76	64	61	61	61	57	60	57	59	58	58	58	57	56	55	53	51	47	43	40	36	32	32	34	68	85	88
6	19/09/2019	14:14:18	75	77	74	72	72	82	78	73	75	73	72	70	66	67	66	64	65	66	66	65	63	64	62	60	60	57	55	53	48	45	42	38	75	85	88
7	19/09/2019	15:17:42	90	80	78	72	68	74	71	68	71	69	75	74	87	76	75	77	77	79	78	77	78	77	78	76	76	76	78	78	81	75	77	68	90	92	93
8	19/09/2019	15:18:42	82	73	73	74	71	78	72	69	70	67	71	68	74	71	71	71	71	73	71	71	72	71	72	70	68	67	64	62	57	54	51	45	82	85	88
9	19/09/2019	17:09:38	65	59	63	65	67	63	61	63	70	68	66	64	54	57	61	58	58	53	52	51	50	55	52	49	49	47	46	47	45	46	46	42	65	76	88
10	19/09/2019	17:10:10	71	61	62	64	67	64	61	66	73	67	68	65	60	61	63	64	68	63	60	55	55	55	55	52	51	49	50	49	49	50	48	45	71	78	89
11	19/09/2019	17:10:54	64	59	61	62	64	64	60	62	70	62	63	65	60	55	51	51	63	52	52	54	48	46	45	42	41	40	38	37	35	33	33	34	64	75	87
12	19/09/2019	17:11:50	50	57	56	57	59	56	53	53	58	55	54	48	40	40	41	43	47	39	38	37	36	36	36	33	32	33	31	30	32	31	31	34	50	65	73
13	19/09/2019	17:39:00	59	71	65	64	67	76	66	63	62	56	55	57	54	56	55	52	53	47	46	45	44	42	42	37	36	34	32	31	32	31	32	34	59	77	84
14	19/09/2019	17:40:24	62	82	78	74	77	78	69	65	71	61	56	58	65	55	57	54	53	49	48	48	47	46	47	43	42	39	35	33	33	31	32	34	62	82	88
15	19/09/2019	17:41:02	64	75	74	71	72	69	69	65	71	61	61	60	67	58	55	55	53	53	52	50	50	49	49	46	46	42	40	38	36	34	34	34	64	79	84
16	19/09/2019	17:41:42	63	69	69	64	67	73	67	64	66	61	60	59	64	58	57	54	53	52	50	49	49	48	48	44	46	42	39	37	35	32	32	34	63	76	83
17	19/09/2019	17:43:46	67	70	64	63	60	66	61	61	64	60	60	60	64	59	59	60	54	59	56	55	55	55	54	51	50	51	50	49	47	40	36	34	67	74	79
18	19/09/2019	17:44:34	66	68	64	62	59	66	60	58	58	57	60	57	69	60	58	56	53	55	54	54	54	53	52	48	48	46	45	42	38	33	32	34	66	74	79
19	19/09/2019	17:47:48	69	75	72	66	65	78	67	64	64	62	66	62	67	62	63	61	59	61	60	58	58	57	57	53	53	51	51	50	46	41	39	35	69	80	84
20	19/09/2019	17:50:22	82	85	81	77	70	79	74	70	77	69	71	71	80	79	75	71	72	73	73	71	70	68	69	65	64	62	62	61	57	53	50	43	82	88	92
21	19/09/2019	17:51:40	79	80	76	73	70	80	75	71	71	68	72	69	74	70	68	69	68	70	69	67	68	68	67	63	63	63	63	64	63	58	58	50	79	85	88
22	19/09/2019	17:52:46	76	80	78	73	72	86	75	73	74	71	72	70	71	68	68	69	66	66	65	64	64	63	64	61	65	57	55	52	47	44	40	38	76	87	90
23	19/09/2019	17:53:54	75	90	84	79	81	84	73	70	80	68	65	69	68	70	66	65	64	64	64	63	62	63	66	60	60	57	53	51	48	48	49	46	75	89	95
24	19/09/2019	17:59:30	73	73	67	67	69	77	68	68	85	68	65	71	64	75	69	65	64	61	61	58	57	54	53	51	49	48	47	45	41	39	35	34	73	86	89
25	19/09/2019	18:00:54	73	72	68	63	64	74	64	62	71	59	61	58	56	57	57	55	54	53	53	52	50	48	48	45	44	41	38	40	37	33	32	34	63	77	81
26	19/09/2019	18:01:32	60	73	68	60	62	68	60	60	62	59	58	58	56	55	56	53	52	51	51	48	46	43	43	40	38	37	33	33	33	31	32	34	60	73	78
27	19/09/2019	18:02:26	68	66	62	61	60	71	62	63	66	62	63	63	61	62	65	61	61	60	59	57	55	53	51	48	46	44	41	39	35	33	32	34	68	76	78
29	20/06/2019	9:12:00	68	65	62	66	75	77	72	71	70	72	68	65	63	63	61	58	59	60	56	56	57	55	52	50	46	42	39	38	35	33	32	34	68	81	84
30	20/06/2019	9:14:04	68	63	62	69	76	72	69	71	74	70	67	65	65	64	60	58	58	59	56	56	57	56	55	53	50	46	42	39	36	33	32	34	68	80	84
31	20/06/2019	9:15:30	71	77	73	72	75	77	73	73	73	73	67	66	66	64	61	57	59	63	58	61	61	60	58	55	53	49	46	42	37	34	33	34	71	82	89
32	20/06/2019	9:16:38	71	71	69	69	73	74	70	72	75	69	67	65	67	64	62	59	60	64	59	60	60	59	57	56	53	50	47	43	37	33	32	34	71	81	86
33	20/06/2019	9:16:48	70	70	69	68	72	74	71	71	73	69	67	64	68	65	61	59	59	63	59	60	60	58	57	56	53	50	46	42	37	33	32	34	70	80	84
34	20/06/2019	9:18:24	75	64	61	64	66	68	63	61	63	62	61	61	63	61	58	57	55	59	57	57	57	56	54	51	50	49	48	45	43	36	34	34	67	74	84

Attachment 9: Noise Contours



Tallawarra A
Standard Operation
$L_{Aeq(15 Minutes)}$

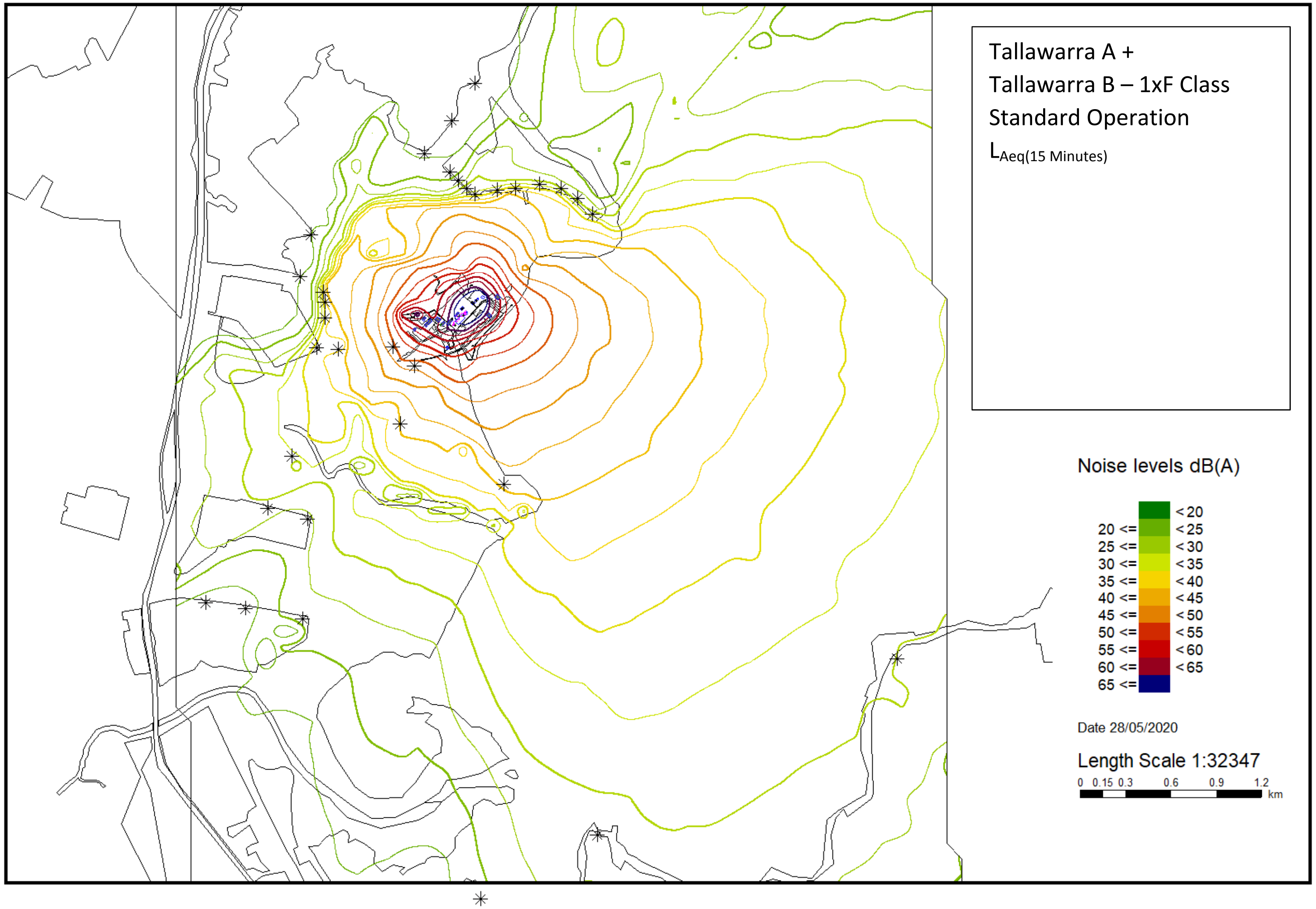
Noise levels dB(A)

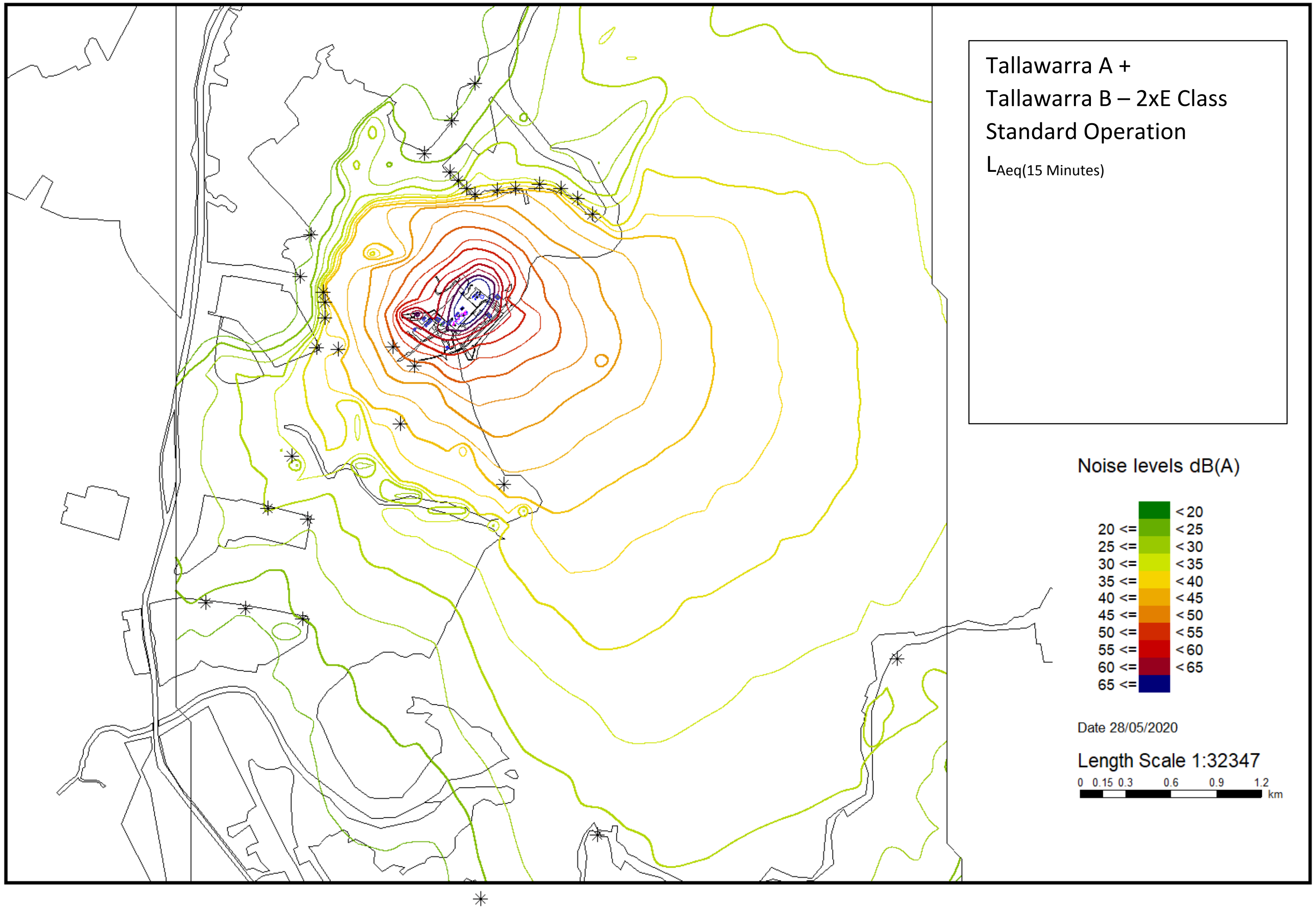
	< 20
20 <=	< 25
25 <=	< 30
30 <=	< 35
35 <=	< 40
40 <=	< 45
45 <=	< 50
50 <=	< 55
55 <=	< 60
60 <=	< 65
65 <=	

Date 28/05/2020

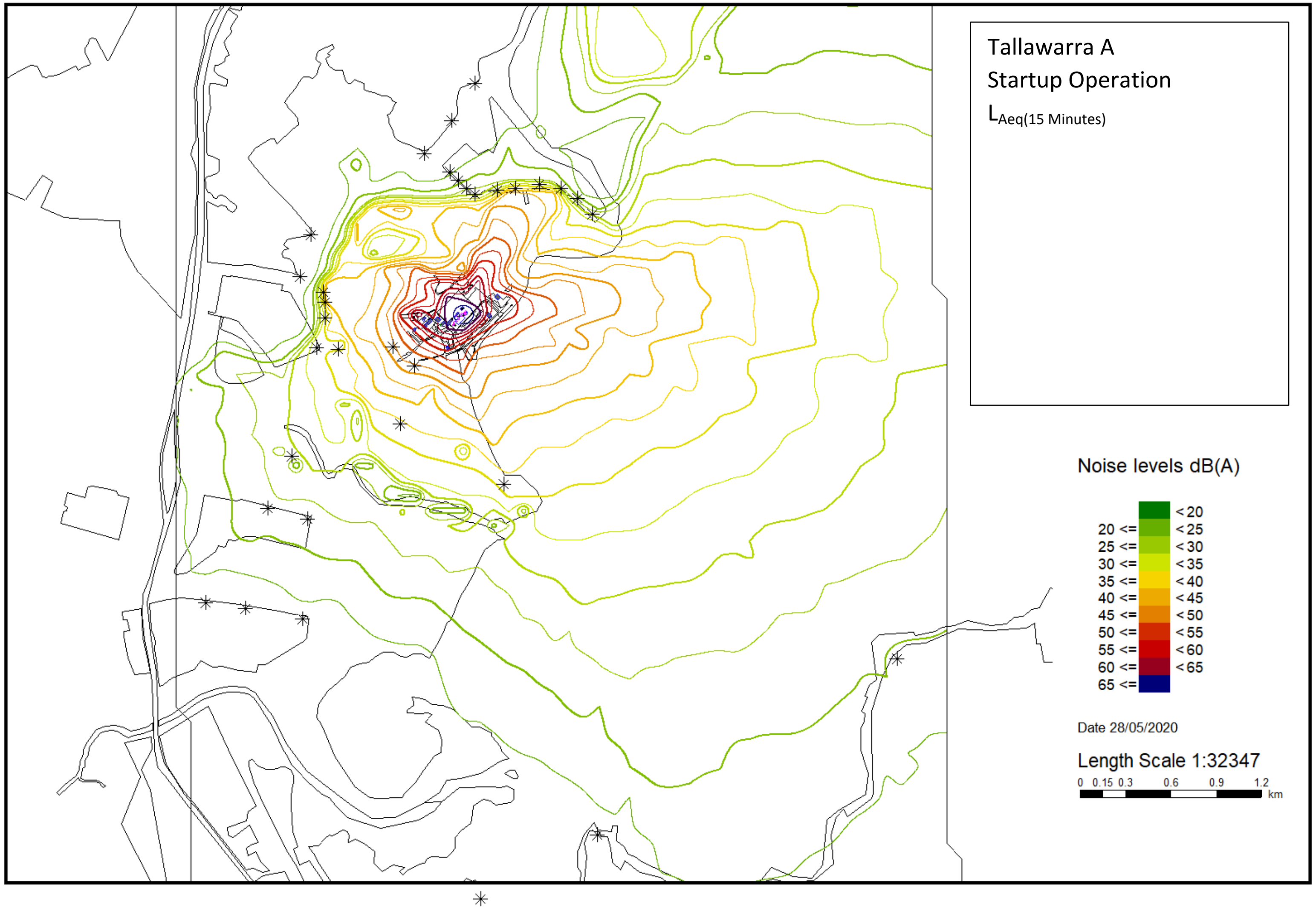
Length Scale 1:32347

0 0.15 0.3 0.6 0.9 1.2 km

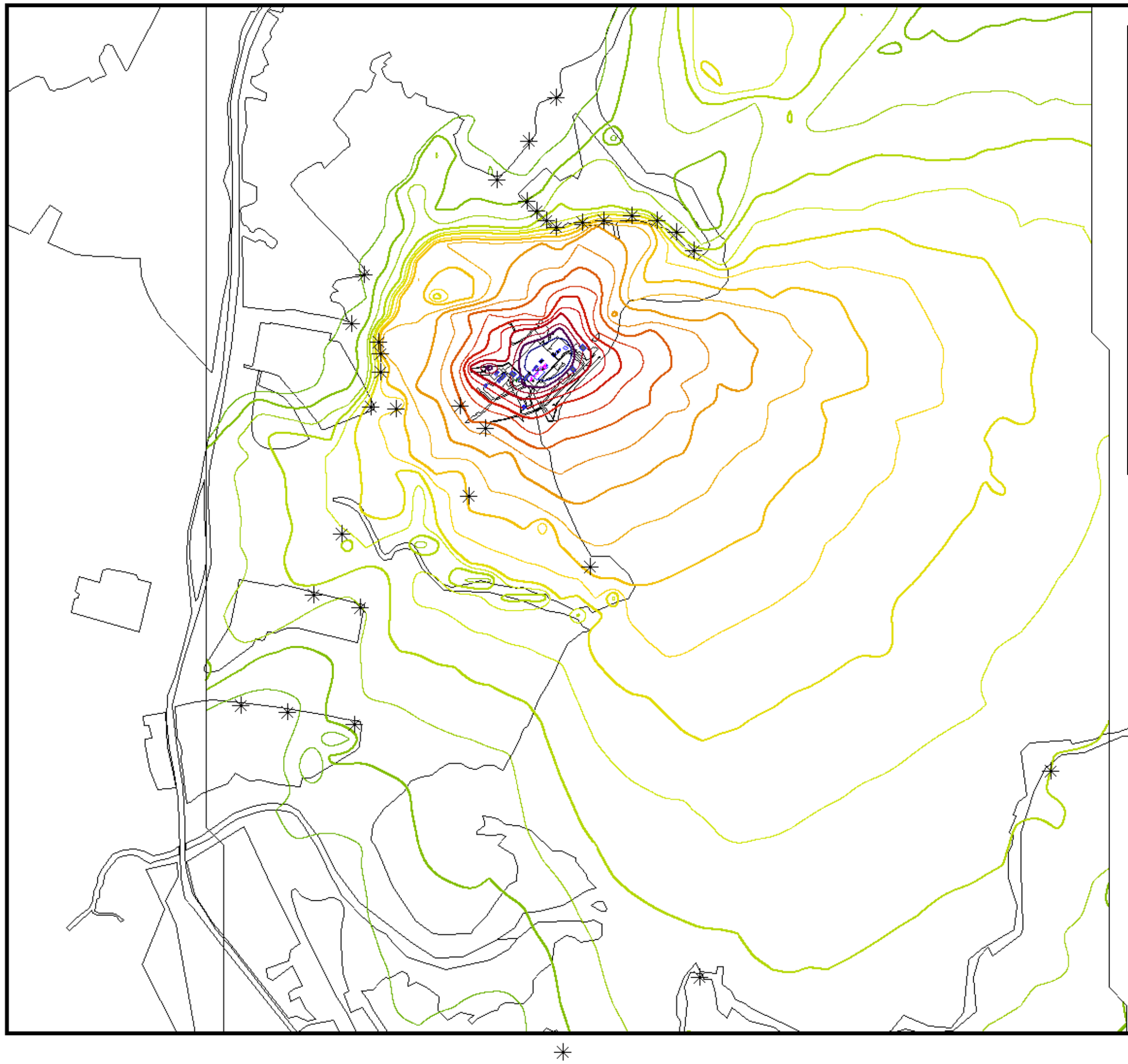

Tallawarra A +
Tallawarra B – 1xF Class
Standard Operation
LAeq(15 Minutes)
Noise levels dB(A)
< 20
20 <= < 25
25 <= < 30
30 <= < 35
35 <= < 40
40 <= < 45
45 <= < 50
50 <= < 55
55 <= < 60
60 <= < 65
65 <=
Date 28/05/2020
Length Scale 1:32347
0 0.15 0.3 0.6 0.9 1.2
km



Tallawarra A +
Tallawarra B – 2xE Class
Standard Operation
$L_{Aeq(15 Minutes)}$
Noise levels dB(A)
< 20
20 <= < 25
25 <= < 30
30 <= < 35
35 <= < 40
40 <= < 45
45 <= < 50
50 <= < 55
55 <= < 60
60 <= < 65
65 <=
Date 28/05/2020
Length Scale 1:32347
0 0.15 0.3 0.6 0.9 1.2
km



Tallawarra A
Startup Operation
L Aeq(15 Minutes)
Noise levels dB(A)
< 20
20 <= < 25
25 <= < 30
30 <= < 35
35 <= < 40
40 <= < 45
45 <= < 50
50 <= < 55
55 <= < 60
60 <= < 65
65 <=
Date 28/05/2020
Length Scale 1:32347
0 0.15 0.3 0.6 0.9 1.2
km



Tallawarra A Startup Operation +
Tallawarra B – 1xF Class Standard Operation
$L_{Aeq(15 Minutes)}$

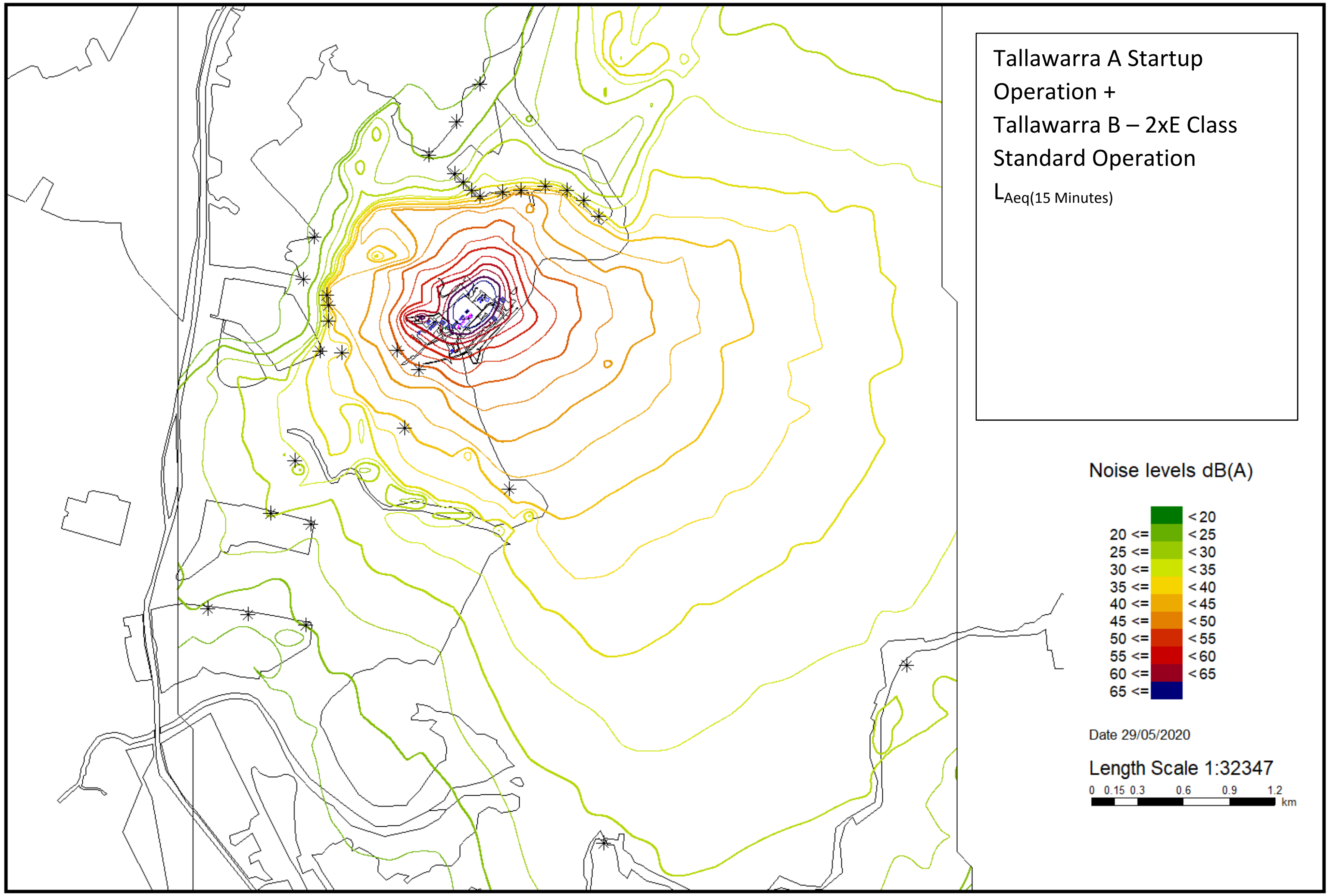
Noise levels dB(A)

	< 20
20 <=	< 25
25 <=	< 30
30 <=	< 35
35 <=	< 40
40 <=	< 45
45 <=	< 50
50 <=	< 55
55 <=	< 60
60 <=	< 65
65 <=	

Date 28/05/2020

Length Scale 1:32347

0 0.15 0.3 0.6 0.9 1.2 km



Tallawarra A Startup
Operation +
Tallawarra B – 2xE Class
Standard Operation
$L_{Aeq(15\ Minutes)}$
Noise levels dB(A)
< 20
20 <= < 25
25 <= < 30
30 <= < 35
35 <= < 40
40 <= < 45
45 <= < 50
50 <= < 55
55 <= < 60
60 <= < 65
65 <=
Date 29/05/2020
Length Scale 1:32347
0 0.15 0.3 0.6 0.9 1.2
km