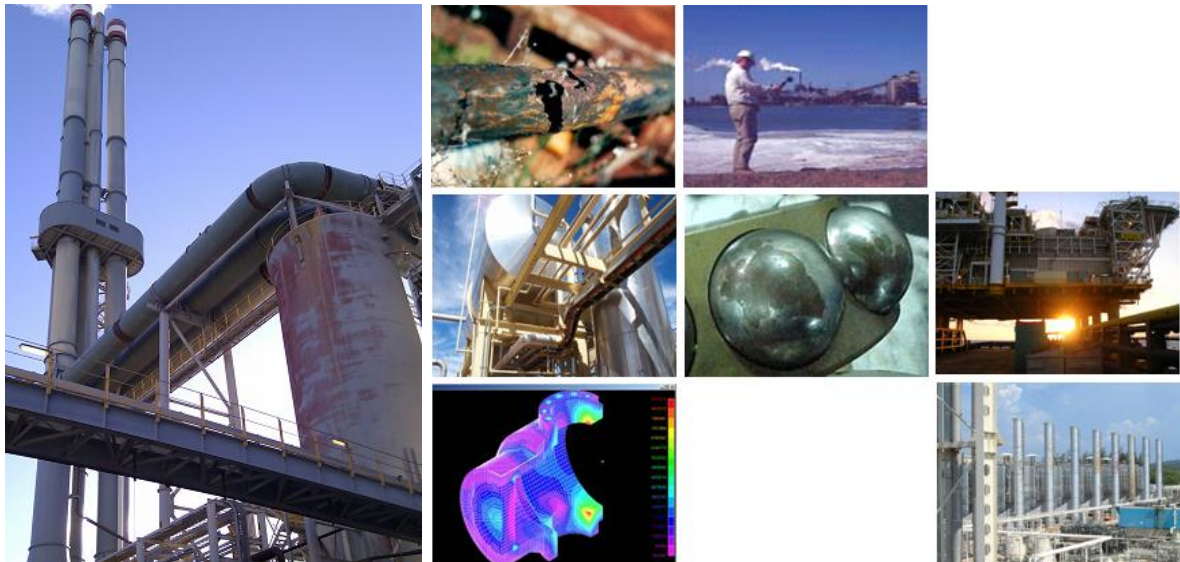


NOISE MONITORING REPORT FOR THE ENVIRONMENTAL PROTECTION (WAGERUP ALUMINA REFINERY NOISE EMISSIONS) AMENDMENT APPROVAL 2013 & 2014



ALCOA OF AUSTRALIA

1370825-22-100-Rev0-7 Sep 15

DOCUMENT CONTROL & REVIEW INFORMATION

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SVT Job No: 1370825
SVT Document No: 1370825-22-100-Rev0-7 Sep 15

Rev	Description	Prepared	Reviewed	Date
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EXECUTIVE SUMMARY

Introduction

Alcoa has been granted approval (The Approval) to allow the level of noise emitted from the Wagerup Alumina Refinery (Refinery) to exceed the standard prescribed by the *Environmental Protection (Noise) Regulations 1997* for noise sensitive locations. The Approval is provisional on noise emissions from the Refinery not exceeding specified noise levels (Approved Levels)¹ at eight locations in the vicinity of the Refinery.

The Approval requires that Alcoa must appoint a noise consultant to undertake and report on a noise monitoring program with the following objectives:

- 1) to provide a comparison of noise emitted from the Refinery during the period for which The Approval has effect, with noise emitted from the Refinery in 2001²; and
- 2) to measure compliance with the Approved Levels.

This report provides the results of the noise monitoring program.

Objective 1: Comparison of Current and Previous Refinery Noise Emissions

Alcoa has monitored noise emissions from the Refinery since October 2002 using continuous noise monitoring systems deployed at two locations; one to the north of the Refinery (Location 1) and one to the south of the Refinery (Location 2). Meteorological data has also been recorded at a weather station close to Location 2. The data collected by these monitoring systems has been used to compare current and previous Refinery noise emissions.

Noise and weather data provided by Alcoa was reviewed and the 12 month period between October 2002 and September 2003 was determined to be the earliest period after 2001 for which sufficient relevant data was available for the comparison.

Noise recorded by the continuous noise monitoring systems includes noise emitted from the Refinery as well as noise from extraneous sources. Therefore, a methodology has been developed to determine the Refinery's contribution to the measured noise levels. (See section 2.4.) The same methodology has been applied to noise data collected during 2002-2003 and to the data collected during the monitoring program for The Approval.

The results of the comparison demonstrate that Refinery noise emissions recorded at both Locations 1 and Location 2 during 2014 and 2015 are lower than those recorded at the same locations during 2002-2003.

¹ Technical terms used in this report (including "Approved Levels") are explained in lay-man's terms in the glossary provided in Appendix A.

² Or, if sufficient relevant data is not available for 2001, data for the year next after 2001 for which sufficient relevant data is available.

Objective 2: Assessment of Compliance with Approved Levels

In order to determine whether or not noise emissions from the Refinery comply with the Approved Levels, attended noise monitoring has been undertaken at each of the eight specified locations for a period of three hours on:

- at least three occasions between 1 May and 30 September 2014; and
- at least three occasions between 1 May and 1 July 2015.

All monitoring was undertaken between the hours of 10 pm and 7 am and was scheduled to coincide with weather conditions that enhance sound propagation towards the relevant monitoring locations. (See section 3.5 for further details of the monitoring methodology.) The recorded noise levels were compared with the Approved Levels for each location.

Observations were made during the monitoring of audible noise sources within the Refinery. The monitoring results were also analysed to determine whether or not noise emissions from the Refinery exhibited tonal characteristics (e.g. whining or droning).

Results from 2014 Compliance Assessment Monitoring Program

Noise monitoring undertaken during 2014 demonstrated compliance with the Approved Levels at four of the eight specified locations (Locations 1, 2, 5 and 6). Compliance at Location 8 could not be determined due to persistent high levels of extraneous noise during the monitoring periods.

Monitored noise levels marginally³ exceeded the Approved Levels at Location 3 on one occasion. Noise from mobile equipment associated with emergency reclaim operations⁴ was identified as the source of the exceedance.

Monitored noise levels marginally⁵ exceeded the Approved Levels at Location 4 on two occasions. On one of these occasions noise from mobile equipment associated with emergency reclaim operations was audible and may have contributed to the exceedance. However, extraneous noise from insects and fauna was significant. On the second occasion, noise from frogs was clearly evident in the same part of the audio spectrum as the Refinery noise emissions and was the probable cause of the measured exceedance.

Monitored noise levels marginally⁶ exceeded the Approved Levels at Location 7 on one occasion. No specific source within the Refinery was identified and the exceedance on this occasion is considered to be due to meteorological conditions conducive to maximum sound propagation from the Refinery towards this location.

³ The L_{A10} Approved Level was exceeded by 0.3 dB and the L_{A1} Approved Level was exceeded by 1.7 dB.

⁴ Emergency reclaim operations occur when unplanned and planned maintenance activities are undertaken on the conveyors or the bucket wheel reclaimer at the bauxite stockpile. During emergency reclaim operations mobile equipment is used to transport bauxite into the process.

⁵ The L_{A10} Approved Level was exceeded by 0.3 dB on the first occasion and 0.9 dB on the second occasion.

⁶ The L_{A10} Approved Level was exceeded by 0.7 dB.

Tonality was audible on some occasions at some locations during the monitoring undertaken in 2014. The sources of audible tonality were determined to be:

- vacuum pumps in Precipitation Building 44-2; and
- the temporary removal of acoustic insulation from blower discharge ducting in Calcination Building 50.

Results from 2015 Compliance Assessment Monitoring Program

Noise monitoring undertaken during 2015 demonstrated compliance with the Approved Levels at six of the eight specified locations (Locations 1, 3, 4, 5, 6 and 7).

Monitored noise levels marginally⁷ exceeded the Approved Levels at Location 2 on one occasion and at Location 8 on one occasion. No specific sources within the Refinery were identified on either occasion and the exceedances are considered to be due to meteorological conditions conducive to maximum sound propagation from the Refinery towards these locations.

Tonality was audible on one occasion at Locations 4 and 5 during the monitoring undertaken in 2015. The most likely source of this tonality was determined to be vacuum pumps in Calcination Building 50.

Tonality was identified from the measured noise spectra on some occasions at Locations 2, 5, 6, 7 and 8. Subjectively, however, this tonality was inaudible by monitoring personnel at the time of the measurements. Subsequent investigations have shown that vacuum pumps in Precipitation Building 44-2 are the most likely source of this tonality.

Summary and Conclusions

A noise monitoring program satisfying the requirements of The Approval has been undertaken.

Noise emissions from the Refinery recorded by continuous monitoring systems at Location 1 and Location 2 during the 2014 and 2015 monitoring program are demonstrably lower than noise emissions recorded at the same locations in 2002-2003.

Exceedances of the Approved Levels were identified at some locations during the monitoring program. In all cases, exceedances of the L_{A10} Approved Levels were less than 1 dB⁸.

Emergency reclaim operations at the Refinery have been identified as the cause of some exceedances. Other exceedances are due to the prevailing weather conditions at the time of the assessment.

Vacuum pumps in Calcination Building 50 and in Precipitation Building 44-2 have been identified as sources of tonality detected on some occasions during the monitoring program. The temporary removal of acoustic insulation from blower discharge ducting in Calcination Building 50 was also identified as a source of tonality. This insulation has been re-instated.

⁷ The L_{A10} Approved Level was exceeded by 0.5 dB at Location 2 and by 0.1 dB at Location 8.

⁸ Changes in noise level of 1 dB or lower are usually audibly undetectable.

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1. INTRODUCTION

1.1 Background

In 2002 Alcoa applied for a variation to the assigned noise levels specified in the *Environmental Protection (Noise) Regulations 1997*. In June 2012, the *Environmental Protection (Wagerup Alumina Refinery Noise Emissions) Approval 2012* was gazetted. This allows Alcoa to exceed the standard prescribed under Regulation 7(1)(a), provided that Alcoa complies with the conditions of the approval. The approval was subsequently appealed.

The appeal determination process was finalised on 10 December 2013 when the *Environmental Protection (Wagerup Alumina Refinery Noise Emissions) Amendment Approval 2013* was gazetted.

A subsequent amendment was issued in October 2014 to correct an error in the coordinates for noise monitoring locations in the appeal decision (the *Environmental Protection (Wagerup Alumina Refinery Noise Emissions) Amendment Approval 2014*).

When read together the following documents outline the approval for the Wagerup Alumina Refinery to exceed the assigned noise levels:

- *Environmental Protection (Wagerup Alumina Refinery Noise Emissions) Approval 2012;*
- *Environmental Protection (Wagerup Alumina Refinery Noise Emissions) Amendment Approval 2013; and*
- *Environmental Protection (Wagerup Alumina Refinery Noise Emissions) Amendment Approval 2014.*

In this document the term 'The Approval' refers to all these documents read together.

Clause 7 of The Approval requires Alcoa to appoint an independent noise consultant for the period commencing 10 March 2014 to 10 December 2015. The independent noise consultant is required to undertake, and report on, a noise monitoring program of work prescribed in clause 8 of The Approval.

SVT Engineering Consultants were appointed by Alcoa to provide the independent noise consultant and nominated Jim McLoughlin as the principal consultant responsible for the completion of the monitoring program, along with three other consultants satisfying the qualifications specified in The Approval. The nominated consultants were notified to the Department of Environmental Regulation (DER) on 7 March 2014. Appendix B provides a brief summary of the nominated consultants.

Clause 9 of The Approval requires the noise consultant to prepare a report on the noise monitoring conducted under clause 8. This report fulfils this requirement.

1.2 Objectives

The objectives of the monitoring program are:

- a) to provide a comparison of noise emitted from the Refinery, as measured by continuous noise monitoring systems at two locations (Location 1 and 2), during the period of The

- Approval and the year 2001, or the year next after 2001 for which sufficient relevant data is available; and
- b) to measure compliance with Approved Levels at eight locations set out in Clause 3 of The Approval.

1.3 Scope

This report has been prepared in two parts: Part A and Part B.

Part A describes the comparison of current Refinery noise emissions with historical noise emissions and has been prepared in accordance with the requirements of Clauses 8(1)(a), 8(2), and 8(3) of The Approval. (Item (a) in the objectives above.)

Part B describes the measurement of compliance with the Approved Levels and has been prepared in accordance with the requirements of Clauses 8(1)(b) and 8(4) of The Approval. (Item (b) in the objectives above.)

2. PART A – COMPARISON OF CURRENT AND HISTORICAL REFINERY NOISE EMISSIONS

2.1 Introduction

Clause 9(3)(a) of The Approval requires a summary to be prepared of at least the last 8 months of noise emissions data collected under the noise monitoring program⁹, and for this data to be compared with relevant noise emissions data collected for the Wagerup Refinery in 2001¹⁰.

Noise levels have been (and continue to be) monitored by Alcoa using continuous noise monitoring systems at one location to the north and one location to the south of the Refinery; Location 1 and Location 2, respectively. This data has been used as the basis of the comparison.

Location 1 is sited close to the Refinery access road (Willowdale Road) at the point fixed by MGA94 coordinates 398164 East and 6359322 North. Location 2 is sited close to Bancell Road at the point fixed by 398202 East and 6356379 North.

Weather data has been (and continues to be) simultaneously monitored at a weather station close to Bancell Road, south of the Refinery, at the point fixed by MGA94 coordinates 397904.2 East and 6356418.3 North.

Figure 2-1 shows the locations of the noise monitoring systems and the weather station.

The following sections describe the procedures used to measure noise emissions, and compare the results of the current noise monitoring program with the historical data selected for the comparison.

⁹ Because of the time required to analyse data and publish this report, it is not practical to include data for the period right up to the due date of the report. Therefore, this report includes data and analysis for the 17 month period between 10th March 2014 and 21st August 2015. Monitoring will continue beyond this date for the period during which The Approval has effect.

¹⁰ Or, if sufficient relevant data is not available for 2001, data for the year next after 2001 for which sufficient relevant data is available.

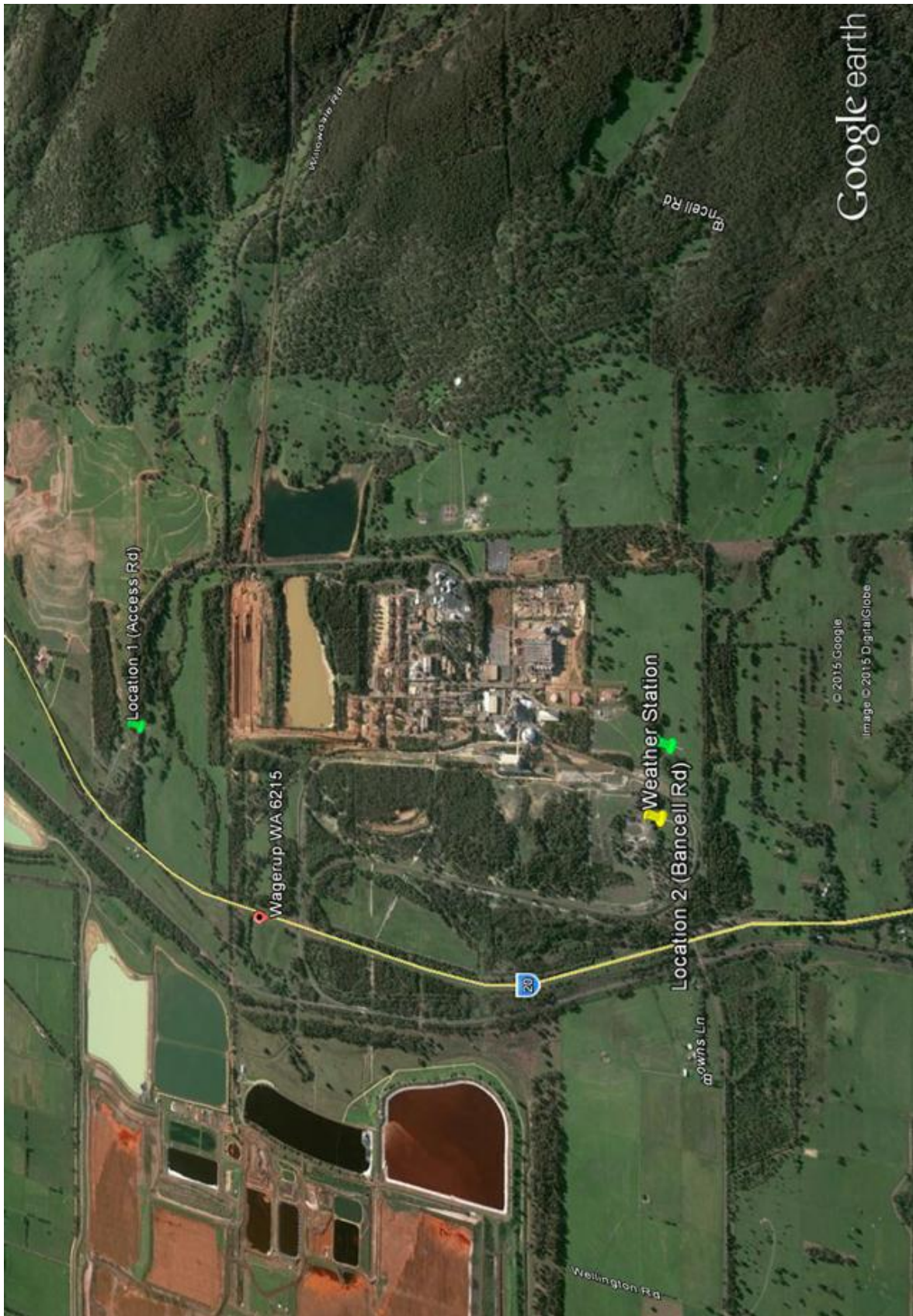


Figure 2-1 : Noise and Weather Monitoring Locations (Image courtesy of Google earth)

2.2 Selection of Data for Comparison

SVT has reviewed noise and weather data supplied by Alcoa for the period between 2001 and 2003, and has determined that the 12 month period between October 2002 and September 2003 is the earliest period after 2001 for which sufficient relevant data is available for comparison. The data was selected on the following grounds:

- Before October 2002, no noise logger was available at Location 1 (to the north of the Refinery);
- The data collected from the Bancell Road weather station in 2001 is no longer available; and
- With a few exceptions¹¹, it was found that there was a high percentage of noise and weather data available for each month between October 2002 and September 2003.

2.3 Review of Noise Monitoring Systems

A review of the monitoring systems used to collect data during the period between October 2002 and September 2003 was conducted by SVT in 2002 as part of a review of noise emissions from the Wagerup Refinery on behalf of the Department of Environmental Protection. The findings were presented in Section 4.1 of SVT Report AV/02/08/005, *Review of Environmental Noise Emissions From Alcoa Wagerup Refinery, Revision 0, December 2002*. In summary the 2002 review found:

"Alcoa's noise monitoring network is a comprehensive system that employs up-to-date technology. It has been well conceived and implemented, and is capable of accurately monitoring sound levels. The system includes a meteorological station that allows further interpretation of the monitored noise data."

Alcoa replaced the continuous noise monitoring system in 2013 because some of the technology had become obsolete and the monitors were becoming less reliable. The new monitors were installed in the same locations.

SVT has inspected the noise monitoring systems currently installed at Locations 1 and 2 and is satisfied that they are well designed and implemented systems capable of accurately monitoring sound levels. Both satisfy the requirements for sound measuring equipment specified in the *Environmental Protection (Noise) Regulations 1997. (The Regulations.)* They record the same statistical noise level parameters over the same time periods (6 minutes) as the system used in 2002 and 2003, thus allowing a direct comparison of current and historical data to be undertaken.

Figure 2-2 and Figure 2-3 show the current noise monitoring systems.

¹¹ Limited noise data is available for Location 1 during August 2002, and no data is available for Location 1 during September 2003. No rainfall data is available for August and September 2003.



Figure 2-2 : Noise Monitoring System at Location 1



Figure 2-3 : Noise Monitoring System at Location 2

2.4 Methodology for Determining Refinery Contribution to Measured Noise Levels

Alcoa has provided SVT with noise data from their continuous monitoring systems at Location 1 and Location 2, and meteorological data from their Bancell Road weather station.

Noise recorded at the monitoring locations includes contributions from the Refinery and from extraneous sources. The L_{A95} level is the noise level exceeded for 95% of the time period (i.e. 95% of each 6 minute period) and represents the consistent, underlying noise excluding most short term noise events such as passing vehicles, animal calls, etc. The L_{A95} noise measurement parameter has been selected to provide the greatest confidence that the recorded noise levels are representative of noise emissions from the Refinery.

The following methodology (developed in consultation with DER representatives) has been followed to determine the Refinery's contribution to measured noise levels:

- L_{A95} noise level data for each 6 minute period has been synchronised with the simultaneously recorded weather data.
- Noise data has been rejected for wind speeds greater than 3 m/s and less than 0.5 m/s. This is consistent with the methodology adopted previously by Herring Storer Acoustics (Report No.: 4417-3 -05029-4-2-5 *Noise Feasibility study Relative to Operating License No 6217/8 Condition N3*) and reduces the likelihood of measured levels being affected by wind generated noise.
- Noise data has been rejected where the wind direction is not downwind of the Refinery; within a window of 90 degrees. (Noise from the Refinery is likely to be at its highest under downwind conditions and recorded levels are less likely to be affected by extraneous noise sources from other directions.) Wind direction angles used to define down-wind conditions for Locations 1 and 2 are between 115.5 – 205.5 degrees and 335.2 – 65.2 degrees respectively.
- Noise level data has been rejected for periods when rainfall was recorded¹² because noise generated by rain affects measured levels.
- Noise level data has been rejected where the average noise level (L_{Aeq}) in any 6 minute period is greater than the noise level exceeded for 10% of that period (L_{A10}). This eliminates periods where high level noise events from extraneous sources are likely to affect the L_{A95} data.
- The remaining subset of L_{A95} noise data has been analysed to determine the monthly medians, upper 10th percentiles¹³ and standard deviations for the current monitoring program and for the 12 month period from October 2002 to September 2003¹⁴.

¹² No rainfall data is available for August and September 2003.

¹³ The upper 10th percentile data is included in the tables provided in Appendix D so that the data analysis is consistent with the analysis of data collected in 2002-2003 conducted by Herring Storer Acoustics in their report no.: 4417-3 -05029-4-2-5 *Noise Feasibility study Relative to Operating License No 6217/8 Condition N3*.

¹⁴ This data set includes noise data from August and September 2003 for which no rainfall data is available.

2.5 Results from Continuous Noise Monitoring Program

The following sections (2.5.1 and 2.5.2) present comparisons of the monthly median L_{A95} data collected during the 2002-2003 period, with data collected during 2014 and 2015 at Locations 1 and 2.

The tables in Appendix D provide the following additional information:

- Annual, seasonal and monthly median and upper 10th percentile levels for both day time and night time hours; and
- Standard deviations and numbers of data points included in the analyses.

The charts in Appendix E show the statistical distribution of the L_{A95} noise level data.

2.5.1 Location 1

Figure 2-4 compares monthly noise level data collected during the 2002-2003 period, with data collected between March 2014 and August 2015 at Location 1.

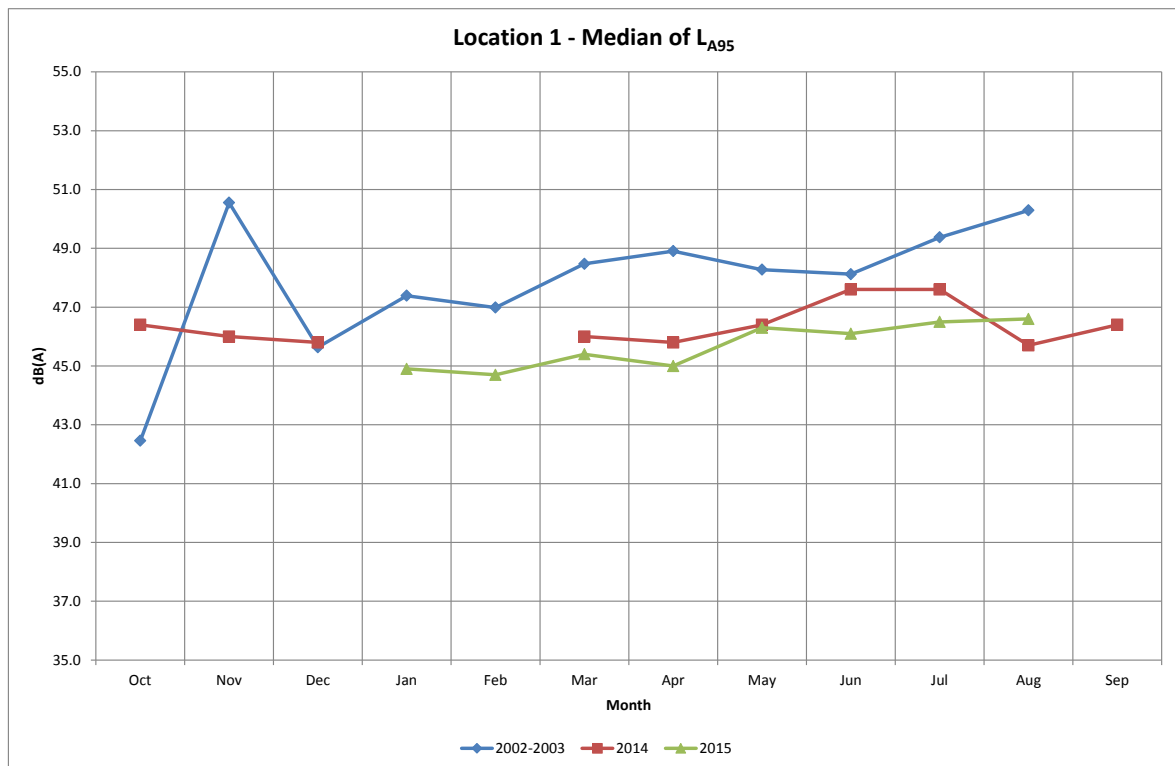


Figure 2-4 : Location 1, Comparison of Median L_{A95}

The monthly median L_{A95} noise levels from the most recent monitoring (2014 and 2015) are mostly lower than those measured during 2002-2003¹⁵.

2.5.2 Location 2

Figure 2-5 compares monthly noise level data collected during the 2002-2003 period, with data collected between March 2014 and August 2015 at Location 2.

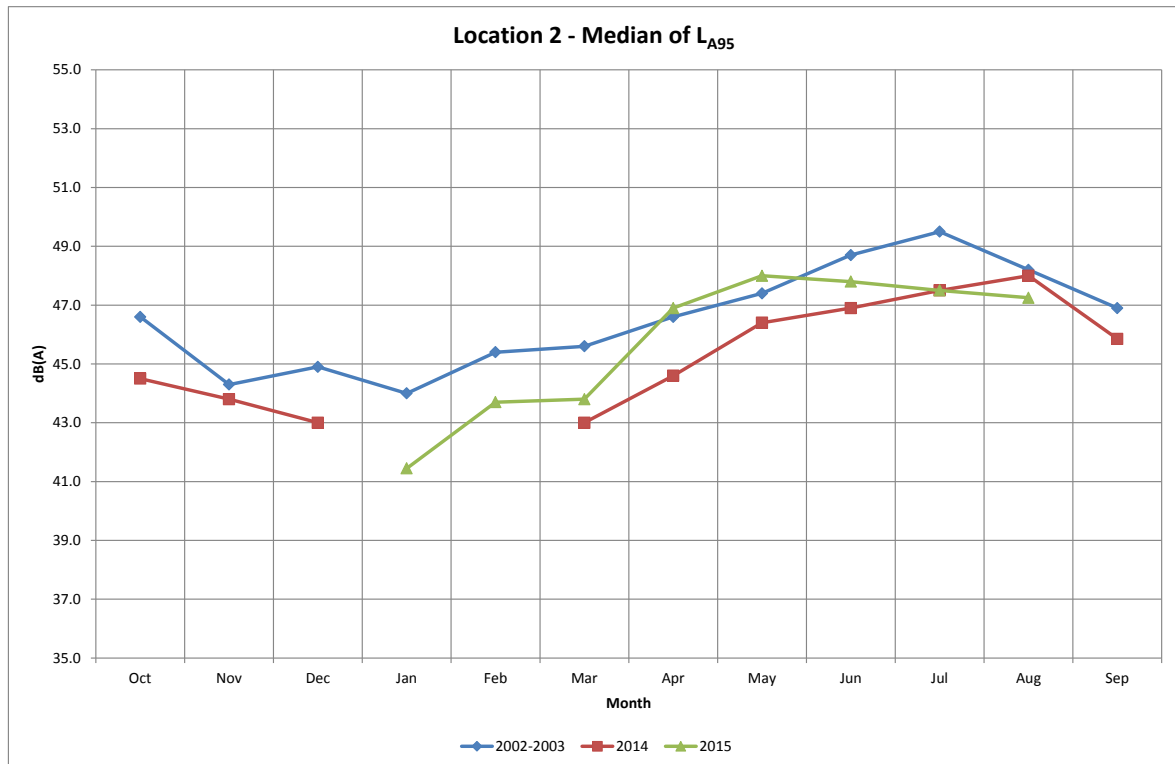


Figure 2-5 : Location 2, Comparison of Median L_{A95}

The monthly median L_{A95} noise levels recorded during 2014 are lower than those measured during 2002-2003. Noise levels measured during 2015 are also lower than those measured during 2002-2003 excepting the months of April and May when marginally higher (less than 1 dB) values were recorded.

2.6 Conclusions

The results presented above (and in Appendices D and E) demonstrate that Refinery noise emissions recorded at both Locations 1 and Location 2 during 2014 and 2015 are lower than those recorded at the same locations during 2002-2003.

Median L_{A95} noise levels recorded at Location 1, north of the Refinery, were lower than those recorded during 2002-2003 in all seasons of the year. Monthly median L_{A95} noise levels were lower

¹⁵ Alcoa has advised that there is uncertainty over the exact siting of Location 1 during October and November 2002, and it is noted that no data is provided for these months in the Herring Storer report No.: 4417-3 -05029-4-2-5 *Noise Feasibility Study Relative to Operating License No 6217/8 Condition N3*.

than those recorded during 2002-2003 in all months except for the months of October and December 2014.

Median L_{A95} noise levels recorded at Location 2, south of the Refinery, were similar to or lower than those recorded during 2002/2003 in all seasons of the year. Monthly median L_{A95} noise levels were lower than those recorded during 2002/2003 except for the months of April and May 2015.

3. PART B – COMPLIANCE ASSESSMENT MONITORING

3.1 Introduction

Alcoa has been granted approval for a variation to the assigned noise levels specified in the *Environmental Protection (Noise) Regulations 1997*. This allows Alcoa to exceed the standard prescribed under Regulation 7(1)(a) (other than the L_{Amax} assigned level) if the noise emitted from the Refinery does not exceed Approved Levels (refer section 3.4) specified in clause 3 of The Approval at eight off-site locations.

Clause 8(1)(b) of The Approval requires Alcoa's independent noise consultant to conduct compliance monitoring at each of the eight off-site locations specified in Clause 2 (see section 3.3 and Appendix C). This monitoring must be conducted between 1 May and 30 September 2014, and between 1 May and 1 July 2015.

The following sections describe the compliance monitoring procedures and compare the monitored levels with the Approved Levels.

3.2 Specific Requirements of the Compliance Monitoring

Clause 8(4) of The Approval requires that noise monitoring be undertaken at each of the eight locations on:

- at least 3 occasions between 1 May and 30 September 2014; and
- at least 3 occasions between 1 May and 1 July 2015.

The monitoring must be conducted between 2200 hours on any day to 0700 hours the next day.

Within these parameters, the methodology specifies that the independent noise consultant should attempt to schedule monitoring under conditions conducive to maximum (or near maximum) propagation of Refinery noise emissions to each measurement location.

3.3 Compliance Monitoring Locations

The eight off-site locations¹⁶ are specified in The Approval and are shown in Figure 3-1. The definitions of each of the locations contained in The Approval are provided in Appendix C.

¹⁶ Note that compliance monitoring Locations 1 & 2 are not the same as the continuous monitoring Locations 1 & 2 referenced in Part A of this report.

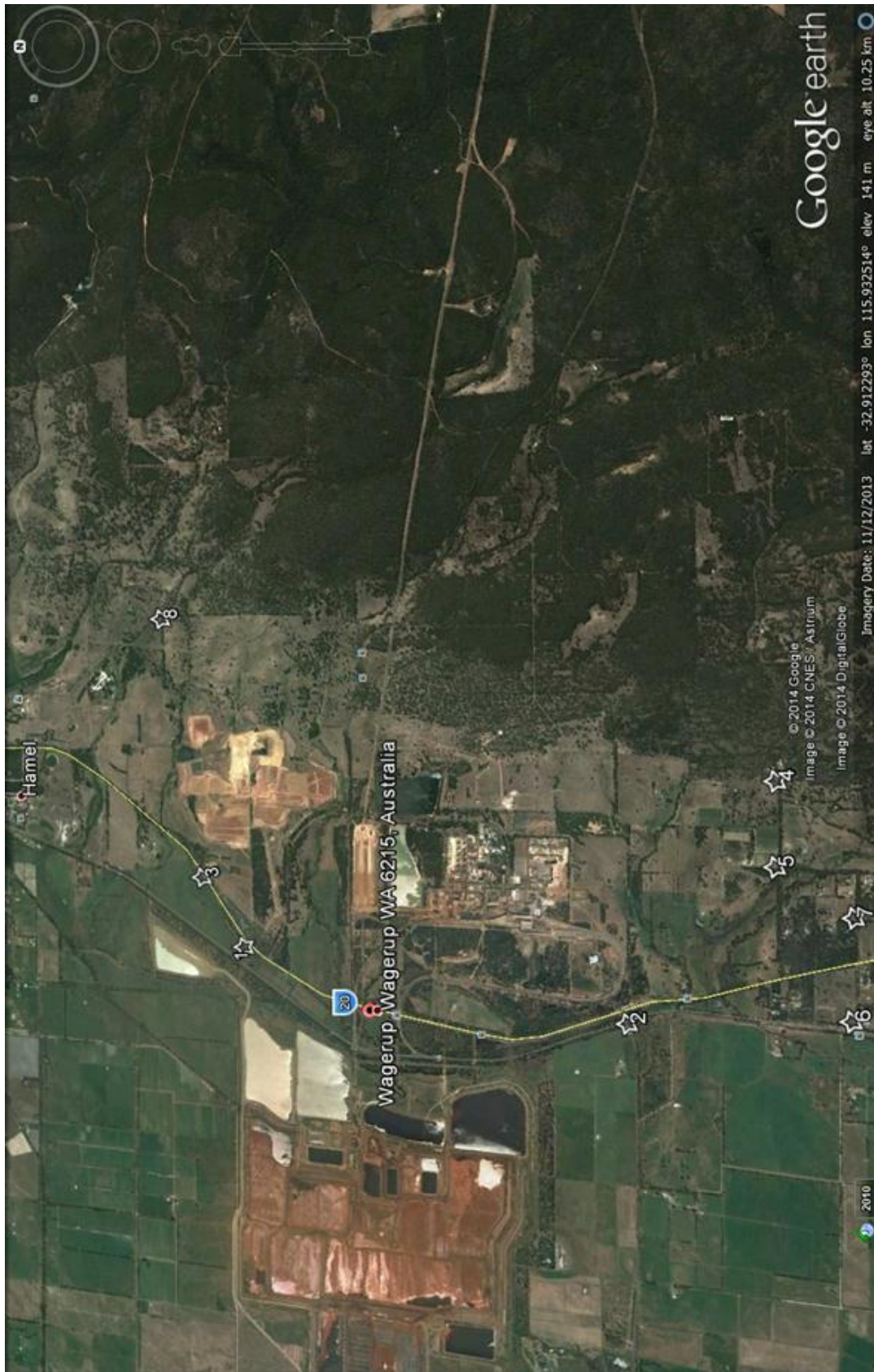


Figure 3-1 : Noise Monitoring Locations (Image courtesy of Google earth)

3.4 Approved Levels

The Approved Levels are specified in terms of two statistical noise level parameters:

- L_{A1} means a noise level which is not to be exceeded for more than 1% of any period of 3 hours; and
- L_{A10} means a noise level which is not to be exceeded for more than 10% of any period of 3 hours.

Table 3-1 summarises the approved noise levels for the night-time period for each of the eight locations.

Table 3-1 : Approved Noise Levels (Night-time)

Compliance Monitoring Location	Approved Levels dB(A)	
	L_{A10}	L_{A1}
1	47	49
2	46	48
3	45	47
4	41	45
5	41	45
6	37	45
7	37	45
8	36	45

3.5 Noise Monitoring and Compliance Assessment Procedure

The procedure adopted for compliance assessment monitoring was developed in consultation with Department of Environmental Regulation (DER) representatives.

The procedure stipulates attended monitoring over a 3 hour assessment period between the hours of 10 pm and 7 am. During each 3 hour assessment period, the noise monitor was paused and re-started so as to exclude, as far as practical, noise from extraneous sources such as passing road vehicles and trains. In some instances the recorded data was post-processed to eliminate extraneous noise events which were not excluded at the time of the measurements, (e.g. short-lived events such as localised bird calls or train horns).

Where measured noise levels were below the Approved Levels at the relevant monitoring location, no additional analysis of the measured data was undertaken to determine the Refinery's contribution to the recorded levels. (I.e. the recorded noise levels include contributions from Refinery noise emissions as well as background noise.)

Where measured levels were above the Approved Levels, but were affected by continuous noise from insects and other fauna, a filtering process agreed with the DER was applied to the measurements before assessing compliance. This process involved excluding the high frequency (high pitched) part of the audio spectrum which can be dominated by noise from insects and fauna, but which is largely unaffected by noise emissions from the Refinery at the monitoring locations.

Continuous noise loggers were also deployed at each location at the same time as the attended monitoring was undertaken. This data was collected as back up information and has not been analysed or used to determine compliance except on a small number of occasions where the primary measurements were unusable.

Tonality in Refinery noise emissions (e.g. whining or droning), as defined in *The Regulations*, was also assessed as part of the monitoring program.

Throughout the noise monitoring periods, the monitoring personnel communicated with Refinery process controllers to determine whether any relevant activities were occurring within the Refinery which may have affected the noise measurements.

Detailed weather forecasts were supplied by Alcoa to enable measurements to be scheduled under conditions conducive to maximum (or near maximum) propagation of Refinery noise emissions to each measurement location.

3.6 Monitoring Equipment

Noise monitoring was undertaken using equipment satisfying the rules for sound measuring equipment specified in *The Regulations*. The equipment had been calibrated in an approved calibration laboratory with the 2 year period preceding the date of the measurements. Field performance checks of the equipment were conducted using a standard sound source before and after the measurements were made.

3.7 Dates of Noise Monitoring

Attended noise monitoring was undertaken on six separate occasions between 12 June and 11 September 2014 and on four occasions between 5 May and 5 June 2015. Table 3-2 summarises the dates and locations assessed on each occasion.

Table 3-2 : Dates of Attended Noise Monitoring

Site Trip No.	Start Date	End Date	No. of Consecutive Nights	Compliance Monitoring Locations Assessed
2014				
1	12 June 2014	14 June 2014	2	1, 2, 3, 8
2	24 June 2014	25 June 2014	1	2, 7
3	9 July 2014	11 July 2014	2	2, 4, 5, 6, 7
4	22 July 2014	23 July 2014	1	1, 3, 8
5	19 August 2014	20 August 2014	1	4, 6, 7
6	10 September 2014	11 September 2014	1	4, 5, 8
2015				
7	5 May 2015	7 May 2015	2	1, 2, 3, 8
8	7 May 2015	9 May 2015	2	1, 2, 3, 8
9	25 May 2015	27 May 2015	2	4, 5, 6, 7
10	4 June 2015	5 June 2015	1	4, 5, 6, 7

3.8 Prevailing Meteorological Conditions

All attended monitoring was performed under weather conditions conducive to maximum (or near maximum) propagation of Refinery emissions to each monitoring location. Prevailing wind conditions recorded at the Bancell Road weather station are summarised in the results tables presented for each location (Table 3-5 to Table 3-12) in subsequent sections of this report.

3.9 Results of Compliance Assessment Monitoring

3.9.1 Summary of Noise Measurements

Table 3-3 and Table 3-4 present summaries of the noise monitoring undertaken in 2014 and 2015 respectively. The tables include the highest measured levels recorded on any occasion and, where relevant, the maximum extent of any exceedance of the Approved Levels. More detailed results and comments are provided for each location in the subsequent sections (3.10 to 3.17) of this report.

Table 3-3 : Noise Monitoring Summary 2014

Compliance Monitoring Location	Approved Levels dB(A)		Highest Measured Levels dB(A)		Extent of Any Exceedance dB	
	LA10	LA1	LA10	LA1	LA10	LA1
1	47	49	46.2	46.9	-	-
2	46	48	45.6	48.0	-	-
3	45	47	45.9	48.7	0.9	1.7
4	41	45	41.9	43.1	0.9	-
5	41	45	39.4	44.9	-	-
6	37	45	34.8	37.0	-	-
7	37	45	37.7	40.5	0.7	-
8	36	45	42.0	44.5	-*	-*

*Compliance with the Approved Levels could not be determined from the measurements recorded at Location 8 during 2014 because of persistent high background noise from fauna and insects.

Table 3-4 : Noise Monitoring Summary 2015

Compliance Monitoring Location	Approved Levels dB(A)		Highest Measured Levels dB(A)		Extent of Any Exceedance dB	
	LA10	LA1	LA10	LA1	LA10	LA1
1	47	49	44.8	46.3	-	-
2	46	48	46.5	47.8	0.5	-
3	45	47	42.3	44.6	-	-
4	41	45	39.0	43.6	-	-
5	41	45	37.2	38.6	-	-
6	37	45	33.9	35.8	-	-
7	37	45	34.0	35.9	-	-
8	36	45	36.1	37.9	0.1	-

L_{Amax} noise levels were also measured during the monitoring program. Measured L_{Amax} levels were in all cases attributable to extraneous noise sources (such as bird calls, train horns, dogs barking, passing vehicles, etc). No L_{Amax} levels exceeding the assigned noise levels could be attributed to noise emissions from the Refinery.

3.10 Location 1

3.10.1 Noise Monitoring Results – Location 1

Table 3-5 : Noise Monitoring Results - Location 1

Date	3hr Assessment Period	Residual Measurement Duration	Note	30 m Weather		Measured Noise Levels dB(A)	
				Speed (m/s)	Direction (deg)	LA10	LA1
2014							
13 Jun 2014	2:00am - 5:00am	1 hr 1 min 39 s	1	3 - 4	107 - 124	44.8	46.4
14 Jun 2014	1:40am - 4:40am	1 hr 42 min 55 s	2	0 - 2	14 - 357	43.4	45.6
22-23 Jul 2014	11:00pm - 2:00am	2 hr 07 min 54 s	3	1 - 3	148 - 196	46.2	46.9
2015							
6 May 2015	1:45am - 4:45am	1 hr 38 min 13 s	4	0 - 3	26 - 323	44.1	45.7
6-7 May 2015	10:00pm - 1:00am	1 hr 44 min 57 s	4	1 - 4	113 - 207	41.5	43.2
8 May 2015	1:50am - 4:50am	1 hr 05 min 45 s	5	1 - 3	122 - 216	44.8	46.3
Approved Levels						47	49

Notes:

- 1) Persistent noise from insects.
- 2) Insect noise audible. Material handling activities from bauxite stockpile area also audible.
- 3) Persistent noise from insects and frogs. Refinery audible, no readily identifiable source other than occasional start-up alarm.
- 4) Apron feeder at Mill 3 audible.
- 5) Bauxite stockpile activities audible.

3.10.2 Compliance Assessment – Location 1

Measured noise levels were below the Approved Levels on all occasions at Location 1.

3.10.3 Tonality Assessment – Location 1

Tonality associated with the Refinery was neither audible nor evident from the measured noise spectra on any occasion at Location 1.

3.11 Location 2

3.11.1 Noise Monitoring Results – Location 2

Table 3-6 : Noise Monitoring Results - Location 2

Date	3hr Assessment Period	Residual Measurement Duration	Note	30 m Weather		Measured Noise Levels dB(A)	
				Speed (m/s)	Direction (deg)	LA10	LA1
2014							
13 Jun 2014	2:50am – 5:50am	1 hr 26 min 10 s	-	3 - 4	107 - 121	44.5	46.2
24-25 Jun 2014	10:30pm – 1:30am	1 hr 19 min 11 s	1	1 - 3	3 - 356	44.3	48.0
10 Jul 2014	2:20am – 5:20am	1 hr 0 min 24 s	2	0 - 3	4 - 359	45.6	47.8
2015							
6 May 2015	1:45am - 4:45am	1 hr 59 min 45 s	-	0 - 3	26 - 323	45.4	46.6
7 May 2015	1:35am - 4:35am	1 hr 59 min 40 s	3	1 - 3	78 - 285	46.5	47.8
8-9 May 2015	10:00pm - 1:00am	1 hr 22 min 58 s	-	2 - 4	102 - 230	43.9	45.6
Approved Levels						46	48

Notes:

- 1) Material handling activities from bauxite stockpile audible.
- 2) Some noise from insects and frogs.
- 3) Elevated noise levels between approximately 2:40 am and 4:05 am but no readily identifiable source.

3.11.2 Compliance Assessment – Location 2

Measured noise levels in 2014 were below the Approved Levels on all occasions at Location 2.

Measured noise levels exceeded the LA10 Approved Level on the morning of 7 May 2015 by 0.5 dB. Elevated noise levels were recorded between approximately 2:40 am and 4:05 am but no dominating source within the Refinery was identified as contributing to this exceedance. A train was present within the Refinery at this time, but audible noise from this train was excluded from the measurement. The exceedance on this occasion is considered to be due to meteorological conditions conducive to maximum sound propagation towards this location.

3.11.3 Tonality Assessment – Location 2

Tonality from the Refinery was observed in the 80 Hz 1/3rd octave frequency band during the measurements undertaken on 10 Jul 2014. A visit to the Refinery on 11 July 2014 allowed the source of this tonality to be determined as the vacuum pumps in Precipitation Building 44-2.

The recorded spectrum for the measurements undertaken on 13 June 2014 showed an elevated level in the 500 Hz $1/3^{\text{rd}}$ octave frequency band which satisfied the criteria for demonstrating tonality defined in *The Regulations*. However, subjectively this tonality was inaudible by monitoring personnel at the time of the measurements and so the cause of the elevated level in this frequency band was not determined.

During 2015, the measurements undertaken on the night of 8-9 May showed an elevated level in the 80 Hz $1/3^{\text{rd}}$ octave frequency band which satisfied the criteria for demonstrating tonality defined in *The Regulations*. Subjectively this tonality was inaudible by monitoring personnel at the time of the measurements, however, subsequent investigations have shown that the vacuum pumps in Precipitation Building 44-2 are the most likely source of this tonality.

3.12 Location 3

3.12.1 Noise Monitoring Results – Location 3

Table 3-7 : Noise Monitoring Results - Location 3

Date	3hr Assessment Period	Residual Measurement Duration	Note	30 m Weather		Measured Noise Levels dB(A)	
				Speed (m/s)	Direction (deg)	L _{A10}	L _{A1}
2014							
12-13 Jun 2014	10:15pm - 1:15am	2 hr 11 min 7 s	1	3 - 4	108 - 126	45.9	48.7
14 Jun 2014	1:35am - 4:35am	2 hr 17 min 25 s	2	0 - 2	14 - 357	40.5	42.2
23 Jul 2014	2:25am - 5:25am	1 hr 19 min 6 s	3	2 - 4	127 - 225	39.8*	43.2*
2015							
5-6 May 2015	10:15pm - 1:15am	2 hr 05 min 46 s	4	2 - 4	107 - 176	42.3	44.6
7 May 2015	1:20am - 4:20am	1 hr 56 min 04 s	-	1 - 3	78 - 269	38.9	42.0
9 May 2015	1:35am - 4:35am	1 hr 32 min 39 s	5	1 - 4	116 - 201	41.5	42.8
Approved Levels						45	47

* Measurement results filtered between 40 Hz and 1 kHz in accordance with the process agreed with the DER.

Notes:

- 1) Emergency reclaim operations in progress when measurements recorded. Mobile equipment associated with these operations audible.
- 2) Persistent noise from insects and frogs.
- 3) Persistent noise from insects and frogs. Material handling activities from bauxite stockpile area also audible.
- 4) Apron feeder at Mill 3 audible.
- 5) Material handling activities from bauxite stockpile audible.

3.12.2 Compliance Assessment – Location 3

On the night of 12-13 June 2014, measured noise levels exceeded the L_{A10} Approved Level by 0.9 dB and the L_{A1} Approved level by 1.7 dB. Mobile equipment (loaders) associated with the emergency reclaim operations were identified as the source of the exceedance.

No exceedances of the Approved Levels were recorded during 2015.

3.12.3 Tonality Assessment – Location 3

The measurements undertaken on the night of 12-13 June 2014 showed an elevated level in the 80 Hz $1/3^{\text{rd}}$ octave frequency band which satisfied the criteria for demonstrating tonality defined in *The Regulations*. Subjectively this tonality was inaudible by monitoring personnel at the time of the measurements, however it is likely that the elevated level in this frequency band is associated with the mobile equipment used during emergency reclaim operations.

Tonality associated with the Refinery was neither audible nor evident from the measured noise spectra on any occasion during 2015.

3.13 Location 4

3.13.1 Noise Monitoring Results – Location 4

Table 3-8 : Noise Monitoring Results - Location 4

Date	3hr Assessment Period	Residual Measurement Duration	Note	30 m Weather		Measured Noise Levels dB(A)	
				Speed (m/s)	Direction (deg)	L _{A10}	L _{A1}
2014							
11 Jul 2014	2:00am - 5:00am	1 hr 28 min 15 s	1	0 - 2	41 - 348	39.9	40.9
19-20 Aug 2014	10:10pm - 1:10am	1 hr 23 min 12 s	2	1 - 4	2 - 358	38.3*	39.8*
20 Aug 2014	1:30am - 4:30am	1 hr 35 min 26 s	2	2 - 5	2 - 359	41.3*	42.5*
11 Sep 2014	2:00am - 5:00am	1 hr 09 min 39 s	3	1 - 2	14 - 284	41.9*	43.1*
2015							
25-26 May 2015	10:00pm - 1:00am	1 hr 32 min 8 s	4	0 - 2	5 - 357	39.0	40.9
26-27 May 2015	10:00pm - 1:00am	0 hr 55 min 51 s	-	1 - 4	90 - 210	35.3	39.3
5 June 2015	1.30am - 4.30am	1 hr 21 min 8 s	-	2 - 3	11 - 26	38.5	43.6
Approved Levels						41	45

* Measurement results filtered between 40 Hz and 1 kHz in accordance with the process agreed with the DER.

Notes:

- 1) Significant noise from insects and frogs. Tonal noise audible in 80 Hz 1/3rd octave frequency band.
- 2) Emergency reclaim operations in progress when measurements recorded. Mobile equipment associated with these operations audible. Significant noise from frogs and insects.
- 3) Emergency reclaim audible from 3.30 am. Significant noise from insects, frogs and birds.
- 4) Tonality was audible in the 125 Hz 1/3rd octave frequency band.

3.13.2 Compliance Assessment – Location 4

Measured noise levels exceeded the L_{A10} Approved Level by 0.3 dB on the morning of 20 August 2014. Mobile equipment associated with emergency reclaim operations was identified as the likely source of the exceedance. However, the measurements were significantly affected by noise from insects and frogs.

Measured noise levels exceeded the L_{A10} Approved Level by 0.9 dB on the morning of 11 September 2014. It is most likely that extraneous noise was the cause of the measured exceedance. On this occasion, noise from frogs was clearly evident in the frequency bands

between 630 Hz and 1000 Hz and, therefore, would not have been removed by the filtering process applied to the measurements.

No exceedances of the Approved Levels were recorded during 2015.

3.13.3 Tonality Assessment – Location 4

Tonality from the Refinery was observed in the 80 Hz 1/3rd octave frequency band during the measurements undertaken on 11 Jul 2014. A visit to the Refinery on the same day allowed the source of this tonality to be determined as the vacuum pumps in Precipitation Building 44-2.

Tonality from the Refinery was observed in the 125 Hz 1/3rd octave frequency band during the measurements undertaken on 25-26 May 2015. Subsequent investigations indicate that vacuum pumps in Calcination Building 50 are the most likely source of this tonality.

3.14 Location 5

3.14.1 Noise Monitoring Results – Location 5

Table 3-9 : Noise Monitoring Results - Location 5

Date	3hr Assessment Period	Residual Measurement Duration	Note	30 m Weather		Measured Noise Levels dB(A)	
				Speed (m/s)	Direction (deg)	LA10	LA1
2014							
10 Jul 2014	2:00am - 5:00am	1 hr 37 min 46 s	1	0 - 3	4 - 359	39.0*	40.9*
11 Jul 2014	1:40am - 4:40am	1 hr 49 min 20 s	1	0 - 2	41 - 348	39.4*	41.1*
11 Sep 2014	1:40am - 4:40am	1 hr 47 min 26 s	2	1 - 2	14 - 168	38.8*	44.9
2015							
25-26 May 2015	10:00pm - 1:00am	1 hr 35 min 28 s	3	0 - 2	5 - 357	37.2	38.6
26-27 May 2015	10:00pm - 1:00am	0 hr 39 min 35 s	4	1 - 4	90 - 210	33.3	34.3
5 June 2015	1:40am to 4:40am	2 hr 12 min 55 s	-	2 - 3	11 - 26	37.2	38.5
Approved Levels						41	45

* Measurement results filtered between 40 Hz and 1 kHz in accordance with the process agreed with the DER.

Notes:

- 1) Significant noise from insects and frogs. Tonality audible in 80 Hz 1/3rd octave frequency band.
- 2) Emergency reclaim audible from 3.30 am. Significant noise from insects and frogs.
- 3) Tonality was audible in the 125 Hz 1/3rd octave frequency band.
- 4) Gusty winds affected background noise and limited residual measurement duration.

3.14.2 Compliance Assessment – Location 5

Measured noise levels were below the Approved Levels on all occasions at Location 5.

3.14.3 Tonality Assessment – Location 5

Tonality from the Refinery was observed in the 125 Hz 1/3rd octave frequency band during the measurements undertaken on 25-26 May 2015. Subsequent investigations indicate that vacuum pumps in Calcination Building 50 are the most likely source of this tonality.

The measurements undertaken on the night of 25-26 May 2015 also showed an elevated level in the 80 Hz 1/3rd octave frequency band which satisfied the criteria for demonstrating tonality defined in *The Regulations*. Subjectively this tonality was inaudible by monitoring personnel at the

time of the measurements, however, subsequent investigations have shown that the vacuum pumps in Precipitation Building 44-2 are the most likely source of this tonality.

3.15 Location 6

3.15.1 Noise Monitoring Results – Location 6

Table 3-10 : Noise Monitoring Results - Location 6

Date	3hr Assessment Period	Residual Measurement Duration	Note	30 m Weather		Measured Noise Levels dB(A)	
				Speed (m/s)	Direction (deg)	LA10	LA1
2014							
9-10 Jul 2014	10:00pm - 1:00am	2 hr 34 min 3 s	-	0 - 2	34 - 132	34.2	37.0
10-11 Jul 2014	10:00pm - 1:00am	1 hr 02 min 42 s	1	0 - 4	4 - 343	34.8	37.0
19-20 Aug 2014	10:00pm - 1:00am	1 hr 07 min 33 s	2	1 - 3	2 - 359	30.6	34.2
2015							
26 May 2015	1.25am - 4.25am	0 hr 53 min 30 s	-	1 - 3	4 - 359	30.7	32.9
27 May 2015	1.25am - 4.25am	0 hr 53 min 9 s	-	1 - 3	57 - 226	32.5	35.0
4-5 June 2015	10.10pm - 1.10am	1 hr 6 min 22 s	3	2 - 4	8 - 23	33.9	35.8
Approved Levels						37	45

Notes:

- 1) Tonality audible in 80 Hz 1/3rd octave frequency band.
- 2) Some noise from frogs and insects.
- 3) Some background noise from dog barking and insects.

3.15.2 Compliance Assessment – Location 6

Measured noise levels were below the Approved Levels on all occasions at Location 6.

3.15.3 Tonality Assessment – Location 6

Tonality from the Refinery was observed in the 80 Hz 1/3rd octave frequency band during the measurements undertaken on 10-11 Jul 2014. A visit to the Refinery on 11 July allowed the source of this tonality to be determined as the vacuum pumps in Precipitation Building 44-2.

The measurements undertaken on the morning of 27 May 2015 showed an elevated level in the 80 Hz 1/3rd octave frequency band which satisfied the criteria for demonstrating tonality defined in *The Regulations*. Subjectively this tonality was inaudible by monitoring personnel at the time of the measurements, however, subsequent investigations have shown that the vacuum pumps in Precipitation Building 44-2 are the most likely source of this tonality.

3.16 Location 7

3.16.1 Noise Monitoring Results – Location 7

Table 3-11 : Noise Monitoring Results - Location 7

Date	3hr Assessment Period	Residual Measurement Duration	Note	30 m Weather		Measured Noise Levels dB(A)	
				Speed (m/s)	Direction (deg)	L _{A10}	L _{A1}
2014							
25 Jun 2014	2:00am - 5:00am	1 hr 30 min 01 s	1	1 - 3	30- 69	37.7	40.5
9-10 Jul 2014	10:10pm - 1:10am	0 hr 41 min 23 s	2	0 - 2	34 - 132	36.2	38.0
10-11 Jul 2014	10:00pm - 1:00am	1 hr 19 min 08 s	3	0 - 4	4 - 343	35.8	37.5
20 Aug 2014	1:30am - 4:30am	1 hr 40 min 10 s	4	2 - 5	0 - 359	33.6*	36.1*
2015							
26 May 2015	1.25am - 4.25am	1 hr 2 min 4 s	5	1 - 3	4 - 359	33.0	35.2
27 May 2015	1.25am - 4.25am	0 hr 58 min 8 s	6	1 - 3	57 - 226	31.5	33.8
4-5 June 2015	10.20pm - 1.20am	1 hr 46 min 28 s	-	2 - 4	8 - 23	34.0	35.9
Approved Levels						37	45

* Measurement results filtered between 40 Hz and 1 kHz in accordance with the process agreed with the DER.

Notes:

- 1) Elevated noise levels between approximately 3 am and 4 am but no readily identifiable source.
- 2) Tonality audible in 80 Hz 1/3rd octave frequency band. Occasional beeping sound heard.
- 3) Tonality audible in 80 Hz 1/3rd octave frequency band.
- 4) Significant noise from frogs, insects and birds. Faint tonality occasionally audible in 500 Hz 1/3rd octave frequency band.
- 5) Some background noise from livestock.
- 6) Some background noise from dog barking and livestock.

3.16.2 Compliance Assessment – Location 7

Measured noise levels exceeded the L_{A10} Approved Level on the morning of 25 June 2014 by 0.7 dB. Elevated noise levels were recorded between approximately 3 am and 4 am but no dominating source was identified as contributing to this exceedance. The exceedance on this occasion is considered to be due to meteorological conditions conducive to maximum sound propagation towards this location.

No exceedances of the Approved Levels were recorded during 2015.

3.16.3 Tonality Assessment – Location 7

Tonality from the Refinery was observed in the 80 Hz 1/3rd octave frequency band during the measurements undertaken on 10-11 Jul 2014. A visit to the Refinery on 11 July allowed the source of this tonality to be determined as the vacuum pumps in Precipitation Building 44-2.

Faint tonality was sometimes audible in the 500 Hz frequency band during the measurements recorded on 20 Aug 2014. In the days following the monitoring, SVT visited the Refinery to assess noise associated with the VOC Emissions Reduction Project. During this assessment, tonality was observed in the 500 Hz 1/3 octave frequency band originating from Calcination Building 50. The temporary removal of acoustic insulation on some sections of the blower discharge ducting was identified as the likely source of tonality observed at this location. Alcoa has advised that this insulation has been re-instated.

The measurements undertaken on the mornings of 26 and 27 May 2015 also showed elevated levels in the 80 Hz 1/3rd octave frequency band which satisfied the criteria for demonstrating tonality defined in *The Regulations*. Subjectively this tonality was inaudible by monitoring personnel at the time of the measurements, however, subsequent investigations have shown that the vacuum pumps in Precipitation Building 44-2 are the most likely source of this tonality.

3.17 Location 8

3.17.1 Noise Monitoring Results – Location 8

Table 3-12 : Noise Monitoring Results - Location 8

Date	3hr Assessment Period	Residual Measurement Duration	Note	30 m Weather		Measured Noise Levels dB(A)	
				Speed (m/s)	Direction (deg)	L _{A10}	L _{A1}
2014							
13-14 Jun 2014	10:00pm - 1:00am	3 hr 00 min 32 s	1	1 - 4	90 - 328	42.0	44.5
22-23 Jul 2014	10:40pm - 1:40am	2 hr 6 min 40 s	2	1 - 3	148 - 196	39.5*	42.6*
10-11 Sep 2014	10:00am - 1:00am	0 hr 46 min 55 s	3	1 - 3	4 - 353	37.0*	40.3*
2015							
5 - 6 May 2015	10:15pm - 1:15am	2 hr 37 min 25 s	4	2 - 4	107 - 176	36.1	37.9
6-7 May 2015	10:00pm - 1:00am	2 hr 52 min 39 s	5	1 - 4	113 - 207	32.4	35.1
7-8 May 2015	10:10pm - 1:10am	1 hr 17 min 22 s	6	1 - 4	108 - 208	34.5	36.8
Approved Levels						36	45

* Measurement results filtered between 40 Hz and 1 kHz in accordance with the process agreed with the DER.

Notes:

- 1) Refinery inaudible, measurements dominated by noise from birds and cows.
- 2) Noise from frogs and insects continuous and dominating. Material handling activities from bauxite stockpile occasionally audible.
- 3) Noise from frogs, insects and birds continuous and dominating.
- 4) Elevated noise levels observed towards the end of the monitoring period.
- 5) Background noise from cows, traffic and occasional wind.
- 6) Material handling activities from bauxite stockpile area audible. Some background noise from occasional wind.

3.17.2 Compliance Assessment – Location 8

Although measured L_{AS10} noise levels were higher than the Approved Levels on each monitoring occasion during 2014, compliance could not be determined because all measurements were dominated by noise from birds, insects and other fauna.

Measured noise levels exceeded the L_{A10} Approved Level on the night of 5-6 May 2015 by 0.1 dB. Elevated noise levels were recorded towards the end of the monitoring period, but no dominating source was identified as contributing to this exceedance. The exceedance on this occasion is

considered to be due to meteorological conditions conducive to maximum sound propagation towards this location.

3.17.3 Tonality Assessment – Location 8

The measurements undertaken on the night of 7-8 May 2015 showed an elevated level in the 80 Hz 1/3rd octave frequency band which satisfied the criteria for demonstrating tonality defined in *The Regulations*. Subjectively this tonality was inaudible by monitoring personnel at the time of the measurements, however, subsequent investigations have shown that the vacuum pumps in Precipitation Building 44-2 are the most likely source of this tonality.

3.18 Conclusions

3.18.1 Conclusions from Monitoring Undertaken in 2014

Noise monitoring undertaken during 2014 demonstrated compliance with the Approved Levels at Locations 1, 2, 5 and 6.

Compliance could not be determined at Location 8 due to persistent high levels of extraneous noise from birds, insects and other fauna during the monitoring periods.

Noise emissions associated with emergency reclaim operations at the Refinery contributed to exceedances of the Approved Levels at Location 3 on the night of 12-13 June 2014. Noise emissions exceeded the L_{A1} and L_{A10} Approved Levels by 1.7 dB and 0.9 dB respectively.

Monitored noise levels exceeded the L_{A10} Approved Levels at Location 4 on the mornings of 20 August 2014 and 11 September 2014 by 0.3 dB and 0.9 dB respectively. Persistent noise from insects and frogs was evident on both occasions. On the morning of 20th August, noise emissions associated with emergency reclaim operations at the Refinery were audible and are likely to have contributed to the measured exceedance. On the morning of 11th September, noise from frogs was clearly evident in the same part of the audio spectrum as Refinery noise emissions and was the probable cause of the measured exceedance.

Monitored noise levels exceeded the L_{A10} Approved Levels at Location 7 on the morning of 25 June 2014 by 0.7 dB. No specific source within the Refinery was identified as contributing to this exceedance. The exceedance is considered to be due to meteorological conditions conducive to maximum sound propagation from the Refinery towards this location.

Tonality was audible in the 80 Hz 1/3rd octave frequency band on some occasions at Locations 2, 4, 5 and 6. The source of this tonality was identified as vacuum pumps in Precipitation Building 44-2 at the Refinery.

Tonality was audible in the 500 Hz 1/3rd octave frequency band at Location 7 on the morning of 20 August 2014. The temporary removal of acoustic insulation on some section of blower discharge ducting in Calcination Building 50 during the Refinery's VOC Emissions Reduction Project was identified as the source of this tonality.

The recorded spectrum for the measurements undertaken at Location 2 on 13 June 2014 showed an elevated level in the 500 Hz 1/3rd octave frequency band which satisfied the criteria for demonstrating tonality defined in *The Regulations*. However, subjectively this tonality was

inaudible by the monitoring personnel at the time of the measurement, so the cause of the elevated level in this frequency band was not determined.

L_{Amax} noise levels were also measured during the 2014 monitoring program. Measured L_{Amax} levels were in all cases attributable to extraneous noise sources (such as bird calls, train horns, dogs barking, passing vehicles, etc). No L_{Amax} levels exceeding the assigned noise levels could be attributed to noise emissions from the Refinery.

3.18.2 Conclusions from Monitoring Undertaken in 2015

Noise monitoring undertaken during 2015 demonstrated compliance with the Approved Levels at Locations 1, 3, 4, 5, 6 and 7.

Monitored noise levels exceeded the L_{A10} Approved Levels at Location 2 on the morning of 7 May 2015 by 0.5 dB. No specific source within the Refinery was identified as contributing to this exceedance. The exceedance is considered to be due to meteorological conditions conducive to maximum sound propagation from the Refinery towards this location.

Monitored noise levels exceeded the L_{A10} Approved Levels at Location 8 on the night of 5-6 May 2015 by 0.1 dB. No specific source within the Refinery was identified as contributing to this exceedance. The exceedance is considered to be due to meteorological conditions conducive to maximum sound propagation from the Refinery towards this location.

Tonality was audible in the 125 Hz $1/3^{rd}$ octave frequency band at Locations 4 and 5 on the night of 25-26 May 2015. Subsequent investigations indicate that vacuum pumps in Calcination Building 50 are the most likely source of this tonality.

Tonality in the 80 Hz $1/3^{rd}$ octave frequency band was identified from the measured noise spectra on some occasions at Locations 2, 5, 6, 7 and 8. Subjectively, however, this tonality was inaudible by monitoring personnel at the time of the measurements. Subsequent investigations have shown that the vacuum pumps in Precipitation Building 44-2 are the most likely source of the elevated levels in this frequency band.

L_{Amax} noise levels were also measured during the 2015 monitoring program. Measured L_{Amax} levels were in all cases attributable to extraneous noise sources (such as bird calls, train horns, dogs barking, passing vehicles, etc). No L_{Amax} levels exceeding the assigned noise levels could be attributed to noise emissions from the Refinery.

APPENDIX A GLOSSARY

The following table explains the technical terms used in this report. The explanations are provided in lay-man's terms and are not intended to be technical definitions. The table also includes common abbreviations used throughout the report.

Term or Abbreviation	Explanation
A-weighting	All of the noise level parameters in this report include the subscript "A" (eg L_{A1} , L_{A10} , etc). The "A" refers to a standard frequency weighting which is applied to sound measurements and relates to the human perception of sound at different frequencies.
Approved calibration laboratory	An approved calibration laboratory is one which has been approved by the CEO of the DER, or is registered with the National Association of Testing Authorities (NATA).
Approved Levels	The Approved Levels are defined in The Approval (see relevant entries in this table) and are noise levels which are not to be exceeded at eight specific locations in the vicinity of the Wagerup Refinery. There are two types of approved level: L_{A1} and L_{A10} (see relevant entries in this table).
Assigned Noise Level	Assigned noise levels are the levels of noise allowed to be received at a various types of premises at a particular time of the day or night. There are three types of assigned level: L_{Amax} , L_{A1} and L_{A10} (see relevant entries in this table) and they are specified in Regulation 7 of the Environmental Protection (Noise) Regulations 1997.
Decibel (dB)	The decibel is a logarithmic unit used to measure the amplitude of a sound. 0 dB corresponds approximately to the threshold of human hearing, and 140 dB corresponds to the threshold of pain. An increase in noise level of 3 dB corresponds to a doubling of sound energy, but subjectively represents only a small change in loudness. Changes in noise level of 1 dB or lower are usually undetectable to the human ear. A change in level of 10 dB subjectively represents a doubling of loudness.
DER	Department of Environmental Regulation.
Frequency	The rate of vibration of a sound which is commonly associated with the subjective term "pitch". Frequency is measured in Hertz (Hz) where 1 Hz is one vibration per second. An example of a high frequency sound would be the buzz from a mosquito. An example of a low frequency sound would be a low note from a bass guitar.
L_{A1}	The noise level exceeded for 1% of the time, e.g. for more than one minute in 100 minutes.

Term or Abbreviation	Explanation
L _{A1} approved level	A noise level which is not to be exceeded for more than 1% of any period of 3 hours.
L _{A10}	The noise level exceeded for 1% of the time, e.g. for more than ten minutes in 100 minutes.
L _{A10} approved level	A noise level which is not to be exceeded for more than 10% of any period of 3 hours.
L _{A95}	The noise level exceeded for 95% of the time, e.g. for more than 95 minutes in 100 minutes. This noise level parameter represents the consistent, underlying noise excluding most short term noise events such as passing vehicles, animal calls, etc.
L _{Aeq}	This is the noise level which if maintained constant would contain the equivalent sound energy as the actual sound occurring during a specified period. It is often considered as the "average" noise level for the period.
L _{Amax}	The maximum noise level in a measurement period.
Noise	Unwanted sound.
One third octave (1/3 rd) frequency band	The nominal frequency range of human hearing is from 20 Hz to 20,000 Hz. 1/3 rd octave frequency bands are smaller ranges of frequencies within this range. There are 31 1/3 rd octave bands in the human range of hearing. A 1/3 rd octave band is defined by its centre frequency. For example the 100 Hz 1/3 rd octave band represents a range of frequencies centred at 100 Hz.
Refinery	Alcoa's Wagerup Alumina Refinery.
Spectrum	The entire range over which some measurable property of a physical system or phenomenon (frequency in this report) can vary.
Standard sound source	A device which produces sound at a specified level and frequency which is used to check the accuracy of sound measuring equipment.
The Approval	<p>When read together,</p> <ul style="list-style-type: none"> the <i>Environmental Protection (Wagerup Alumina Refinery Noise Emissions) Approval 2012</i>, the <i>Environmental Protection (Wagerup Alumina Refinery Noise Emissions) Amendment Approval 2013</i>, and the <i>Environmental Protection (Wagerup Alumina Refinery Noise Emissions) Amendment Approval 2014</i> <p>outline the approval for the Wagerup Alumina Refinery to exceed the assigned noise levels. In this document the term 'The Approval' refers to all documents read together.</p>
The Regulations	The Environmental Protection (Noise) Regulations 1997.

Term or Abbreviation	Explanation
Tonality	The quality of a sound characterized by a distinct pitch such as a musical note, droning or whining. Tonal sounds are considered to be more intrusive than non-tonal sounds.

APPENDIX B SVT PERSONNEL NOMINATED FOR THE ROLE OF INDEPENDENT NOISE CONSULTANT

Clause 7 of The Approval specifies the following requirements for the independent noise consultant.

The independent consultant must be a person who:

- a) has the qualifications and skills necessary to competently undertake, and report on, the noise monitoring program;
- b) is a member of a professional body or association, the objects of which are to promote and advance the practice of acoustics in Australia;
- c) is not a related body corporate or a subsidiary (as those terms are defined in the Corporations Act 2001 (Commonwealth) section 9) of Alcoa; and
- d) is not an employee of Alcoa or any such related body corporate or subsidiary.

Details of the nominated consultants are summarized in the table below.

Name	Title	Qualifications	Experience & Professional Memberships
Jim McLoughlin	Business Unit Leader Principal Consultant Engineer	Bachelor of Science (Hons) (Electro-acoustics) Master of Science (Acoustics)	28 years'+ experience in acoustics Member of Australian Acoustical Society (AAS)
Granger Bennet	Group Leader Principal Consultant Engineer	Master of Engineering (Acoustics & Electrical Engineering)	20 years' experience in acoustics Member of the Australian Acoustical Society (AAS) Member of Engineers Australia
Greg Stewart	Technical Authority Principal Consultant Engineer	Bachelor of Engineering Master of Engineering Science (Noise & Vibrations)	11 years' experience in acoustics Member of Australian Acoustical Society (AAS) Member of American Society of Mechanical Engineers (ASME)
Ruisen (Roy) Ming	Senior Consultant Engineer	Bachelor of Science Master of Science Doctor of Philosophy	20 years' experience in acoustics Member of Acoustical Society of America (ASA)

APPENDIX C OFF-SITE LOCATIONS DEFINED IN THE APPROVAL

The following locations are specified in the Environmental Protection (Wagerup Alumina Refinery Noise Emissions) Approval 2012:

Location 1 means any place at or adjacent to the north-eastern corner of Lot 16 on Plan 202652, near the intersection of Willowdale Road and South Western Highway, Wagerup;

Location 2 means any place at or adjacent to the south-eastern corner of Lot 145 on Plan 232779, near the intersection of Bancell Road and South Western Highway, Wagerup;

Location 3 means any place at or adjacent to the western boundary of Lot 1 on Diagram 51826, near South Western Highway, Wagerup;

Location 4 means any place at or adjacent to the south-western corner of Lot 500 on Plan 22014, near the water treatment plant on Boundary Road, Wagerup;

Location 5 means any place at or adjacent to the south-eastern corner of Lot 2606 on Plan 249779, near Boundary Road, Wagerup;

Location 6 means any place at or adjacent to the north-western corner of the intersection of Millar Street and Aitken Street, Wagerup;

Location 7 means any place at or adjacent to the intersection of Chapter Road and Aitken Street, Wagerup;

Location 8 means any place at or adjacent to the south-western corner of Lot 102 on Diagram 85596, near Waterous Road, Wagerup.

APPENDIX D RESULTS FROM CONTINUOUS NOISE MONITORING

Appendix D-1 Location 1 – October 2002 – September 2003

Monitoring period	Time of Day	Upper 10 th Percentile of L _{A95}	Median L _{A95}	Standard Deviation	No. of Data Points
Annual (Oct '02 to Sep '03)	Day	51.3	48.1	4.2	9401
	Night	51.0	48.1	3.7	6243
Annual (Oct '02 to Jul '03) ¹⁷	Day	51.3	48.0	4.3	9348
	Night	51.0	48.1	3.7	6192
Winter (Jun – Aug) ¹⁸	Day	51.4	48.7	2.4	1405
	Night	51.9	49.1	2.3	828
Spring (Sep – Nov) ¹⁹	Day	57.7	49.0	6.7	2309
	Night	51.4	48.3	4.6	1678
Summer (Dec – Feb)	Day	49.5	46.7	3.6	2901
	Night	49.8	47.1	3.7	2219
Autumn (Mar – May)	Day	51.0	48.9	2.1	2786
	Night	51.0	48.6	2.1	1518
Monthly (Oct 02)	Day	50.4	40.5	4.3	866
	Night	50.6	41.7	4.6	654
Monthly (Nov 02)	Day	59.4	50.6	5.3	1443
	Night	51.6	49.6	2.5	1024
Monthly (Dec 02)	Day	48.7	46.3	5.1	1034
	Night	49.0	45.8	5.4	772
Monthly (Jan 03)	Day	50.0	47.4	2.6	990
	Night	50.1	48.0	2.1	851
Monthly (Feb 03)	Day	49.5	46.7	1.9	877
	Night	49.8	47.3	1.8	596
Monthly (March 03)	Day	50.1	48.7	1.8	1010
	Night	50.4	48.6	1.2	558
Monthly (April 03)	Day	51.4	49.5	2.2	1088

¹⁷ Excluding noise data for which no corresponding rainfall data is available

¹⁸ Excluding noise data from August for which no corresponding rainfall data is available

¹⁹ Excluding noise data from September for which no corresponding rainfall data is available

Monitoring period	Time of Day	Upper 10 th Percentile of L _{A95}	Median L _{A95}	Standard Deviation	No. of Data Points
	Night	51.5	49.7	2.8	509
Monthly (May 03)	Day	50.9	48.7	2.1	688
	Night	50.6	48.0	2.0	451
Monthly (June 03)	Day	50.4	48.1	2.2	809
	Night	50.9	48.6	1.8	451
Monthly (July 03)	Day	52.0	49.8	2.4	543
	Night	52.8	50.0	2.8	326
Monthly (Aug 03)	Day	51.9	50.7	2.2	53
	Night	52.6	50.8	1.8	51
Monthly (Sept 03) ²⁰	Day	-	-	-	-
	Night	-	-	-	-

²⁰ No noise data is available for Location 1 during September 2003.

Appendix D-2 Location 2 – October 2002 – September 2003

Monitoring period	Time of Day	Upper 10 th Percentile of L _{A95}	Median L _{A95}	Standard Deviation	No. of Data Points
Annual (Oct '02 to Sep '03)	Day	49.9	46.8	4.4	4119
	Night	50.1	47.6	3.4	3823
Annual (Oct '02 to Jul '03) ²¹	Day	50.0	46.7	4.7	3499
	Night	50.2	47.6	3.6	3077
Winter (Jun – Aug) ²²	Day	50.6	48.8	4.1	1701
	Night	50.6	49.2	2.9	1522
Spring (Sep – Nov) ²³	Day	48.1	46.2	2.3	631
	Night	48.2	46.8	1.5	805
Summer (Dec – Feb)	Day	46.0	43.0	4.3	585
	Night	47.4	45.8	4.1	515
Autumn (Mar – May)	Day	48.9	46.3	4.2	1202
	Night	49.0	46.9	3.6	981
Monthly (Oct 02)	Day	47.5	46.3	1.9	235
	Night	47.9	46.7	1.4	359
Monthly (Nov 02)	Day	45.5	43.4	2.4	105
	Night	49.4	46.0	2.7	56
Monthly (Dec 02)	Day	46.1	43.9	2.9	168
	Night	48.5	45.9	5.3	152
Monthly (Jan 03)	Day	45.5	42.1	4.5	242
	Night	46.5	45.5	3.3	185
Monthly (Feb 03)	Day	46.1	44.0	4.9	175
	Night	47.2	46.3	3.7	178
Monthly (March 03)	Day	46.7	44.9	5.5	275
	Night	46.8	45.9	4.0	237
Monthly (April 03)	Day	47.8	46.2	2.1	337
	Night	48.2	46.9	3.6	346
Monthly (May 03)	Day	49.6	47.0	4.1	590
	Night	50.6	48.1	2.8	398
Monthly (June 03)	Day	50.2	48.3	4.4	601

²¹ Excluding noise data for which no corresponding rainfall data is available

²² Excluding noise data from August for which no corresponding rainfall data is available

²³ Excluding noise data from September for which no corresponding rainfall data is available

Monitoring period	Time of Day	Upper 10 th Percentile of L _{A95}	Median L _{A95}	Standard Deviation	No. of Data Points
	Night	50.2	48.9	3.6	522
Monthly (July 03)	Day	51.3	49.3	4.3	771
	Night	51.0	49.7	2.8	644
Monthly (Aug 03)	Day	49.4	47.3	2.0	329
	Night	50.4	48.7	1.7	356
Monthly (Sept 03)	Day	48.4	46.9	1.8	291
	Night	48.3	46.9	1.4	390

Appendix D-3 Location 1 – March 2014 – December 2014

Monitoring period	Time of Day	Upper 10 th Percentile of L _{A95}	Median L _{A95}	Standard Deviation	No. of Data Points
Annual (Mar '14 to Dec '14)	Day	48.4	45.9	2.9	7957
	Night	49.3	46.9	2.6	6714
Autumn (Mar – May)	Day	47.9	45.5	3.0	2520
	Night	49.0	46.6	2.7	1669
Winter (Jun – Aug)	Day	49.2	46.7	2.6	2273
	Night	49.8	47.7	2.7	1675
Spring (Sep – Nov)	Day	48.1	45.6	3.0	2357
	Night	49.4	47.0	2.5	2363
Summer (Dec)*	Day	48.1	45.7	2.0	807
	Night	48.2	45.9	2.2	1007
Monthly (Mar 14)	Day	47.4	45.1	3.2	629
	Night	48.7	46.9	2.9	416
Monthly (Apr 14)	Day	47.7	45.3	2.9	1283
	Night	49.0	46.4	2.6	741
Monthly (May 14)	Day	48.8	46.3	2.8	608
	Night	49.4	46.6	2.6	512
Monthly (Jun 14)	Day	49.4	47.3	2.5	974
	Night	50.0	47.9	2.4	652
Monthly (Jul 14)	Day	49.3	46.8	2.6	718
	Night	50.1	48.4	2.1	585
Monthly (Aug 14)	Day	48.4	45.6	2.5	581
	Night	48.8	46.0	3.0	438
Monthly (Sept 14)	Day	47.7	45.3	2.9	653
	Night	49.5	47.6	2.3	569
Monthly (Oct 14)	Day	48.5	45.9	3.3	839
	Night	50.0	46.9	2.7	919
Monthly (Nov 14)	Day	47.8	45.5	2.6	865
	Night	48.9	46.6	2.3	875
Monthly (Dec 14)	Day	48.1	45.7	2.0	807
	Night	48.2	45.9	2.2	1007

* Only partial season included

Appendix D-4 Location 2 – March 2014 – December 2014

Monitoring period	Time of Day	Upper 10 th Percentile of L _{AS95}	Median L _{AS95}	Standard Deviation	No. of Data Points
Annual (Mar '14 to Dec '14)	Day	49.2	46.0	2.9	5416
	Night	49.2	47.1	2.4	4537
Autumn (Mar – May)	Day	47.9	45.3	2.7	1656
	Night	48.4	46.5	2.3	1564
Winter (Jun – Aug)	Day	49.6	47.1	2.4	2789
	Night	49.6	47.8	1.8	2208
Spring (Sep – Nov)	Day	48.5	44.2	3.2	771
	Night	48.5	46.1	2.8	713
Summer (Dec)*	Day	45.1	43.1	2.0	200
	Night	46.6	41.9	3.0	52
Monthly (Mar 14)	Day	46.0	42.9	3.2	151
	Night	45.4	43.0	2.5	141
Monthly (Apr 14)	Day	46.8	43.9	3.0	387
	Night	47.9	45.9	2.6	224
Monthly (May 14)	Day	48.2	45.8	2.1	1118
	Night	48.5	46.8	1.8	1199
Monthly (Jun 14)	Day	49.3	46.3	2.5	944
	Night	49.0	47.3	1.8	749
Monthly (Jul 14)	Day	49.8	47.3	2.2	907
	Night	49.6	47.7	1.8	725
Monthly (Aug 14)	Day	49.6	47.5	2.3	938
	Night	49.9	48.3	1.7	734
Monthly (Sept 14)	Day	49.0	45.8	2.8	414
	Night	48.8	46.0	2.5	304
Monthly (Oct 14)	Day	45.5	43.0	2.7	161
	Night	48.6	46.6	3.1	182
Monthly (Nov 14)	Day	48.2	42.7	3.3	196
	Night	47.9	45.7	3.0	227
Monthly (Dec 14)	Day	45.1	43.1	2.0	200
	Night	46.6	41.9	3.0	52

* Only partial season included

Appendix D-5 Location 1 – January 2015 – August 2015

Monitoring period	Time of Day	Upper 10 th Percentile of L _{A95}	Median L _{A95}	Standard Deviation	No. of Data Points
All data (Jan '15 to Jun '15)	Day	48.0	45.6	2.9	6580
	Night	48.7	46.2	2.6	3797
Autumn (Mar – May)	Day	48.2	45.7	3.0	2706
	Night	48.9	46.4	2.4	1395
Winter (Jun – Aug)	Day	48.3	46.2	2.6	2137
	Night	49.2	46.9	2.6	1121
Summer (Jan – Feb)*	Day	47.2	44.4	2.9	1737
	Night	48.0	45.3	2.7	1463
Monthly (Jan 15)	Day	47.2	44.6	2.8	882
	Night	47.7	45.1	2.4	707
Monthly (Feb 15)	Day	47.1	43.9	3.1	855
	Night	48.2	45.6	2.9	756
Monthly (Mar 15)	Day	48.0	45.0	3.3	952
	Night	48.5	46.1	2.5	602
Monthly (Apr 15)	Day	47.5	44.3	3.2	229
	Night	48.7	47.3	2.0	55
Monthly (May 15)	Day	48.4	46.2	2.5	1525
	Night	49.1	46.6	2.3	738
Monthly (Jun 15)	Day	48.5	46.2	2.3	772
	Night	49.3	45.8	2.6	274
Monthly (Jul 15)	Day	48.4	46.3	2.7	778
	Night	49.0	46.8	2.7	407
Monthly (Aug 15)	Day	48.0	45.9	2.7	587
	Night	49.1	47.4	2.6	440

* Only partial season included

Appendix D-6 Location 2 – January 2015 – August 2015

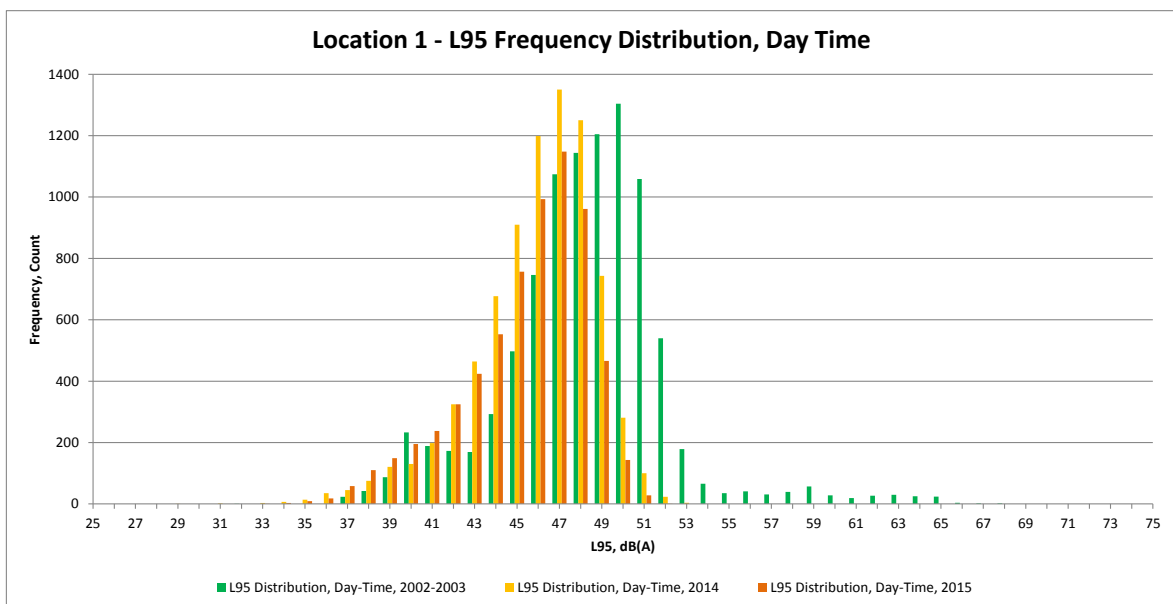
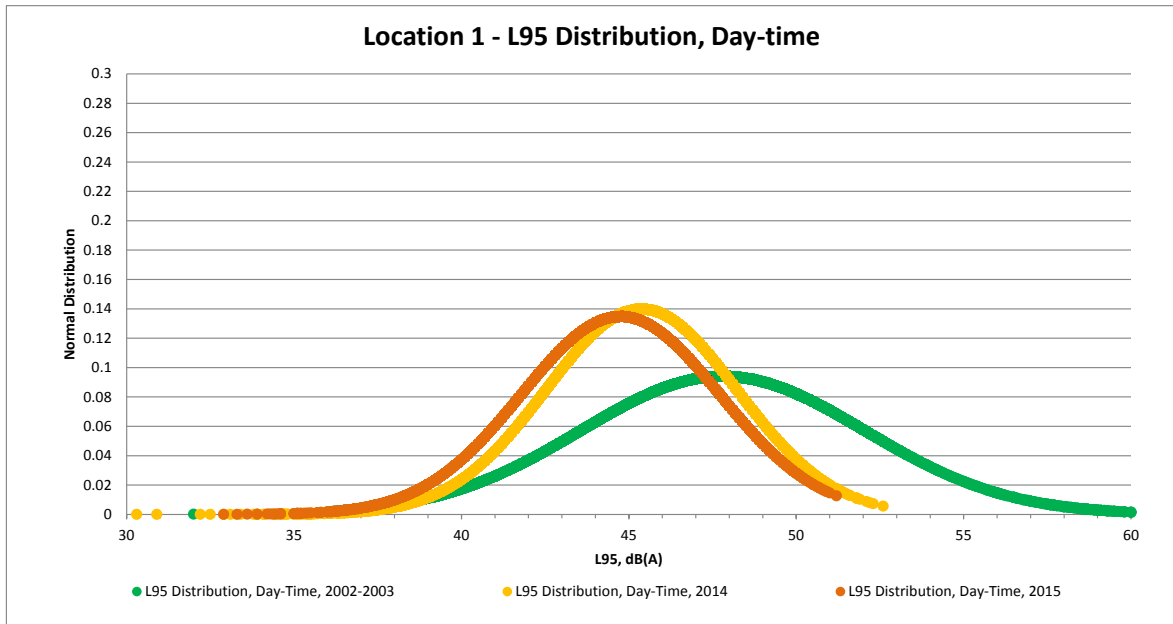
Monitoring period	Time of Day	Upper 10 th Percentile of L _{A95}	Median L _{A95}	Standard Deviation	No. of Data Points
All data (Jan '15 to Jun '15)	Day	49.2	46.8	3.1	4278
	Night	49.8	47.6	2.5	3273
Autumn (Mar – May)	Day	49.2	46.1	3.5	979
	Night	49.8	46.9	2.8	699
Winter (Jun – Aug)	Day	49.4	47.3	2.1	2931
	Night	50.0	47.9	1.8	2274
Summer (Jan – Feb)*	Day	45.8	40.7	3.4	368
	Night	48.3	44.9	3.6	300
Monthly (Jan 15)	Day	44.6	40.1	3.0	162
	Night	47.7	44.2	3.2	90
Monthly (Feb 15)	Day	46.2	41.8	3.6	206
	Night	48.7	45.5	3.6	210
Monthly (Mar 15)	Day	46.5	43.2	3.5	259
	Night	47.3	43.9	2.2	292
Monthly (Apr 15)	Day	48.2	46.5	2.2	323
	Night	49.0	47.6	1.5	179
Monthly (May 15)	Day	50.0	47.1	3.2	397
	Night	50.5	49.0	2.5	228
Monthly (Jun 15)	Day	49.2	47.4	1.9	1125
	Night	49.4	48.1	1.5	905
Monthly (Jul 15)	Day	49.6	47.3	2.2	1315
	Night	50.3	47.8	2.0	820
Monthly (Aug 15)	Day	49.3	46.9	2.2	491
	Night	50.2	47.6	2.1	549

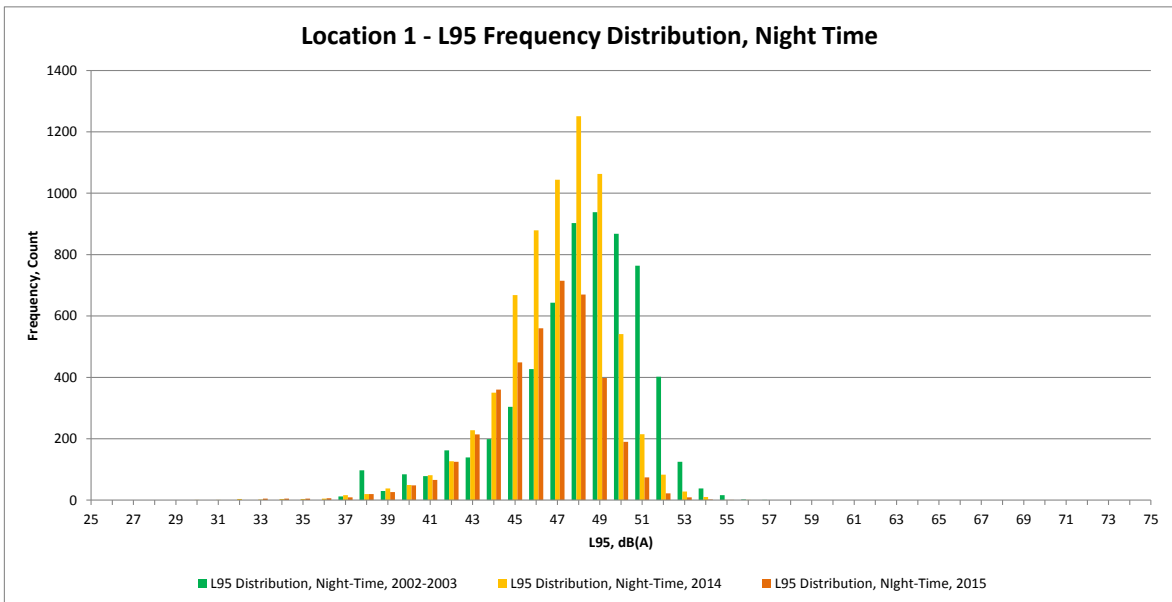
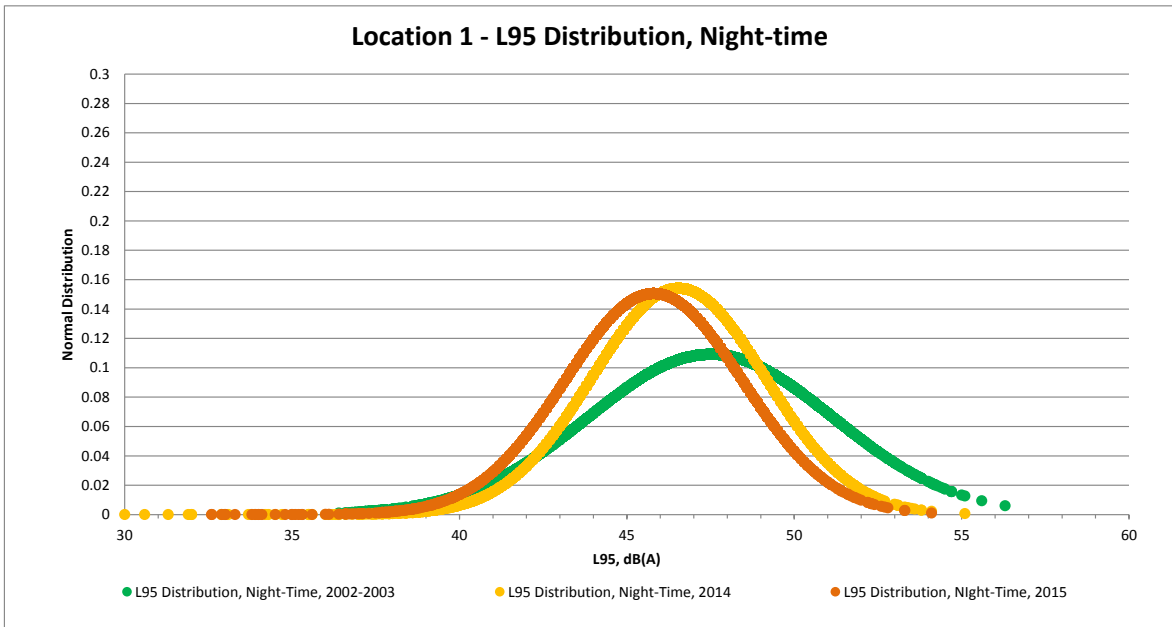
* Only partial season included

APPENDIX E STATISTICAL ANALYSIS CHARTS FROM CONTINUOUS NOISE MONITORING

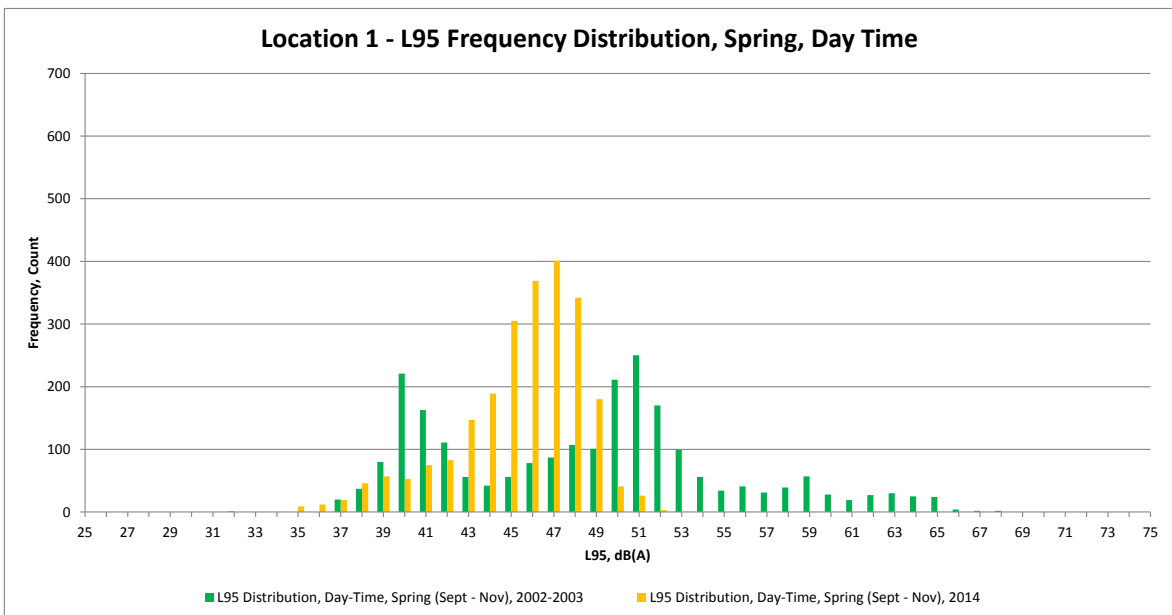
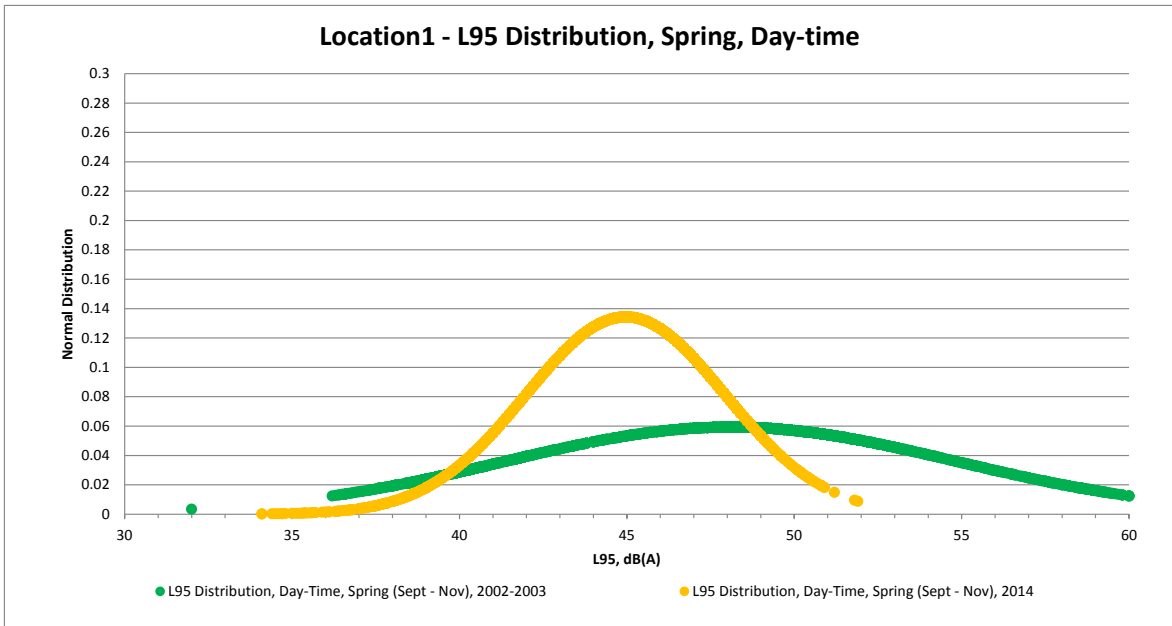
Appendix E-1 Location 1

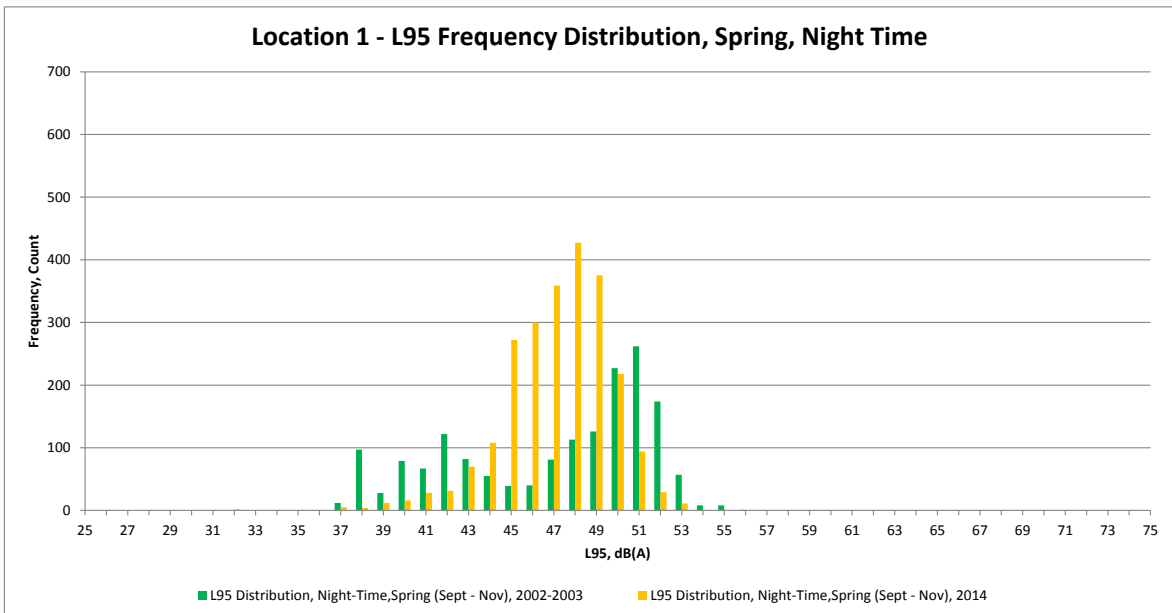
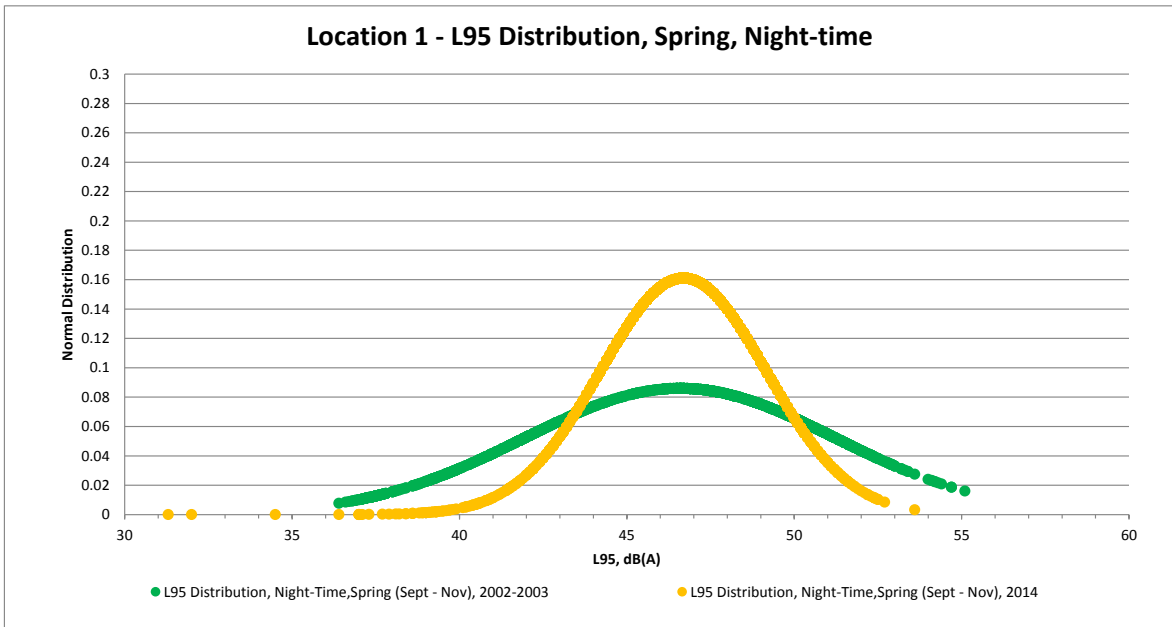
Appendix E-1.1 Location 1 – Annual Data



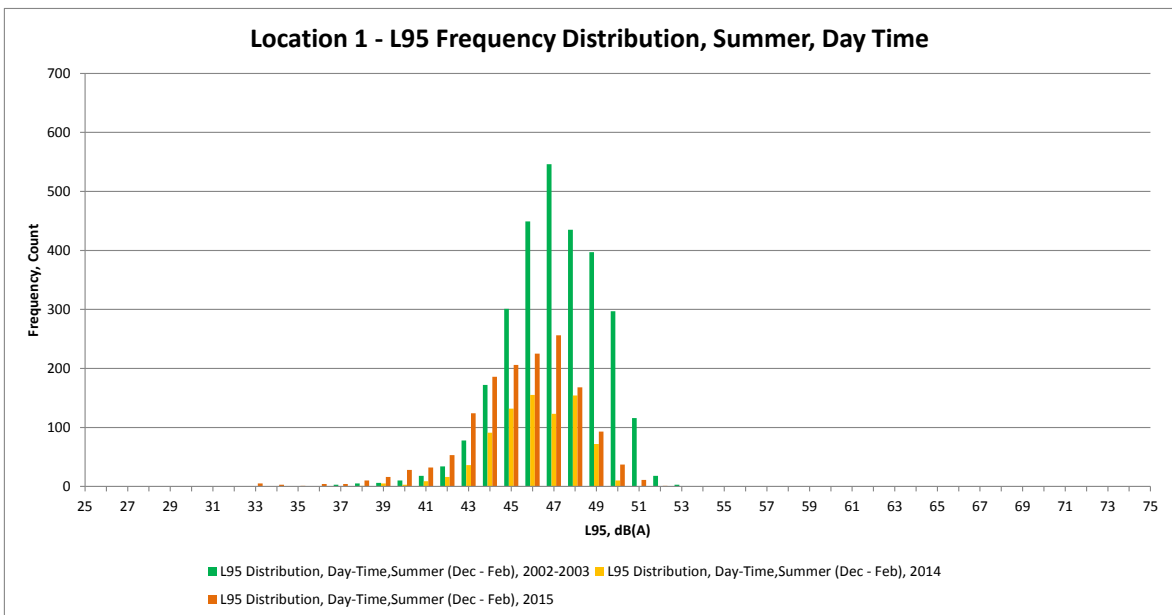
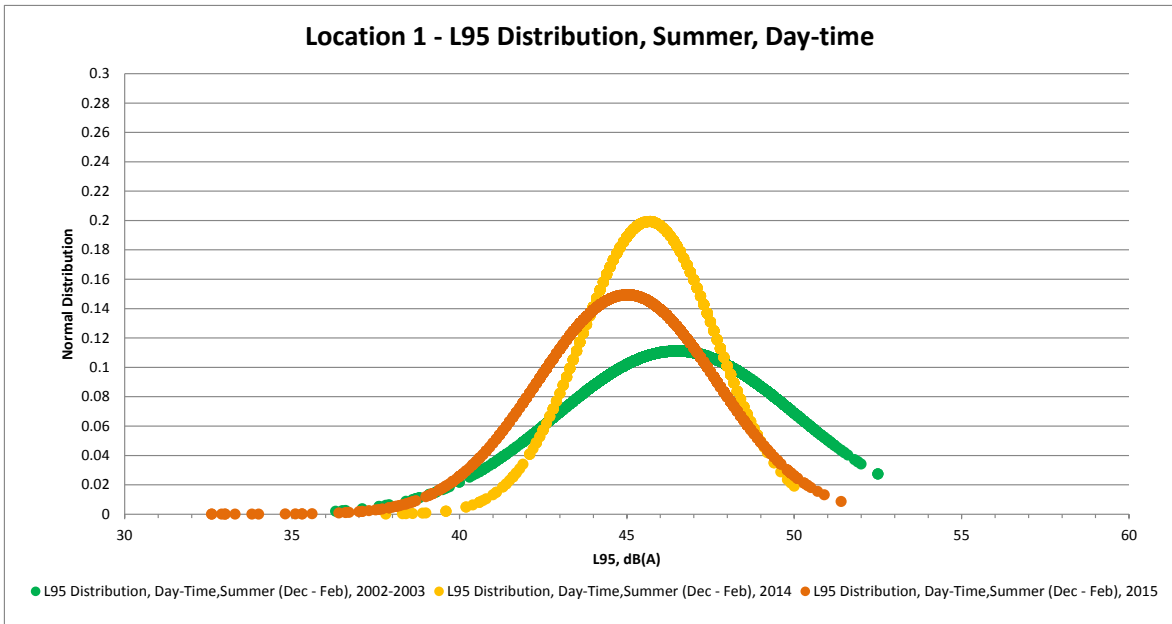


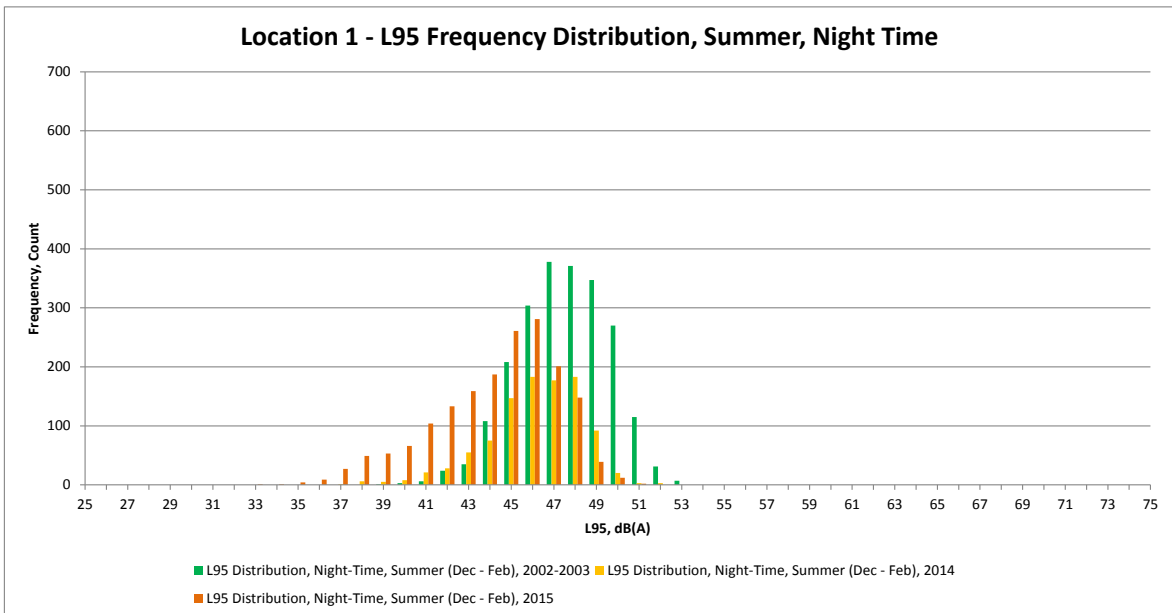
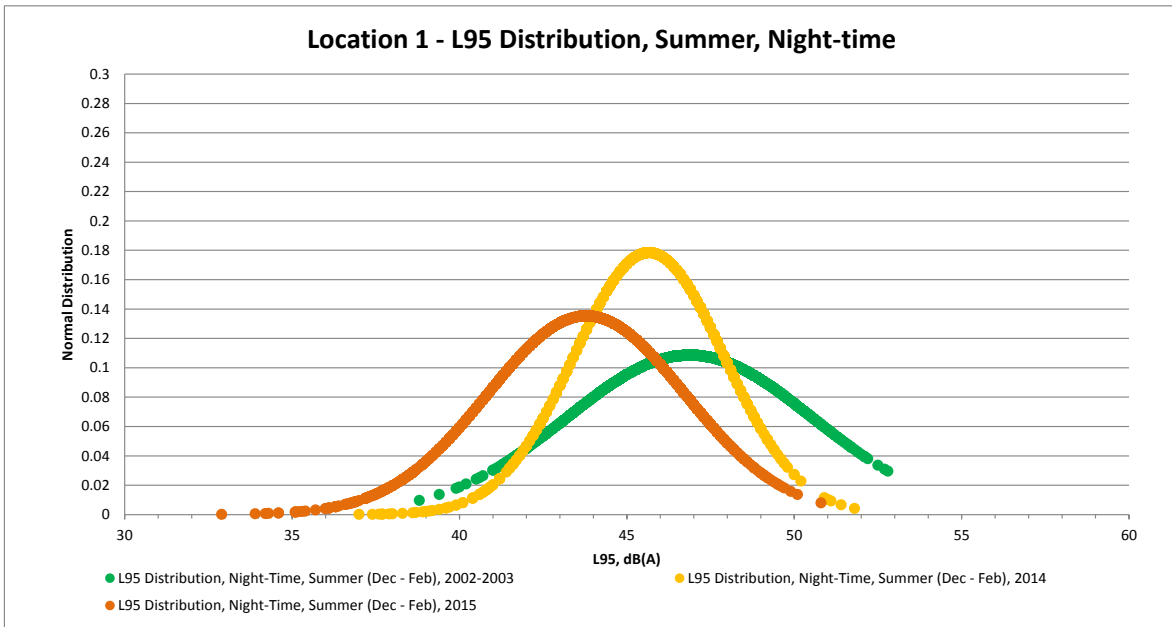
Appendix E-1.2 Location 1 – Spring Data (September – November)



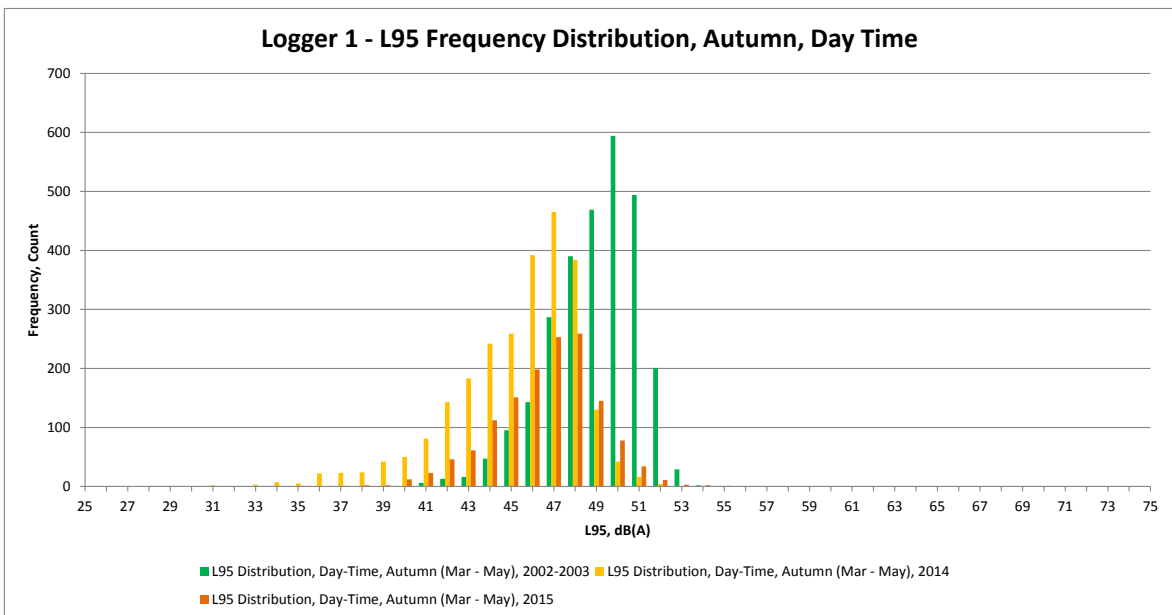
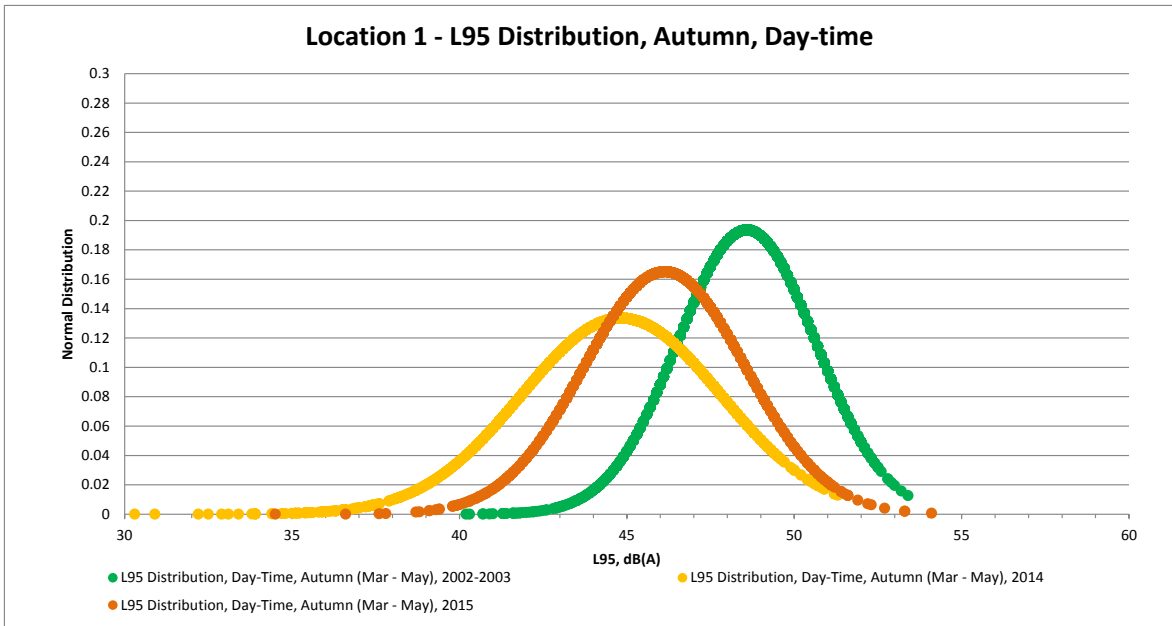


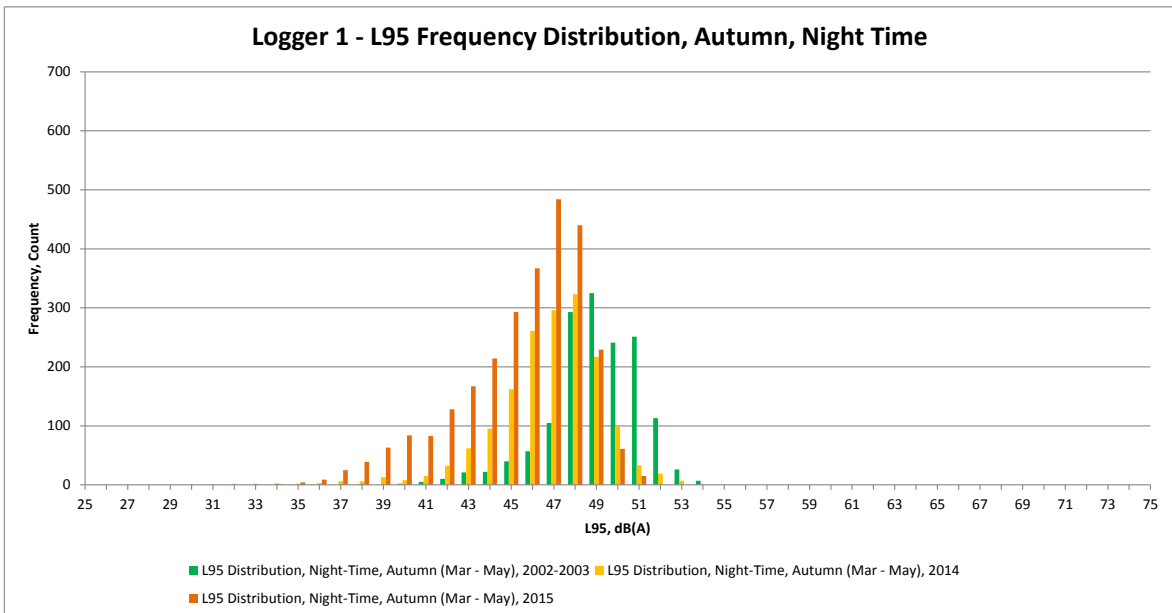
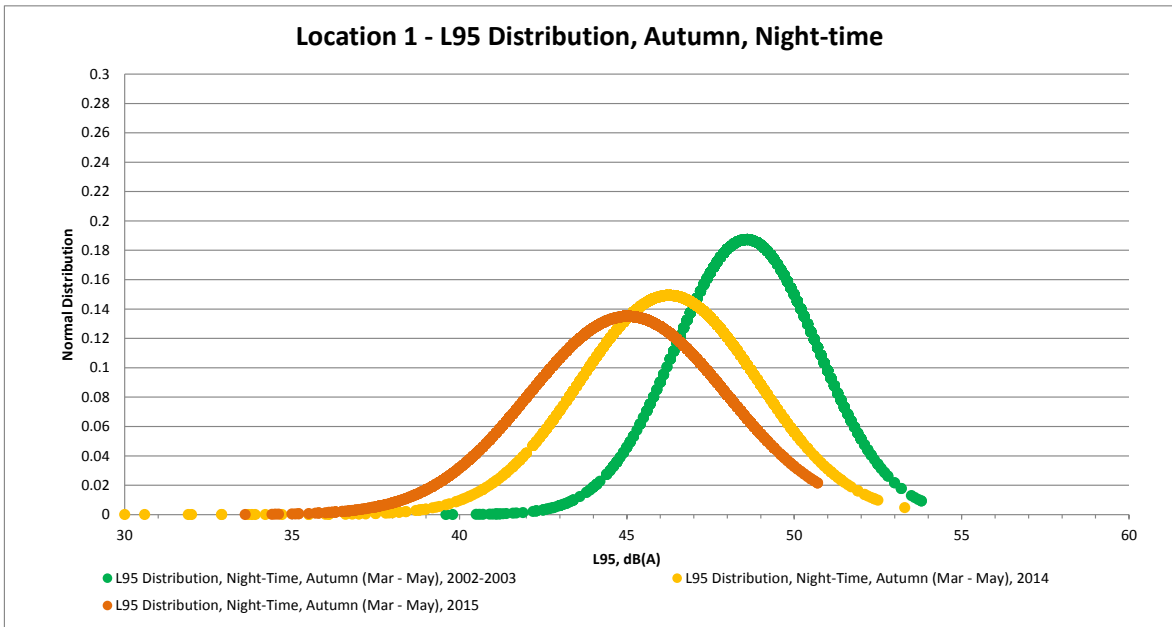
Appendix E-1.3 Location 1 – Summer Data (December – February)



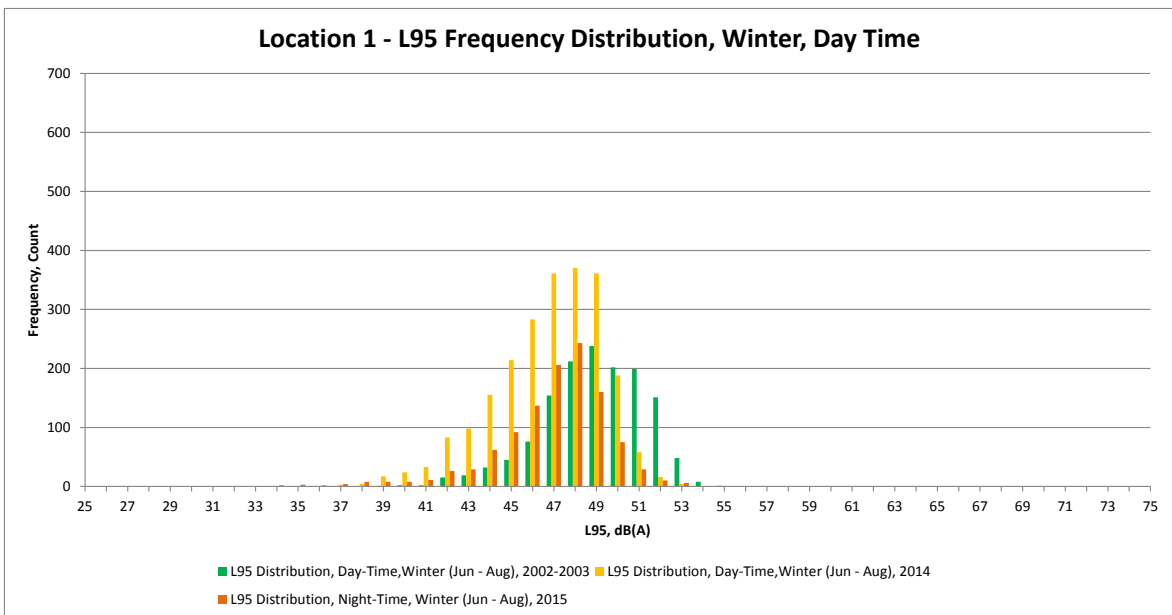
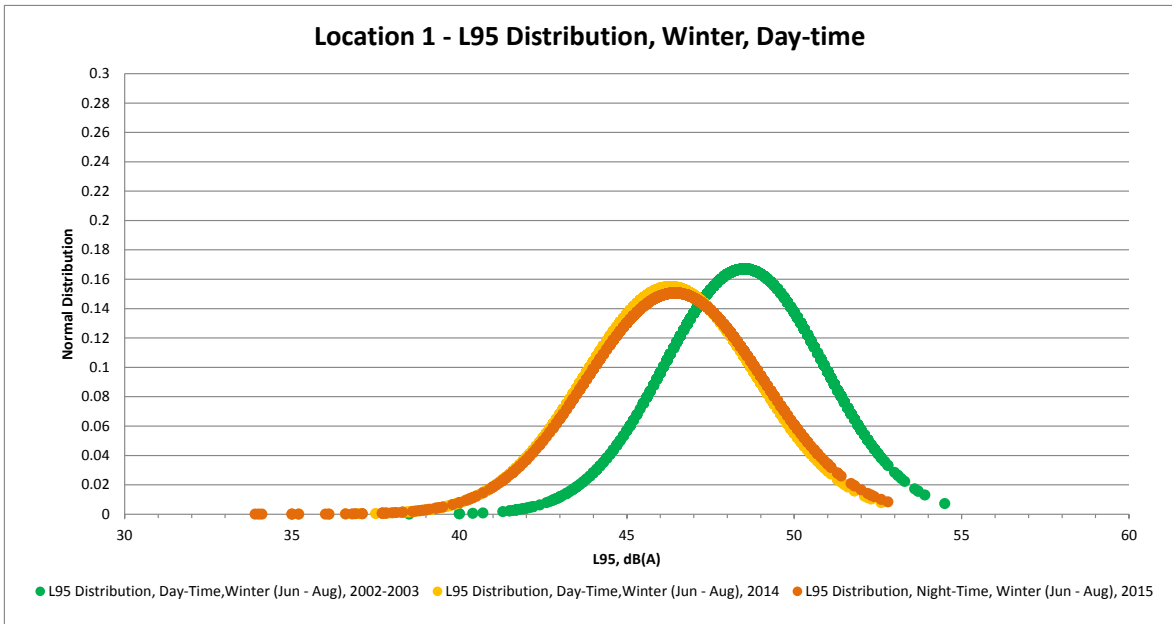


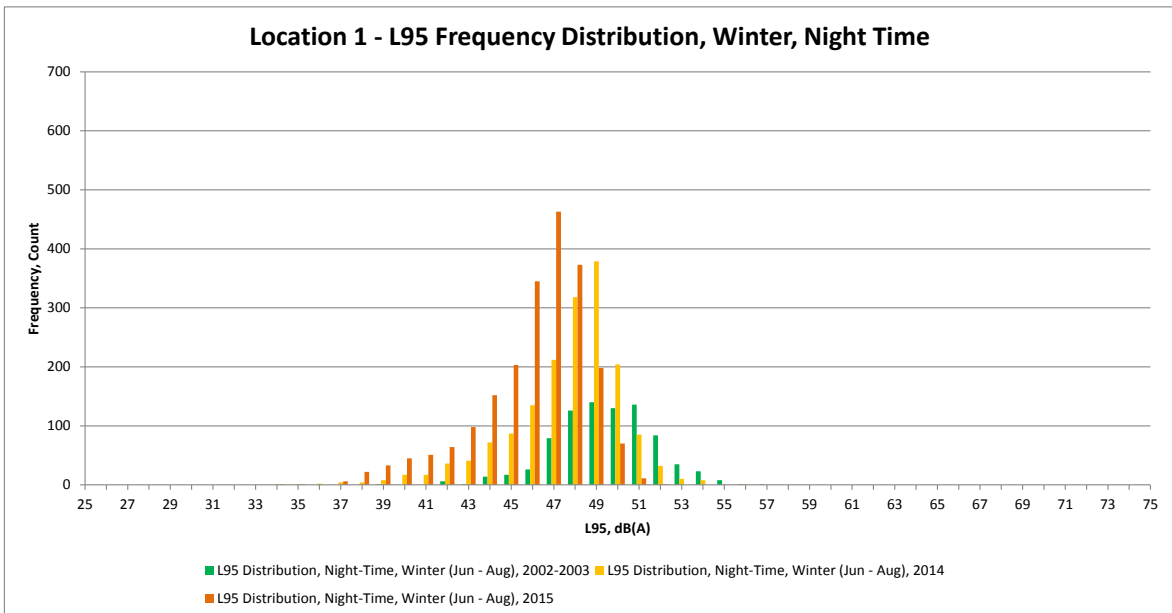
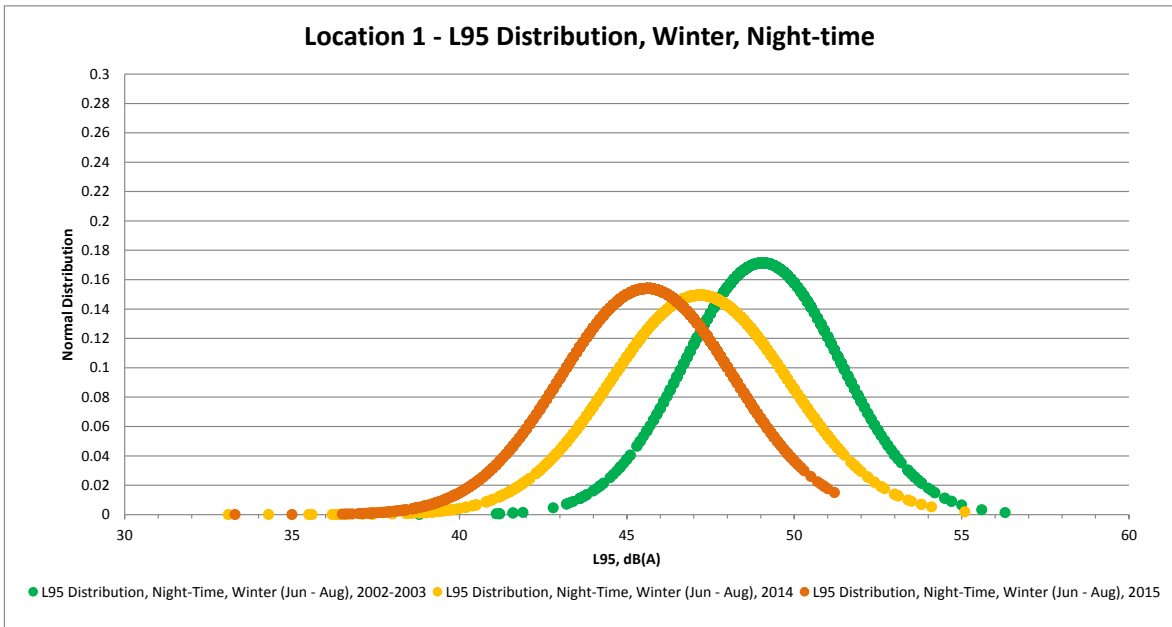
Appendix E-1.4 Location 1 – Autumn Data (March – May)





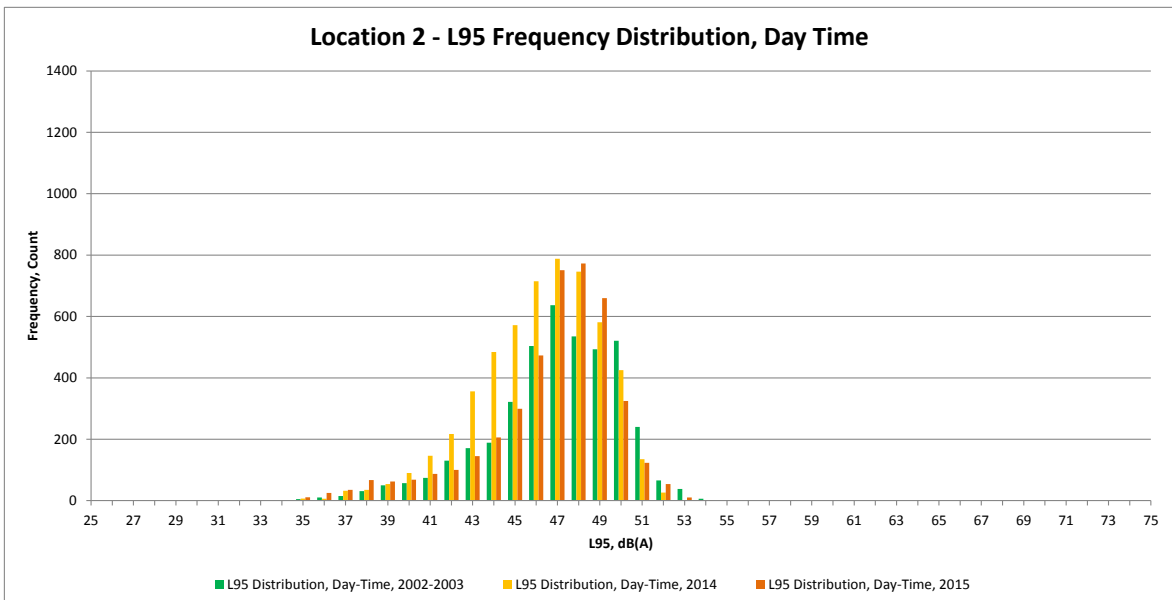
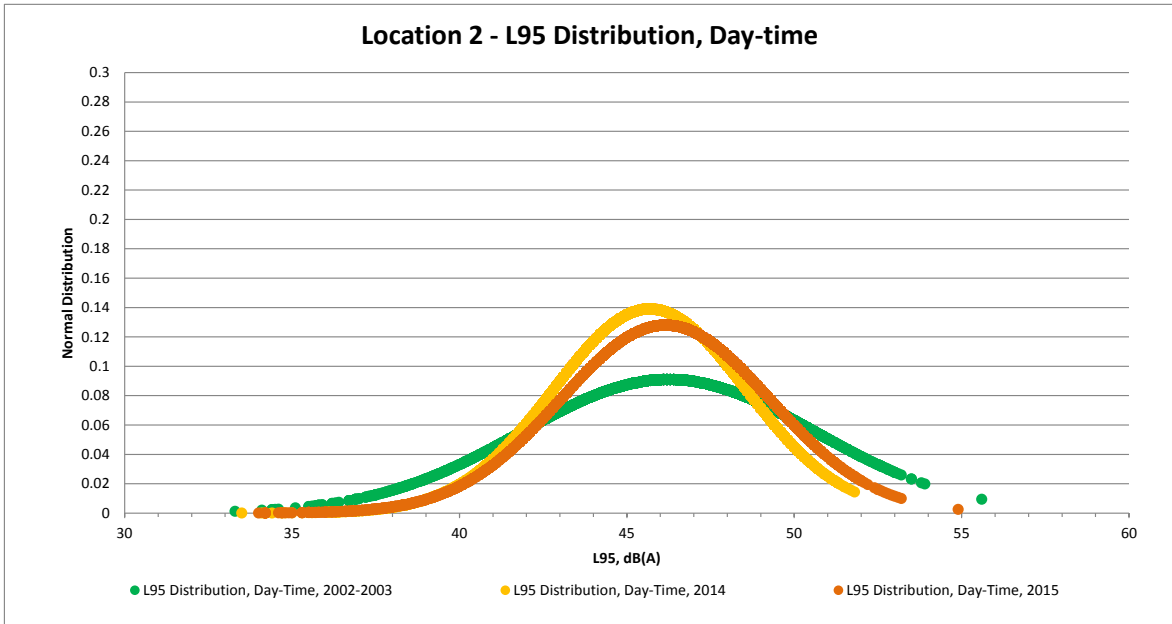
Appendix E-1.5 Location 1 – Winter Data (June – August)

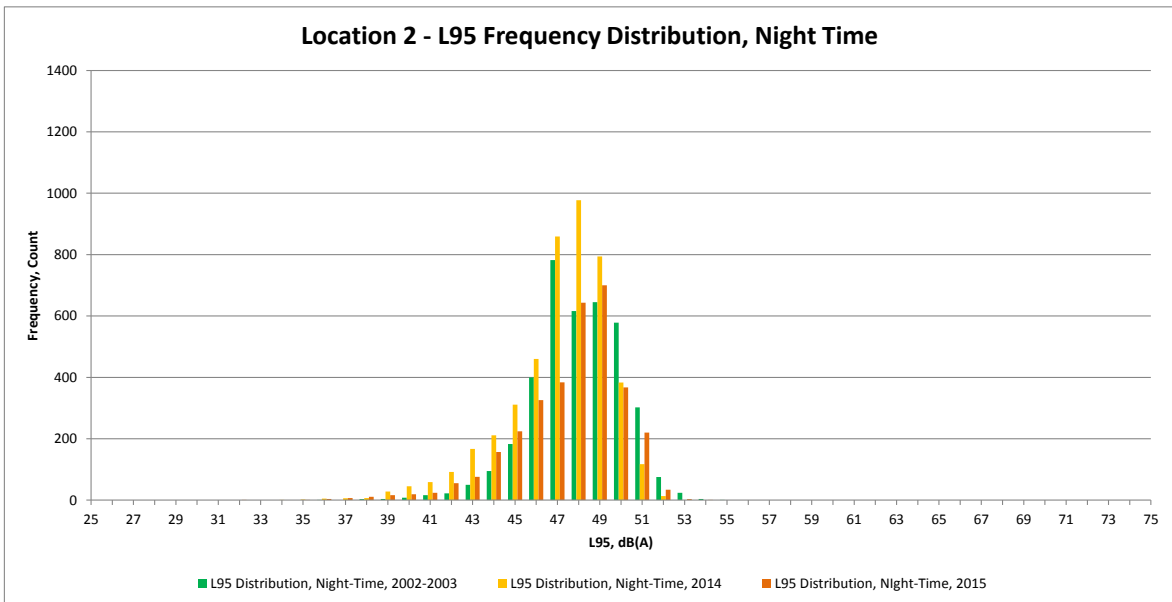
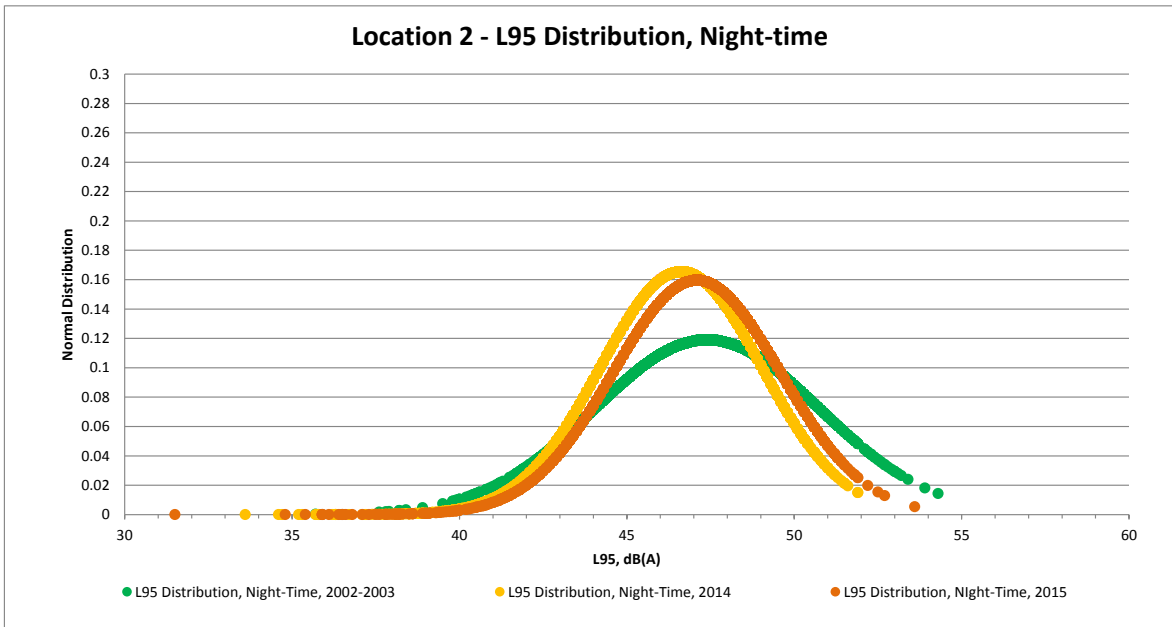




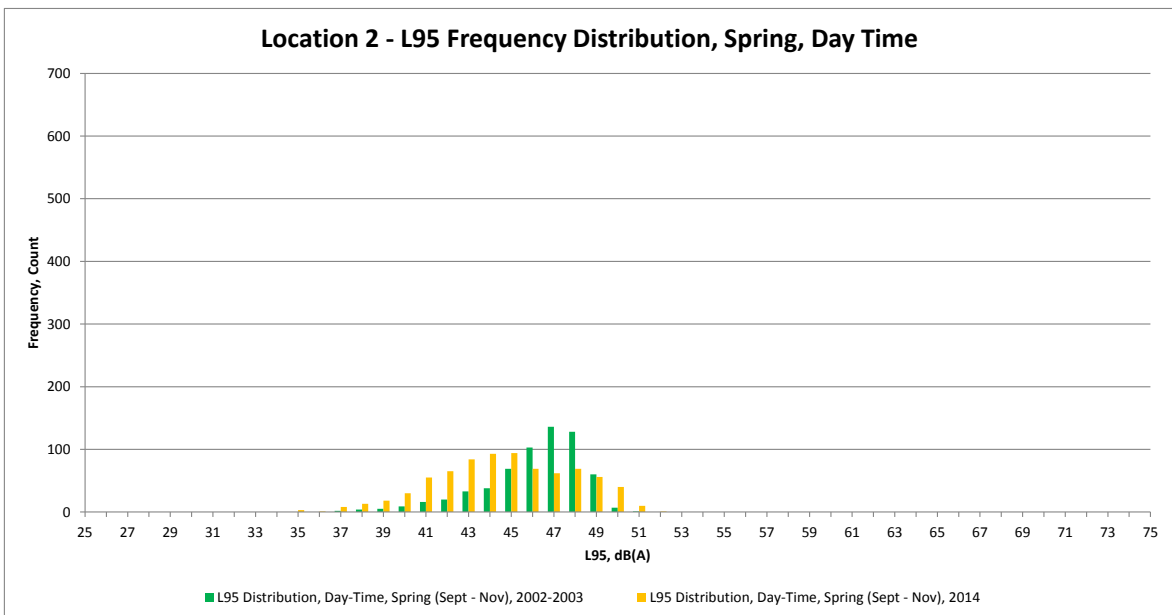
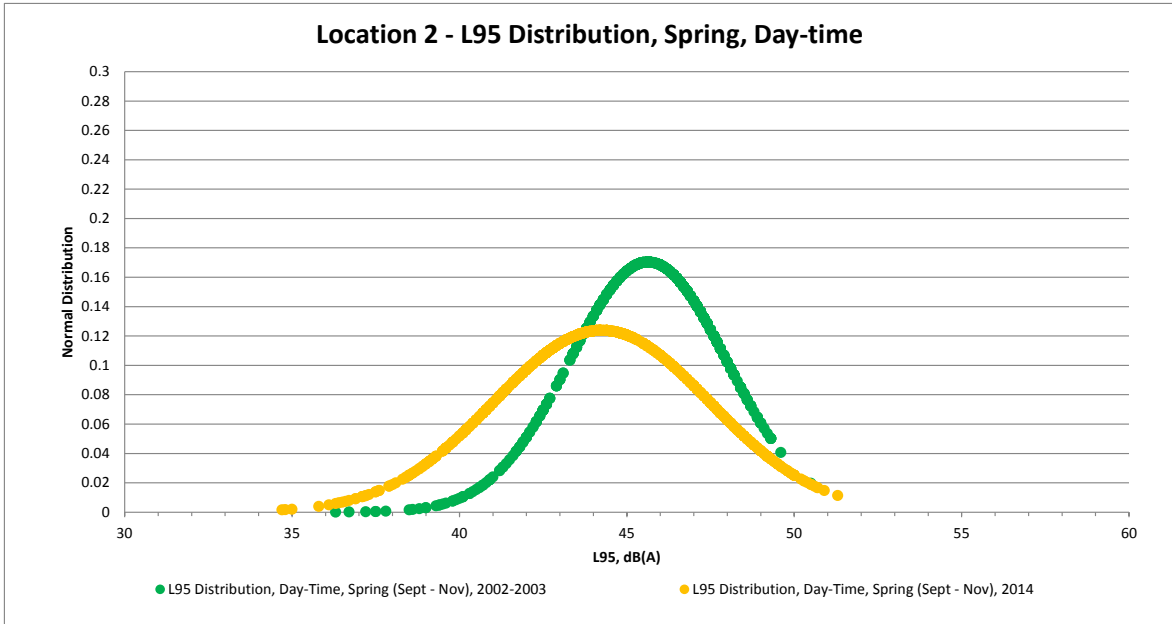
Appendix E-2 Location 2

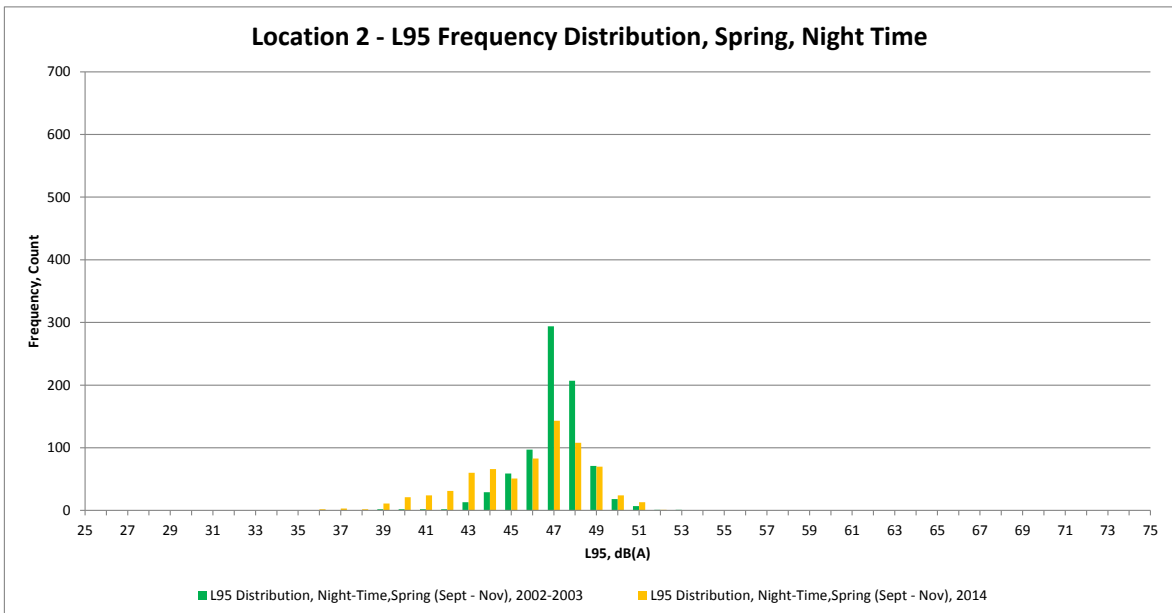
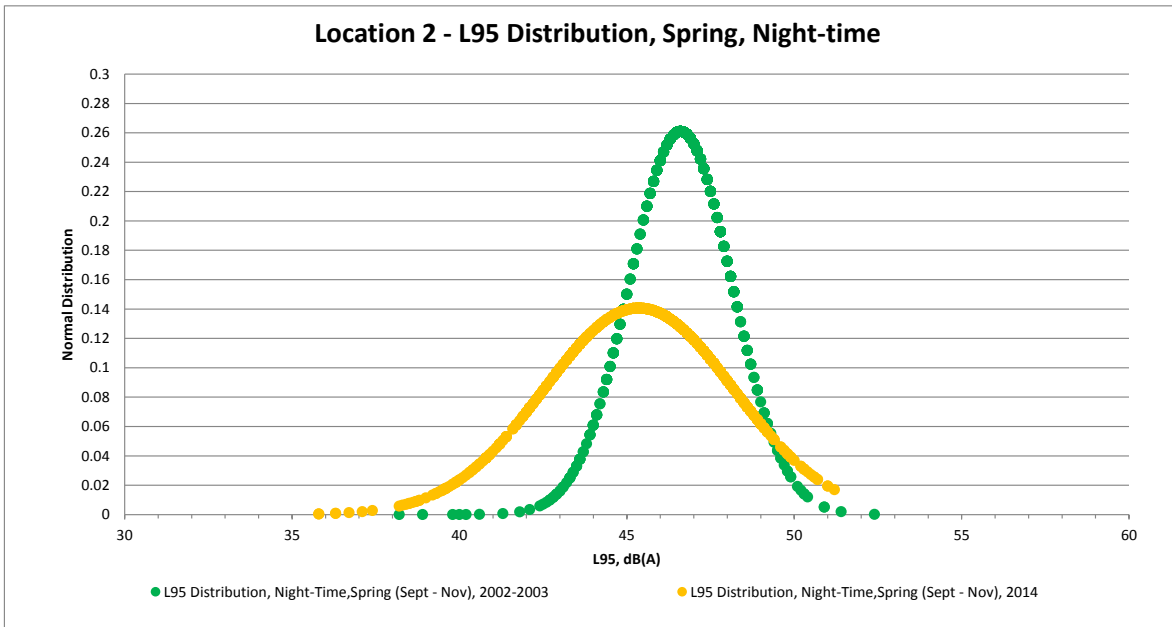
Appendix E-2.1 Location 2 – Annual Data



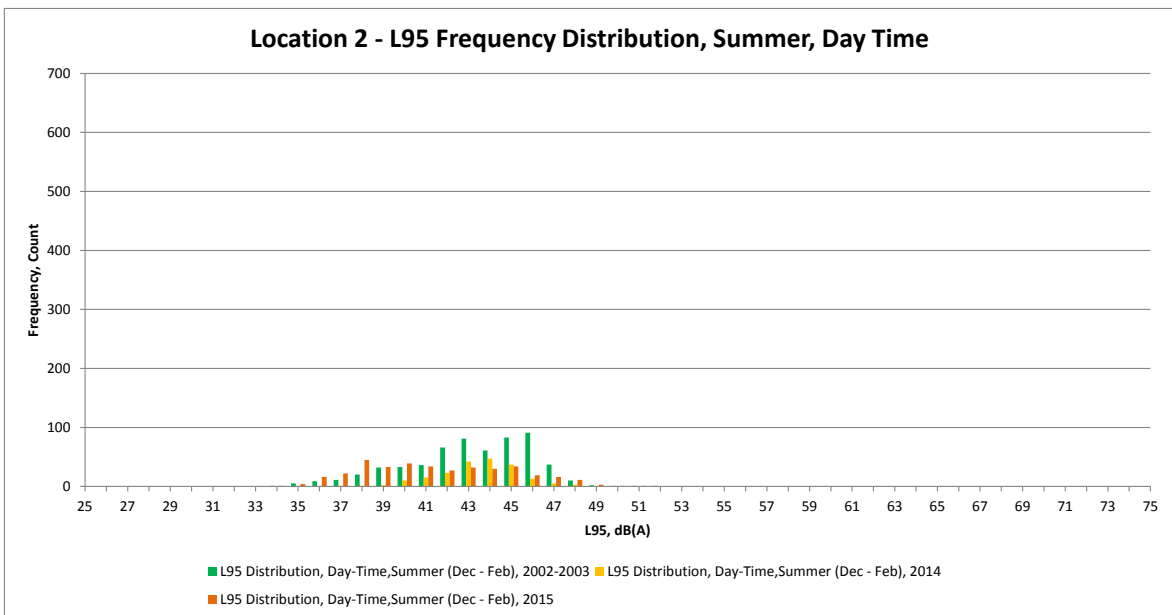
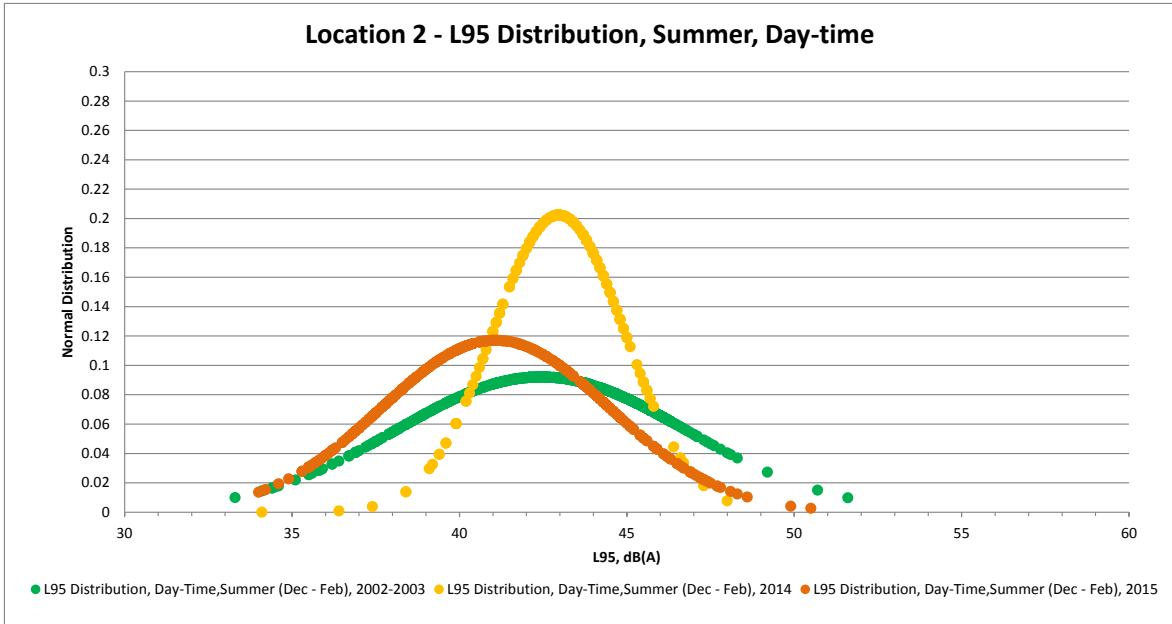


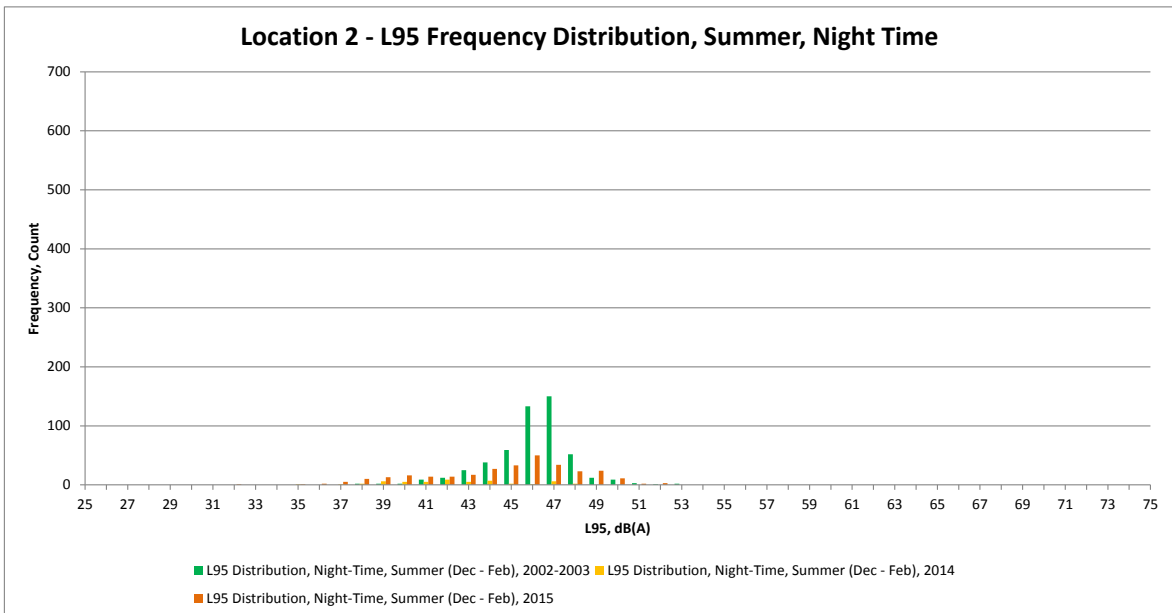
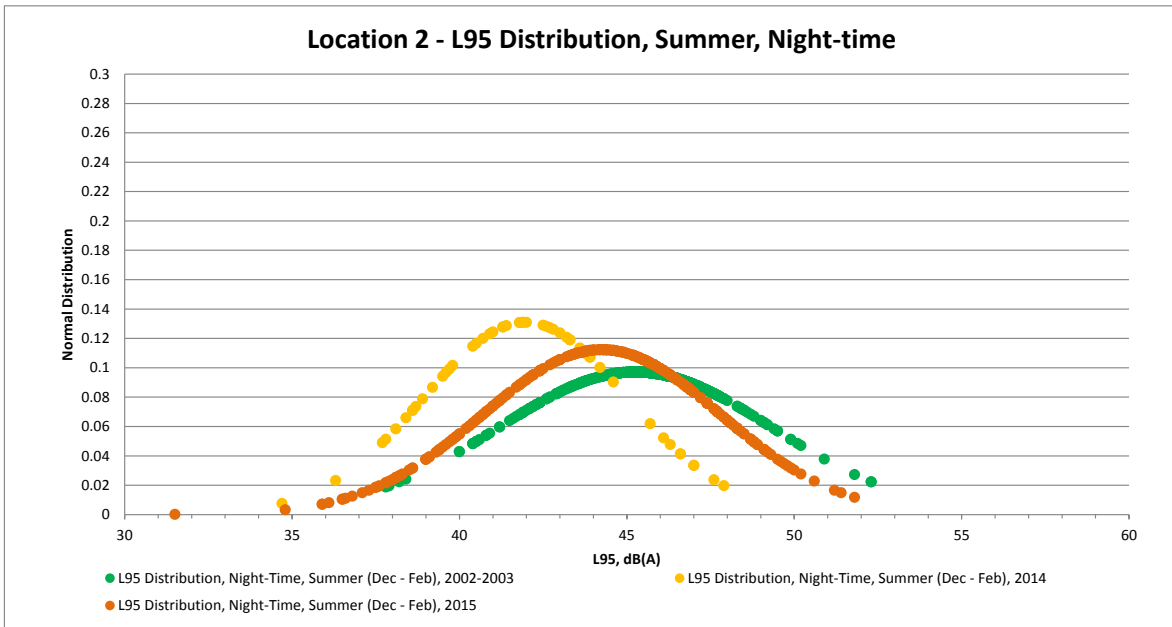
Appendix E-2.2 Location 2 – Spring Data (September – November)



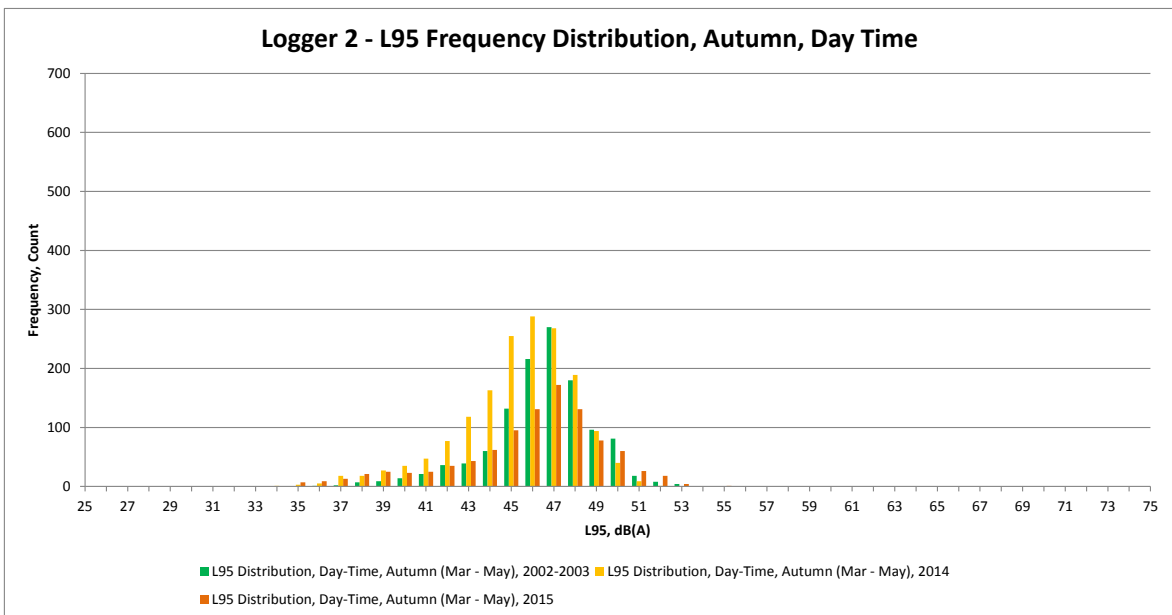
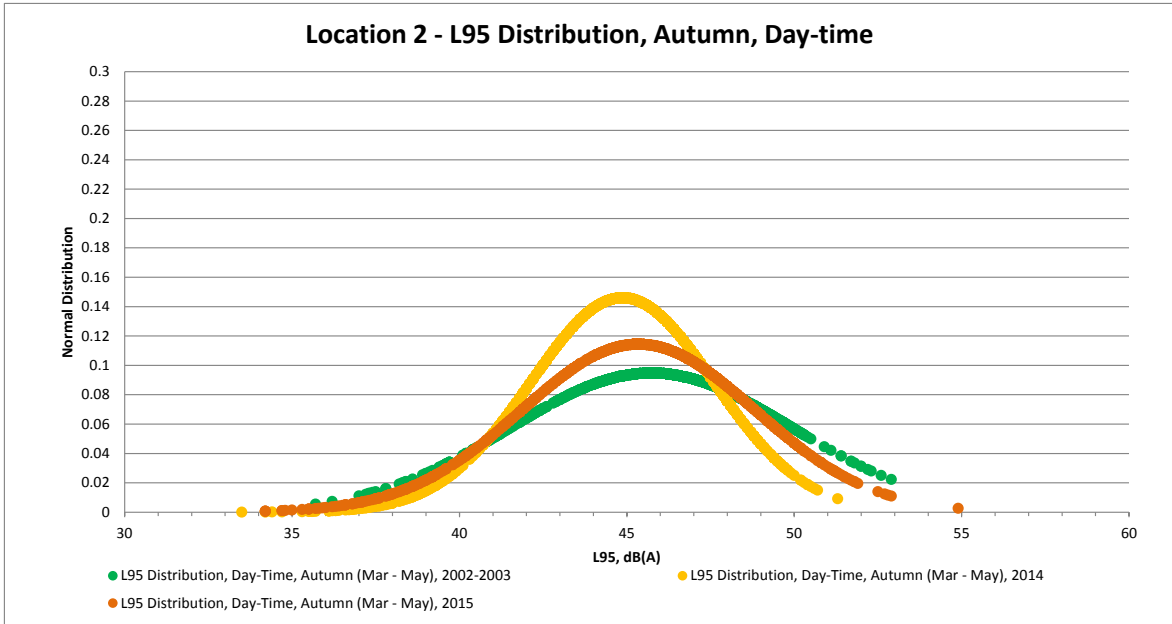


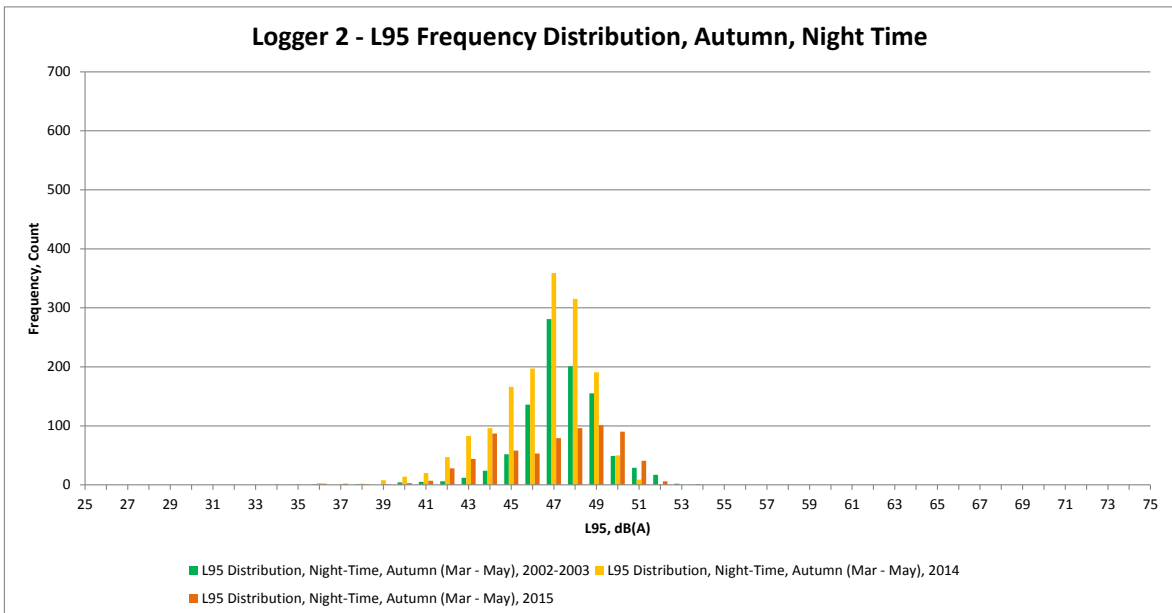
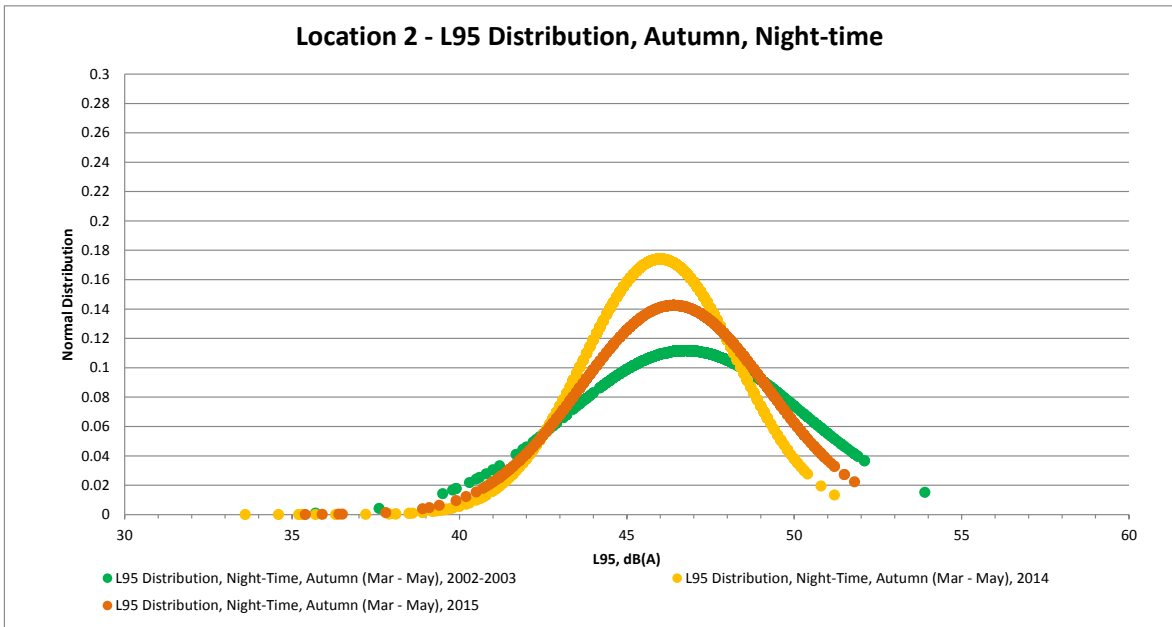
Appendix E-2.3 Location 2 – Summer Data (December – February)



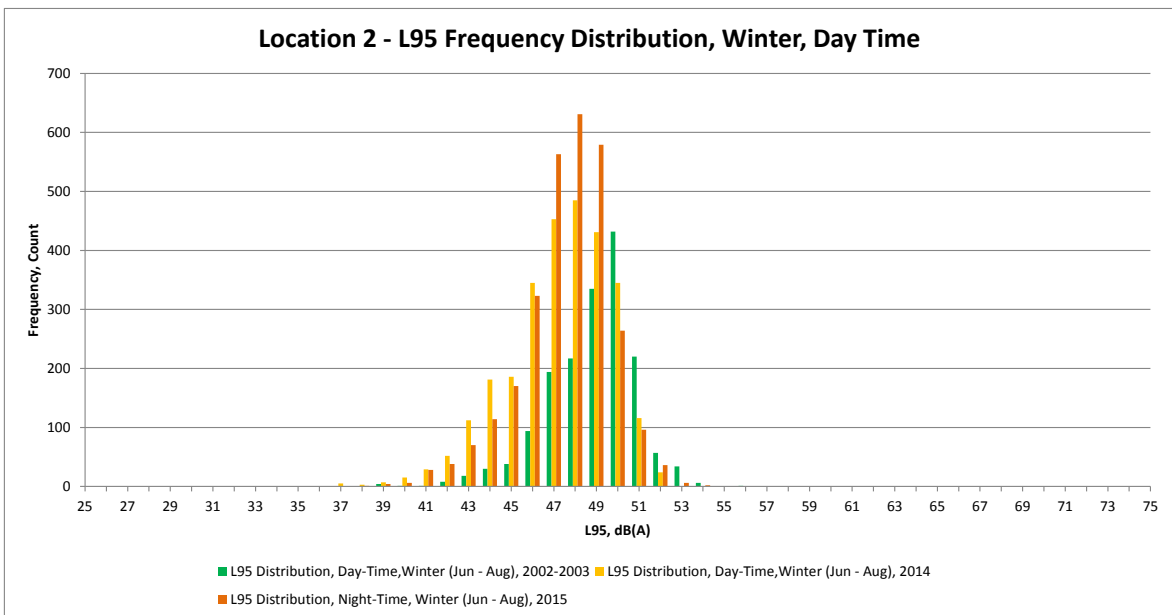
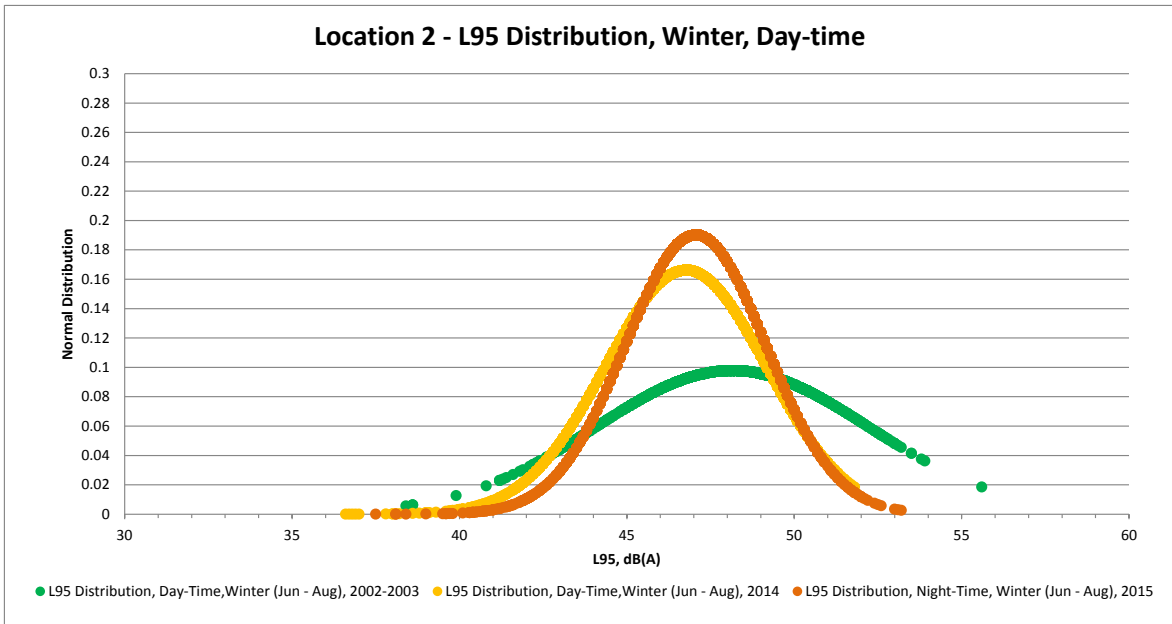


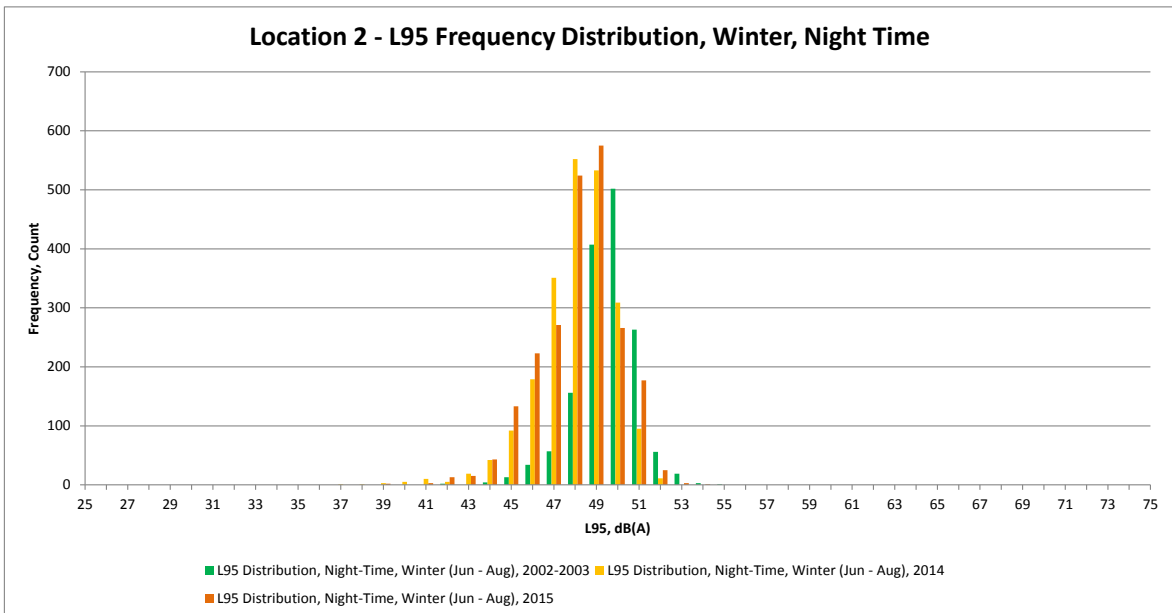
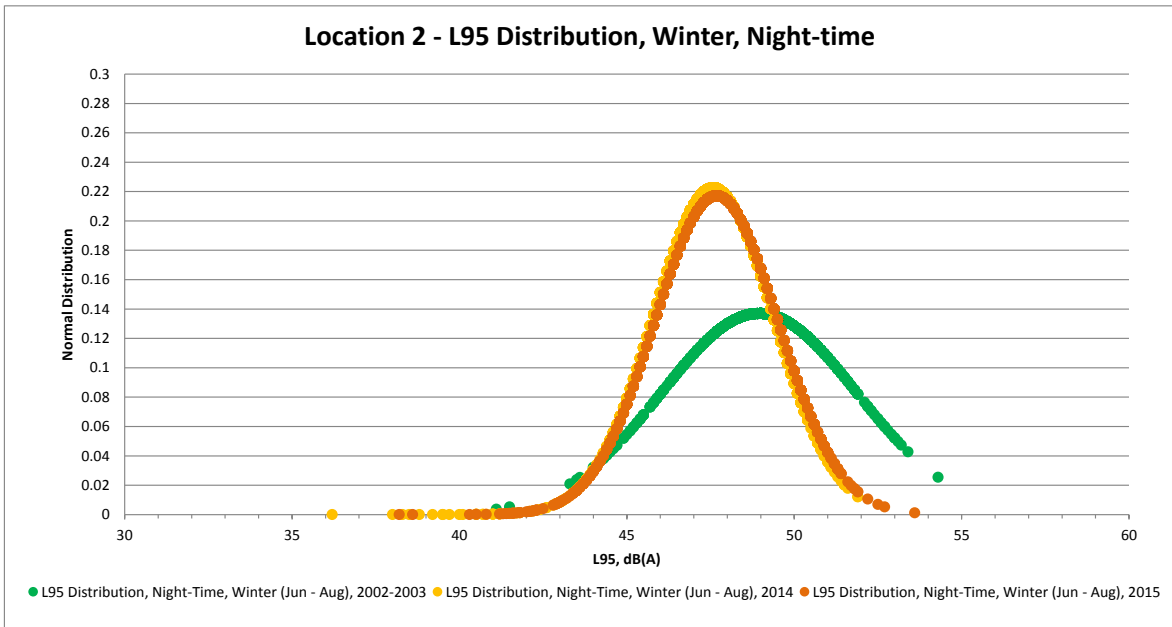
Appendix E-2.4 Location 2 – Autumn Data (March – May)



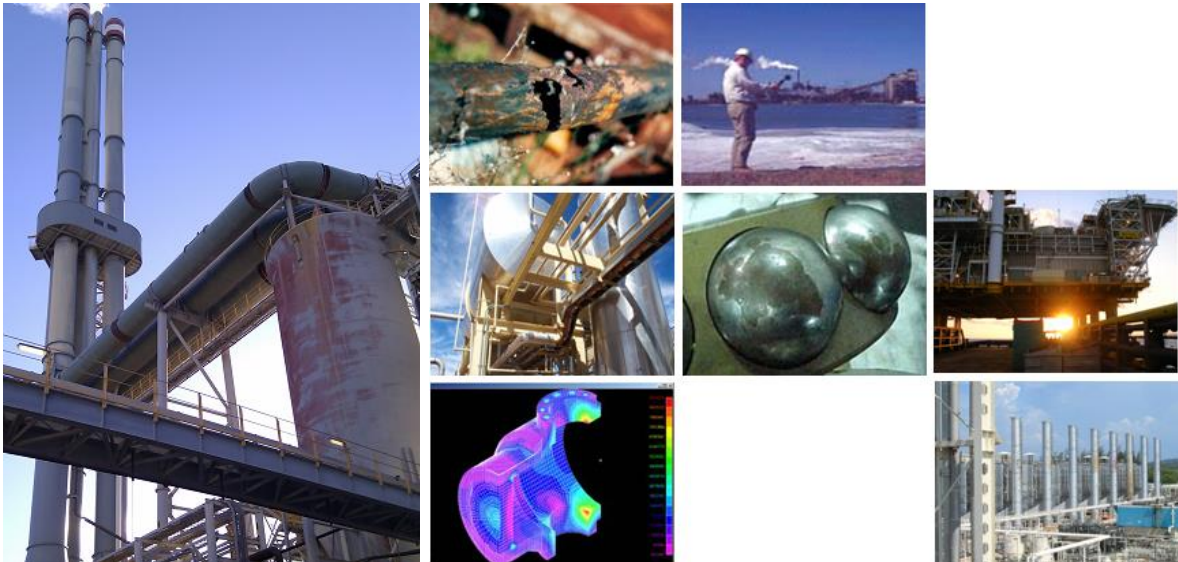


Appendix E-2.5 Location 2 – Winter Data (June – August)





ADDENDUM TO THE NOISE MONITORING REPORT FOR THE ENVIRONMENTAL PROTECTION (WAGERUP ALUMINA REFINERY NOISE EMISSIONS) AMENDMENT APPROVAL 2013 & 2014



ALCOA OF AUSTRALIA

1370825-23-100-Rev1-12 Feb 16

DOCUMENT CONTROL & REVIEW INFORMATION

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SVT Job No: 1370825
SVT Document No: 1370825-23-100-Rev1-12 Feb 16

Rev	Description	Prepared	Reviewed	Date
1	Typographical error & pagination corrected	PK Lim	Jim McLoughlin	12 Feb 16
0	Issued for Use	PK Lim	Jim McLoughlin	9 Feb 16

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EXECUTIVE SUMMARY

Introduction

This report is an addendum to SVT report no. 1370825-22-100¹ (the Main Report) and is to be read in conjunction with the Main Report.

Clause 9(3)(a) of The Approval requires a summary of at least the last 8 months of the monitoring data to be prepared and compared with relevant noise emissions data collected for the Wagerup Refinery in 2001².

Because of the time required to analyse and publish the Main Report, it was not practical to include data for the period between 22nd August 2015 and the end of the period of the Approval (10th December 2015).

This report provides results of Alcoa's continuous noise monitoring program including the period from August 2015 until the December 2015. The results previously presented in the Main Report are also included. The conclusions from the Main Report have been reviewed taking into account the new data.

The objectives, scope and methodology remain unchanged and are provided in the Main Report.

Conclusions

Noise emissions from the Refinery recorded by continuous monitoring systems at Location 1 and Location 2 during the 2014 and 2015 monitoring program are demonstrably lower than noise emissions recorded at the same locations in 2002-2003.

¹ SVT Report No. 1370825-22-100-Rev0-7 Sep 15 "Noise Monitoring Report for the Environmental Protection (Wagerup Alumina Refinery Noise Emissions) Amendment Approval 2013 & 2014"

² Or, if sufficient relevant data is not available for 2001, data for the year next after 2001 for which sufficient relevant data is available.

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1. INTRODUCTION

This report is an addendum to SVT report no. 1370825-22-100³ (the Main Report) and is to be read in conjunction with the Main Report.

Clause 9(3)(a) of The Approval requires a summary of at least the last 8 months of the monitoring data to be prepared and compared with relevant noise emissions data collected for the Wagerup Refinery in 2001⁴.

Because of the time required to analyse and publish the Main Report, it was not practical to include data for the period between 22nd August 2015 and the end of the period of the Approval (10 December 2015).

This report provides results and analysis of Alcoa's continuous noise monitoring program for the entire 21 month period between 10th March 2014 and 9th December 2015.

This addendum updates the results and analysis presented in Part A of the Main Report. The associated tables and charts presented in Appendix D & E of the Main Report have also been updated and are included in Appendix A & B of this addendum.

³ SVT Report No. 1370825-22-100-Rev0-7 Sep 15 "Noise Monitoring Report for the Environmental Protection (Wagerup Alumina Refinery Noise Emissions) Amendment Approval 2013 & 2014"

⁴ Or, if sufficient relevant data is not available for 2001, data for the year next after 2001 for which sufficient relevant data is available.

2. COMPARISON OF CURRENT AND HISTORICAL REFINERY NOISE EMISSIONS

2.1 Results from Continuous Noise Monitoring Program

The following sections (2.1.1 and 2.1.2) present comparisons of the monthly median L_{A95} data collected during the 2002-2003 period, with data collected during 2014 and 2015 at Locations 1 and 2.

The tables in Appendix A provide the following additional information:

- Annual, seasonal and monthly median and upper 10th percentile levels for both day time and night time hours; and
- Standard deviations and numbers of data points included in the analyses.

The charts in Appendix B show the statistical distribution of the L_{A95} noise level data.

2.1.1 Location 1

Figure 2-1 compares monthly noise level data collected during the 2002-2003 period, with data collected between March 2014 and December 2015 at Location 1.

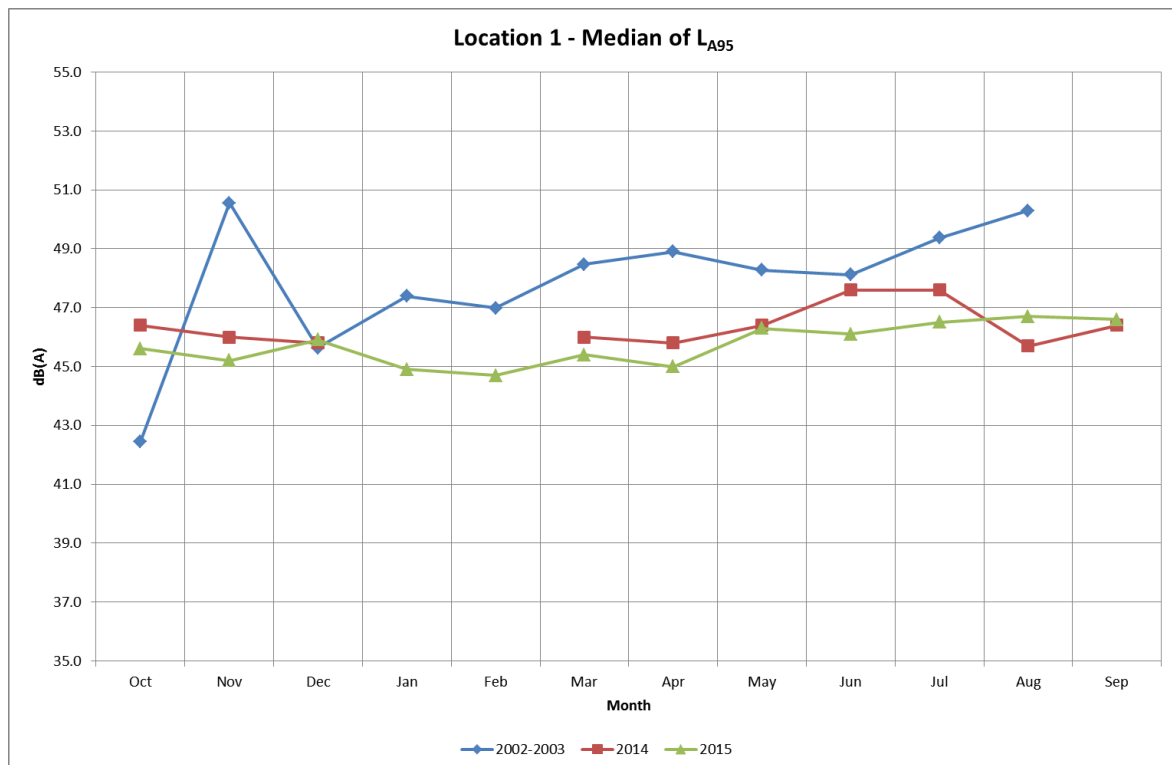


Figure 2-1 : Location 1, Comparison of Median L_{A95}

The monthly median L_{A95} noise levels from the most recent monitoring (2014 and 2015) are mostly lower than those measured during 2002-2003⁵.

2.1.2 Location 2

Figure 2-2 compares monthly noise level data collected during the 2002-2003 period, with data collected between March 2014 and December 2015 at Location 2.

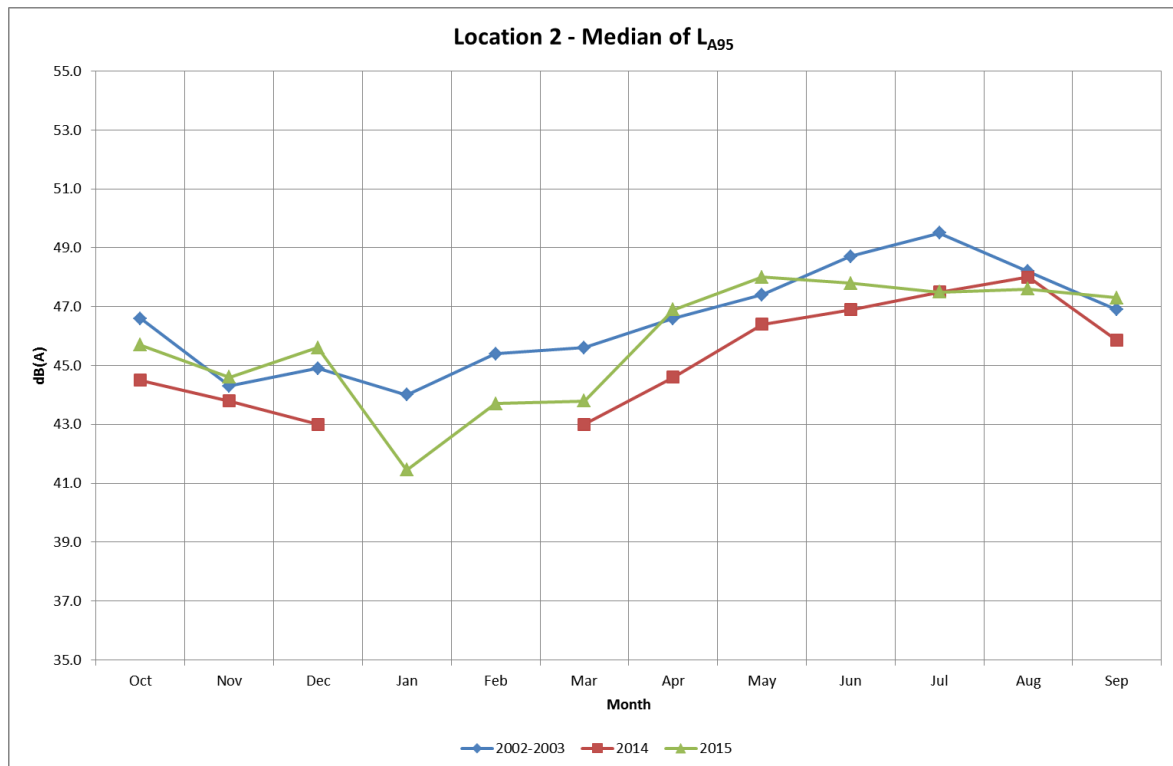


Figure 2-2 : Location 2, Comparison of Median L_{A95}

The monthly median L_{A95} noise levels recorded during 2014 are lower than those measured during 2002-2003. Noise levels measured during 2015 are also lower than those measured during 2002-2003 excepting the months of April, May, September, November and December when marginally higher (less than 1 dB) values were recorded.

2.2 Conclusions

The results presented above (and in Appendices A and B) demonstrate that Refinery noise emissions recorded at both Locations 1 and Location 2 during 2014 and 2015 are lower than those recorded at the same locations during 2002-2003.

Median L_{A95} noise levels recorded at Location 1, north of the Refinery, were lower than those recorded during 2002-2003 in all seasons of the year. Monthly median L_{A95} noise levels were lower

⁵ Alcoa has advised that there is uncertainty over the exact siting of Location 1 during October and November 2002, and it is noted that no data is provided for these months in the Herring Storer report No.: 4417-3 -05029-4-2-5 *Noise Feasibility study Relative to Operating License No 6217/8 Condition N3*.

than those recorded during 2002-2003 in all months except for the months of October and December 2014.

Median L_{A95} noise levels recorded at Location 2, south of the Refinery, were similar to or lower than those recorded during 2002/2003 in all seasons of the year. Monthly median L_{A95} noise levels were lower than those recorded during 2002/2003 except for the months of April, May, September, November and December 2015.

APPENDIX A RESULTS FROM CONTINUOUS NOISE MONITORING

Appendix A-1 Location 1 – October 2002 – September 2003

Monitoring period	Time of Day	Upper 10 th Percentile of L _{A95}	Median L _{A95}	Standard Deviation	No. of Data Points
Annual (Oct '02 to Sep '03)	Day	51.3	48.1	4.2	9401
	Night	51.0	48.1	3.7	6243
Annual (Oct '02 to Jul '03) ⁶	Day	51.3	48.0	4.3	9348
	Night	51.0	48.1	3.7	6192
Winter (Jun – Aug) ⁷	Day	51.4	48.7	2.4	1405
	Night	51.9	49.1	2.3	828
Spring (Sep – Nov) ⁸	Day	57.7	49.0	6.7	2309
	Night	51.4	48.3	4.6	1678
Summer (Dec – Feb)	Day	49.5	46.7	3.6	2901
	Night	49.8	47.1	3.7	2219
Autumn (Mar – May)	Day	51.0	48.9	2.1	2786
	Night	51.0	48.6	2.1	1518
Monthly (Oct 02)	Day	50.4	40.5	4.3	866
	Night	50.6	41.7	4.6	654
Monthly (Nov 02)	Day	59.4	50.6	5.3	1443
	Night	51.6	49.6	2.5	1024
Monthly (Dec 02)	Day	48.7	46.3	5.1	1034
	Night	49.0	45.8	5.4	772
Monthly (Jan 03)	Day	50.0	47.4	2.6	990
	Night	50.1	48.0	2.1	851
Monthly (Feb 03)	Day	49.5	46.7	1.9	877
	Night	49.8	47.3	1.8	596
Monthly (March 03)	Day	50.1	48.7	1.8	1010
	Night	50.4	48.6	1.2	558
Monthly (April 03)	Day	51.4	49.5	2.2	1088
	Night	51.5	49.7	2.8	509
Monthly (May 03)	Day	50.9	48.7	2.1	688
	Night	50.6	48.0	2.0	451
Monthly (June 03)	Day	50.4	48.1	2.2	809

⁶ Excluding noise data for which no corresponding rainfall data is available

⁷ Excluding noise data from August for which no corresponding rainfall data is available

⁸ Excluding noise data from September for which no corresponding rainfall data is available

Monitoring period	Time of Day	Upper 10 th Percentile of L _{A95}	Median L _{A95}	Standard Deviation	No. of Data Points
Monthly (July 03)	Night	50.9	48.6	1.8	451
	Day	52.0	49.8	2.4	543
	Night	52.8	50.0	2.8	326
Monthly (Aug 03)	Day	51.9	50.7	2.2	53
	Night	52.6	50.8	1.8	51
Monthly (Sept 03) ⁹	Day	-	-	-	-
	Night	-	-	-	-

⁹ No noise data is available for Location 1 during September 2003.

Appendix A-2 Location 2 – October 2002 – September 2003

Monitoring period	Time of Day	Upper 10 th Percentile of L _{A95}	Median L _{A95}	Standard Deviation	No. of Data Points
Annual (Oct '02 to Sep '03)	Day	49.9	46.8	4.4	4119
	Night	50.1	47.6	3.4	3823
Annual (Oct '02 to Jul '03) ¹⁰	Day	50.0	46.7	4.7	3499
	Night	50.2	47.6	3.6	3077
Winter (Jun – Aug) ¹¹	Day	50.6	48.8	4.1	1701
	Night	50.6	49.2	2.9	1522
Spring (Sep – Nov) ¹²	Day	48.1	46.2	2.3	631
	Night	48.2	46.8	1.5	805
Summer (Dec – Feb)	Day	46.0	43.0	4.3	585
	Night	47.4	45.8	4.1	515
Autumn (Mar – May)	Day	48.9	46.3	4.2	1202
	Night	49.0	46.9	3.6	981
Monthly (Oct 02)	Day	47.5	46.3	1.9	235
	Night	47.9	46.7	1.4	359
Monthly (Nov 02)	Day	45.5	43.4	2.4	105
	Night	49.4	46.0	2.7	56
Monthly (Dec 02)	Day	46.1	43.9	2.9	168
	Night	48.5	45.9	5.3	152
Monthly (Jan 03)	Day	45.5	42.1	4.5	242
	Night	46.5	45.5	3.3	185
Monthly (Feb 03)	Day	46.1	44.0	4.9	175
	Night	47.2	46.3	3.7	178
Monthly (March 03)	Day	46.7	44.9	5.5	275
	Night	46.8	45.9	4.0	237
Monthly (April 03)	Day	47.8	46.2	2.1	337
	Night	48.2	46.9	3.6	346
Monthly (May 03)	Day	49.6	47.0	4.1	590
	Night	50.6	48.1	2.8	398
Monthly (June 03)	Day	50.2	48.3	4.4	601
	Night	50.2	48.9	3.6	522
Monthly (July 03)	Day	51.3	49.3	4.3	771
	Night	51.0	49.7	2.8	644

¹⁰ Excluding noise data for which no corresponding rainfall data is available

¹¹ Excluding noise data from August for which no corresponding rainfall data is available

¹² Excluding noise data from September for which no corresponding rainfall data is available

Monitoring period	Time of Day	Upper 10 th Percentile of L _{A95}	Median L _{A95}	Standard Deviation	No. of Data Points
Monthly (Aug 03)	Day	49.4	47.3	2.0	329
	Night	50.4	48.7	1.7	356
Monthly (Sept 03)	Day	48.4	46.9	1.8	291
	Night	48.3	46.9	1.4	390

Appendix A-3 Location 1 – March 2014 – December 2014

Monitoring period	Time of Day	Upper 10 th Percentile of L _{A95}	Median L _{A95}	Standard Deviation	No. of Data Points
Annual (Mar '14 to Dec '14)	Day	48.4	45.9	2.9	7957
	Night	49.3	46.9	2.6	6714
Autumn (Mar – May)	Day	47.9	45.5	3.0	2520
	Night	49.0	46.6	2.7	1669
Winter (Jun – Aug)	Day	49.2	46.7	2.6	2273
	Night	49.8	47.7	2.7	1675
Spring (Sep – Nov)	Day	48.1	45.6	3.0	2357
	Night	49.4	47.0	2.5	2363
Summer (Dec)*	Day	48.1	45.7	2.0	807
	Night	48.2	45.9	2.2	1007
Monthly (Mar 14)	Day	47.4	45.1	3.2	629
	Night	48.7	46.9	2.9	416
Monthly (Apr 14)	Day	47.7	45.3	2.9	1283
	Night	49.0	46.4	2.6	741
Monthly (May 14)	Day	48.8	46.3	2.8	608
	Night	49.4	46.6	2.6	512
Monthly (Jun 14)	Day	49.4	47.3	2.5	974
	Night	50.0	47.9	2.4	652
Monthly (Jul 14)	Day	49.3	46.8	2.6	718
	Night	50.1	48.4	2.1	585
Monthly (Aug 14)	Day	48.4	45.6	2.5	581
	Night	48.8	46.0	3.0	438
Monthly (Sept 14)	Day	47.7	45.3	2.9	653
	Night	49.5	47.6	2.3	569
Monthly (Oct 14)	Day	48.5	45.9	3.3	839
	Night	50.0	46.9	2.7	919
Monthly (Nov 14)	Day	47.8	45.5	2.6	865
	Night	48.9	46.6	2.3	875
Monthly (Dec 14)	Day	48.1	45.7	2.0	807
	Night	48.2	45.9	2.2	1007

* Only partial season included.

Appendix A-4 Location 2 – March 2014 – December 2014

Monitoring period	Time of Day	Upper 10 th Percentile of L _{AS95}	Median L _{AS95}	Standard Deviation	No. of Data Points
Annual (Mar '14 to Dec '14)	Day	49.2	46.0	2.9	5416
	Night	49.2	47.1	2.4	4537
Autumn (Mar – May)	Day	47.9	45.3	2.7	1656
	Night	48.4	46.5	2.3	1564
Winter (Jun – Aug)	Day	49.6	47.1	2.4	2789
	Night	49.6	47.8	1.8	2208
Spring (Sep – Nov)	Day	48.5	44.2	3.2	771
	Night	48.5	46.1	2.8	713
Summer (Dec)*	Day	45.1	43.1	2.0	200
	Night	46.6	41.9	3.0	52
Monthly (Mar 14)	Day	46.0	42.9	3.2	151
	Night	45.4	43.0	2.5	141
Monthly (Apr 14)	Day	46.8	43.9	3.0	387
	Night	47.9	45.9	2.6	224
Monthly (May 14)	Day	48.2	45.8	2.1	1118
	Night	48.5	46.8	1.8	1199
Monthly (Jun 14)	Day	49.3	46.3	2.5	944
	Night	49.0	47.3	1.8	749
Monthly (Jul 14)	Day	49.8	47.3	2.2	907
	Night	49.6	47.7	1.8	725
Monthly (Aug 14)	Day	49.6	47.5	2.3	938
	Night	49.9	48.3	1.7	734
Monthly (Sept 14)	Day	49.0	45.8	2.8	414
	Night	48.8	46.0	2.5	304
Monthly (Oct 14)	Day	45.5	43.0	2.7	161
	Night	48.6	46.6	3.1	182
Monthly (Nov 14)	Day	48.2	42.7	3.3	196
	Night	47.9	45.7	3.0	227
Monthly (Dec 14)	Day	45.1	43.1	2.0	200
	Night	46.6	41.9	3.0	52

* Only partial season included.

Appendix A-5 Location 1 – January 2015 – December 2015

Monitoring period	Time of Day	Upper 10 th Percentile of L _{AS95}	Median L _{AS95}	Standard Deviation	No. of Data Points
All data (Jan 15 to Dec 15)	Day	48.0	45.5	2.9	9887
	Night	48.7	46.2	2.5	6834
Autumn (Mar – May)	Day	48.2	45.7	3.0	2706
	Night	48.9	46.4	2.4	1395
Winter (Jun - Aug)	Day	48.4	46.3	2.6	2421
	Night	49.2	46.9	2.6	1266
Spring (Sept – Nov)	Day	47.6	45.3	2.8	2694
	Night	48.6	46.1	2.2	2271
Summer (Jan – Feb, Dec)*	Day	47.1	44.6	2.8	2066
	Night	48.0	45.7	2.5	1902
Monthly (Jan 15)	Day	47.2	44.6	2.8	882
	Night	47.7	45.1	2.4	707
Monthly (Feb 15)	Day	47.1	43.9	3.1	855
	Night	48.2	45.6	2.9	756
Monthly (Mar 15)	Day	48.0	45.0	3.3	952
	Night	48.5	46.1	2.5	602
Monthly (Apr 15)	Day	47.5	44.3	3.2	229
	Night	48.7	47.3	2.0	55
Monthly (May 15)	Day	48.4	46.2	2.5	1525
	Night	49.1	46.6	2.3	738
Monthly (Jun 15)	Day	48.5	46.2	2.3	772
	Night	49.3	45.8	2.6	274
Monthly (Jul 15)	Day	48.4	46.3	2.7	778
	Night	49.0	46.8	2.7	407
Monthly (Aug 15)	Day	48.3	46.3	2.6	871
	Night	49.2	47.3	2.5	585
Monthly (Sept 15)	Day	48.3	46.0	2.4	965
	Night	49.3	47.4	2.1	692
Monthly (Oct 15)	Day	47.5	45.2	3.1	723
	Night	48.6	46.0	2.4	700
Monthly (Nov 15)	Day	46.8	44.8	2.6	1006
	Night	47.2	45.5	1.7	879
Monthly (Dec 15)*	Day	46.8	45.4	1.7	329
	Night	48.0	46.3	1.8	439

* Only partial season included (until 10th December 2015).

Appendix A-6 Location 2 – January 2015 – December 2015

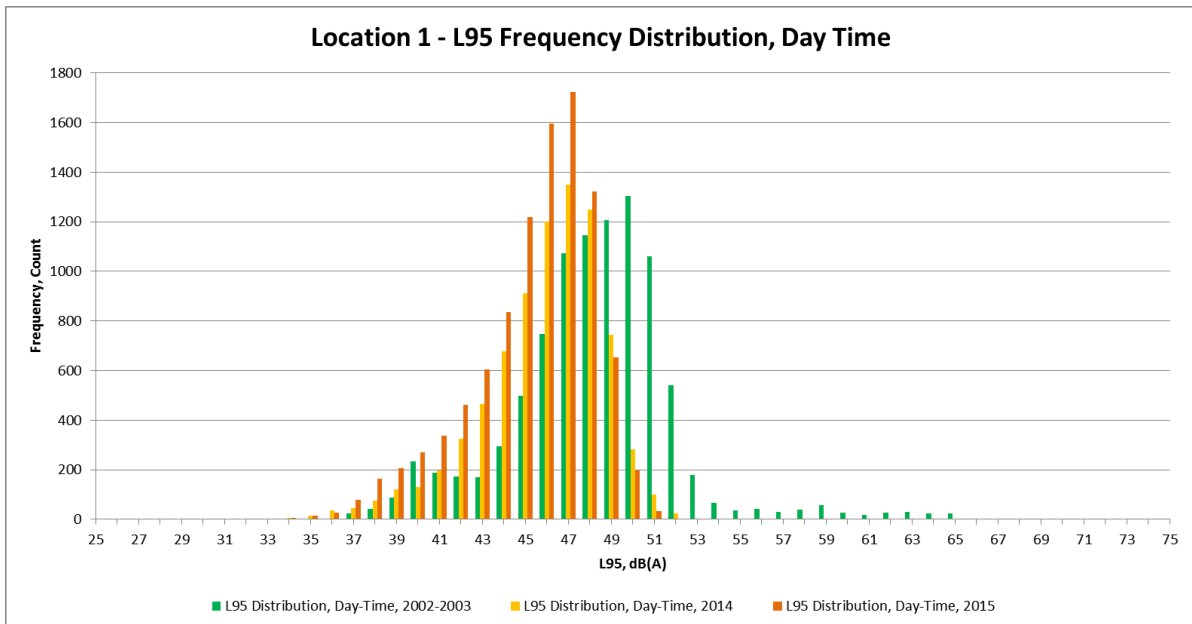
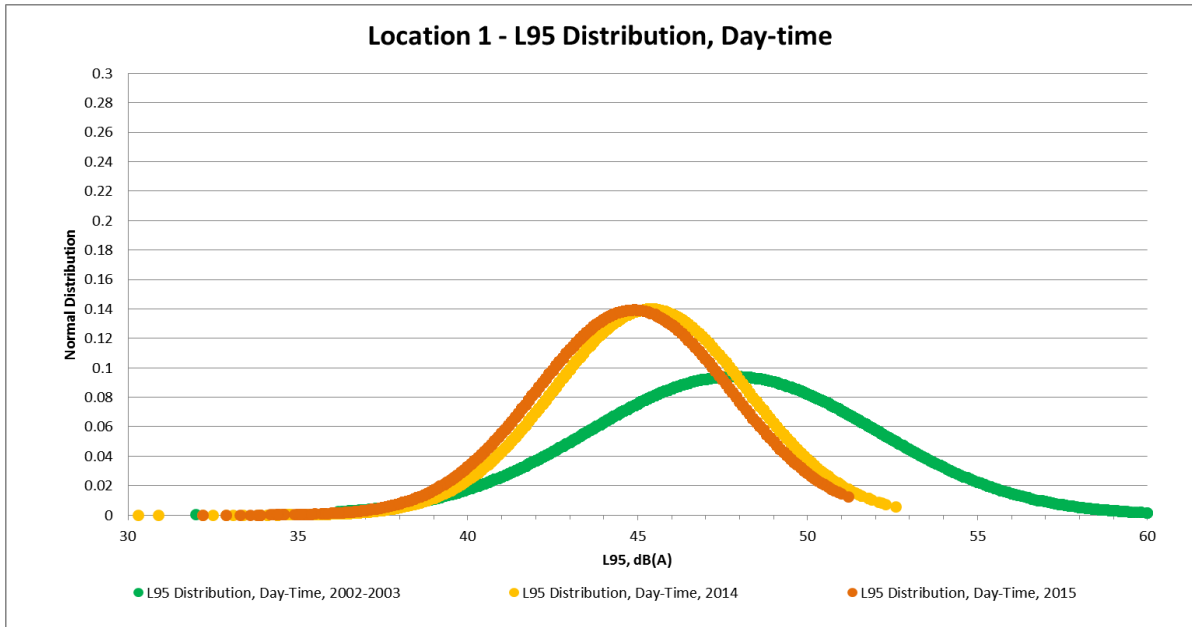
Monitoring period	Time of Day	Upper 10 th Percentile of L _{AS95}	Median L _{AS95}	Standard Deviation	No. of Data Points
All data (Jan 15 to Dec 15)	Day	49.1	46.7	3.1	5684
	Night	49.6	47.4	2.4	4740
Autumn (Mar – May)	Day	49.2	46.1	3.5	979
	Night	49.8	46.9	2.8	699
Winter (Jun-Aug)	Day	49.4	47.3	2.1	3183
	Night	49.9	48.0	1.8	2536
Spring (Sept – Nov)	Day	48.6	45.7	3.3	1142
	Night	49.0	46.5	2.3	1159
Summer (Jan – Feb, Dec)*	Day	45.9	40.9	3.4	380
	Night	48.3	45.3	3.4	346
Monthly (Jan 15)	Day	44.6	40.1	3.0	162
	Night	47.7	44.2	3.2	90
Monthly (Feb 15)	Day	46.2	41.8	3.6	206
	Night	48.7	45.5	3.6	210
Monthly (Mar 15)	Day	46.5	43.2	3.5	259
	Night	47.3	43.9	2.2	292
Monthly (Apr 15)	Day	48.2	46.5	2.2	323
	Night	49.0	47.6	1.5	179
Monthly (May 15)	Day	50.0	47.1	3.2	397
	Night	50.5	49.0	2.5	228
Monthly (Jun 15)	Day	49.2	47.4	1.9	1125
	Night	49.4	48.1	1.5	905
Monthly (Jul 15)	Day	49.6	47.3	2.2	1315
	Night	50.3	47.8	2.0	820
Monthly (Aug 15)	Day	49.3	47.0	2.2	743
	Night	49.9	48.1	2.0	811
Monthly (Sept 15)	Day	49.4	47.1	2.4	467
	Night	49.2	47.5	1.8	449
Monthly (Oct 15)	Day	48.0	45.2	3.3	441
	Night	48.6	45.9	2.3	517
Monthly (Nov 15)	Day	46.4	43.5	3.1	234
	Night	47.9	45.3	2.2	193
Monthly (Dec 15)*	Day	48.5	44.4	2.7	12
	Night	47.7	46.0	1.1	46

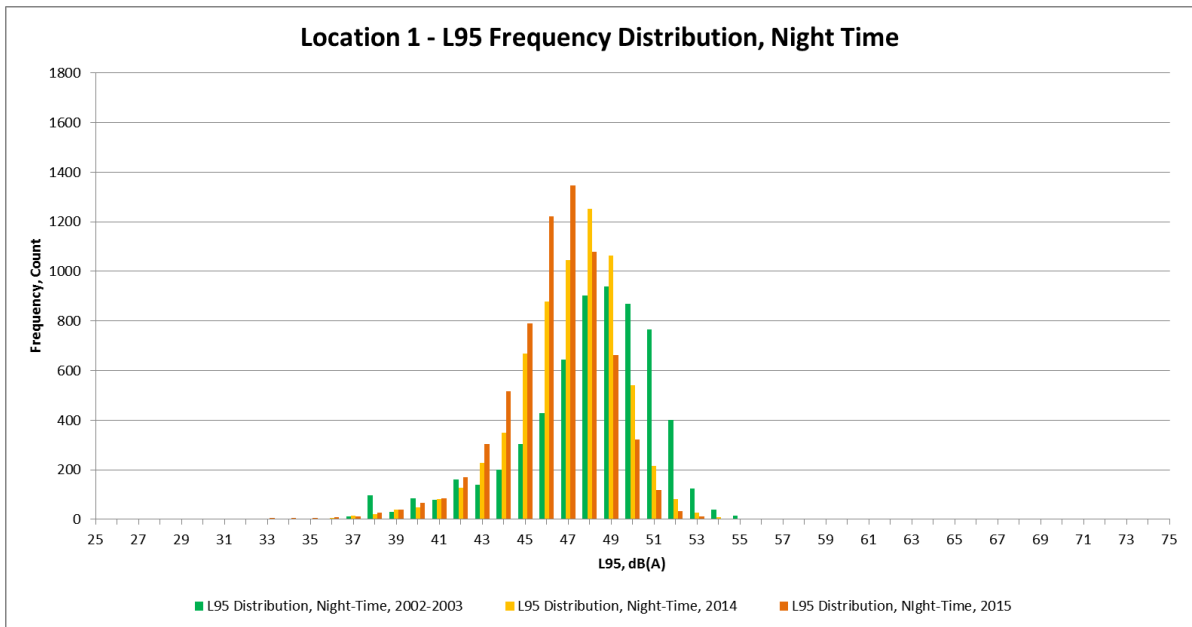
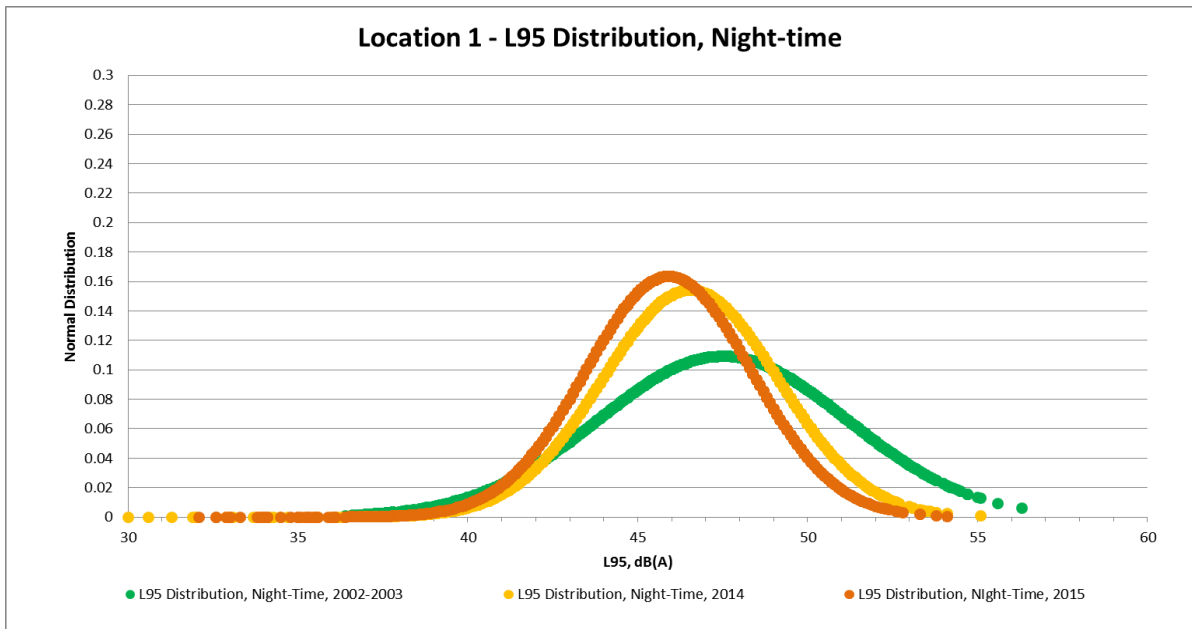
* Only partial season included (until 10th December 2015).

APPENDIX B STATISTICAL ANALYSIS CHARTS FROM CONTINUOUS NOISE MONITORING

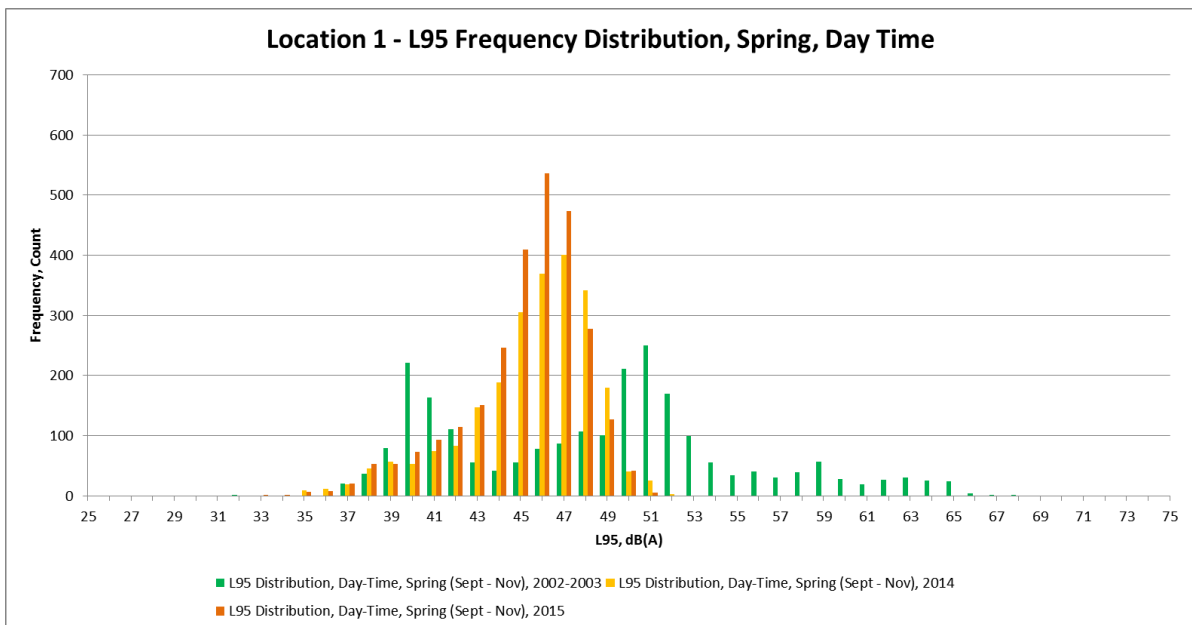
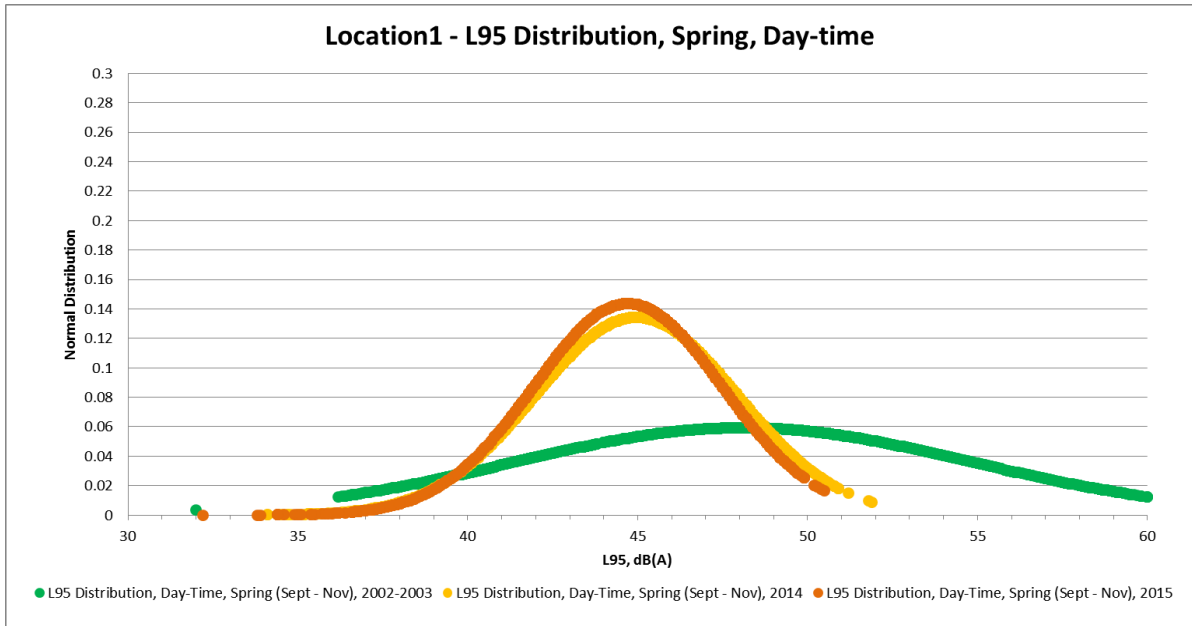
Appendix B-1 Location 1

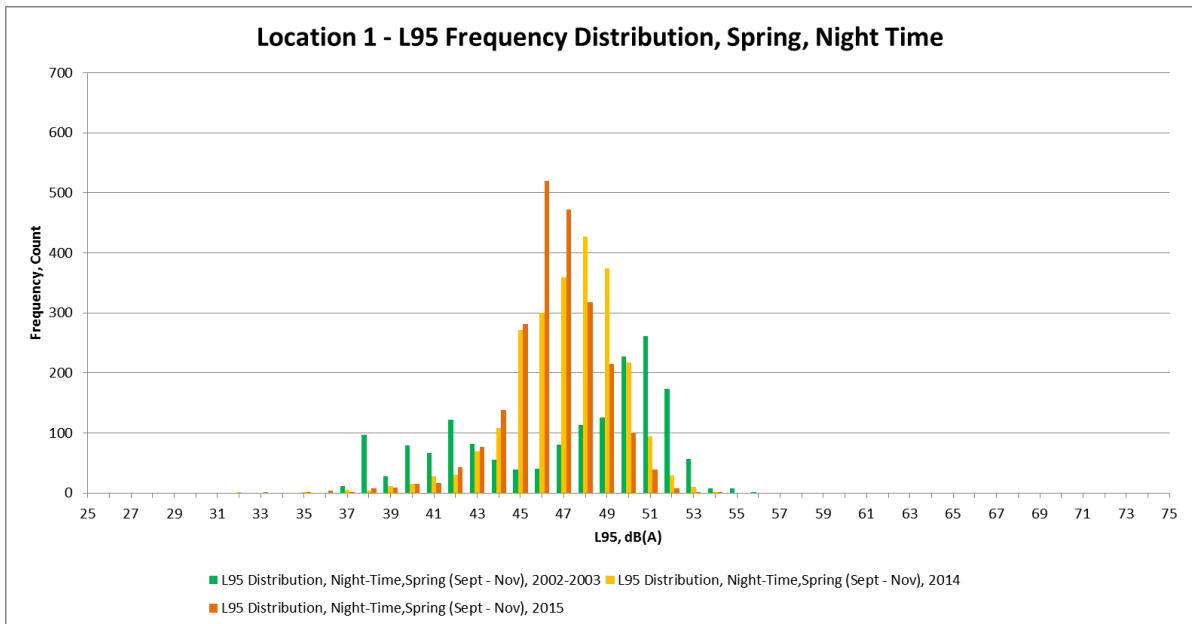
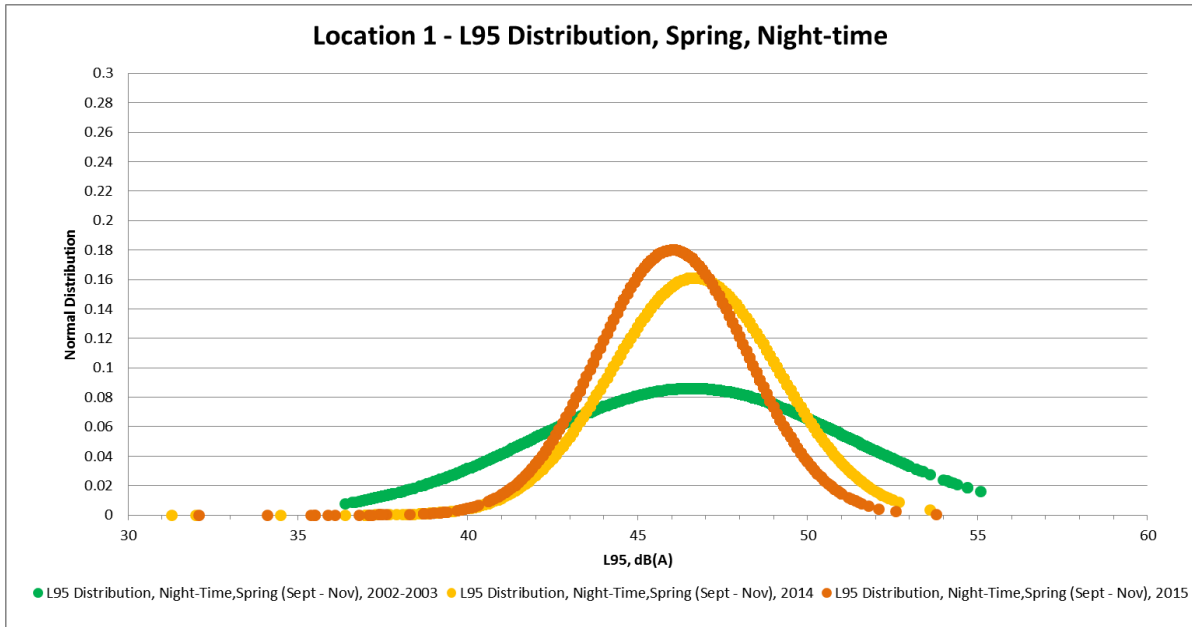
Appendix B-1.1 Location 1 – Annual Data



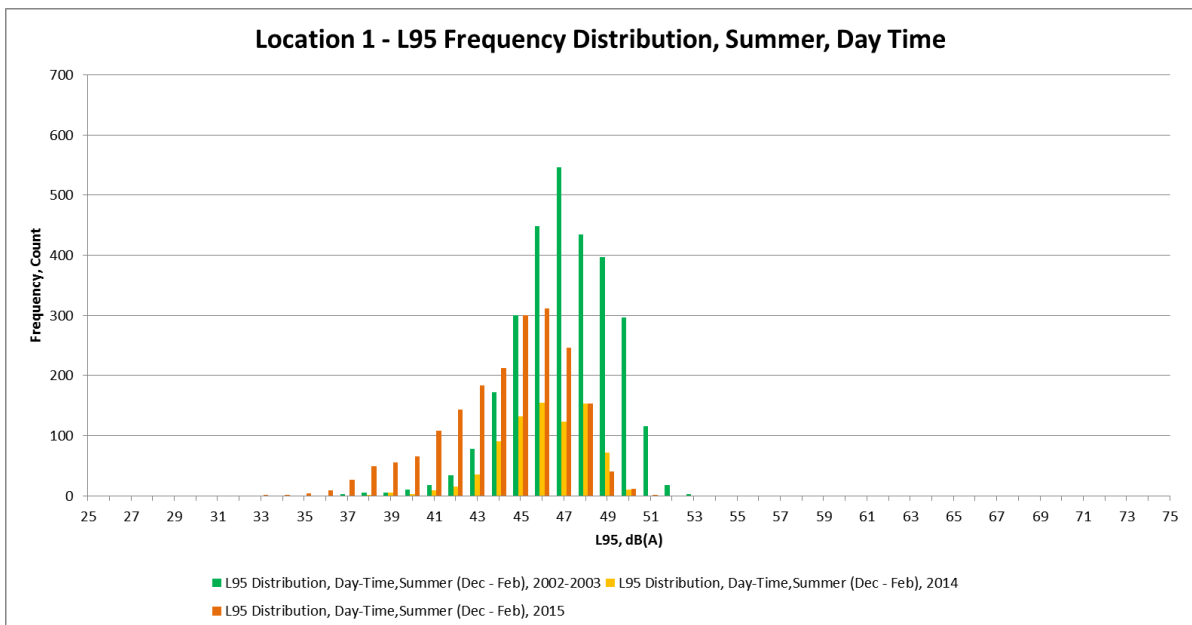
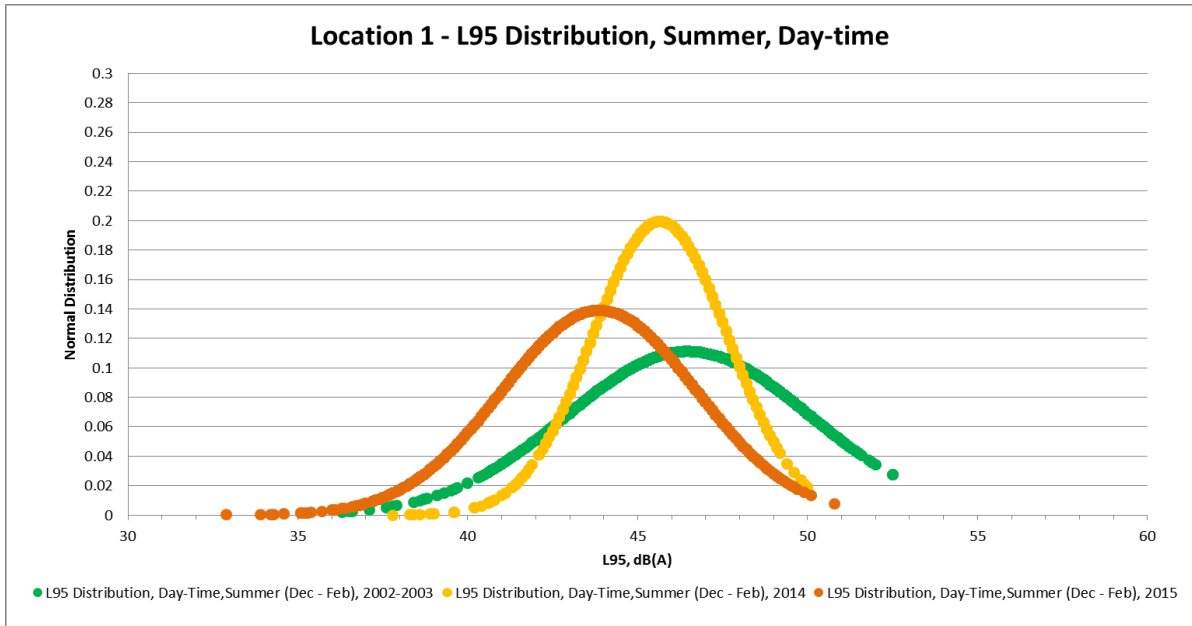


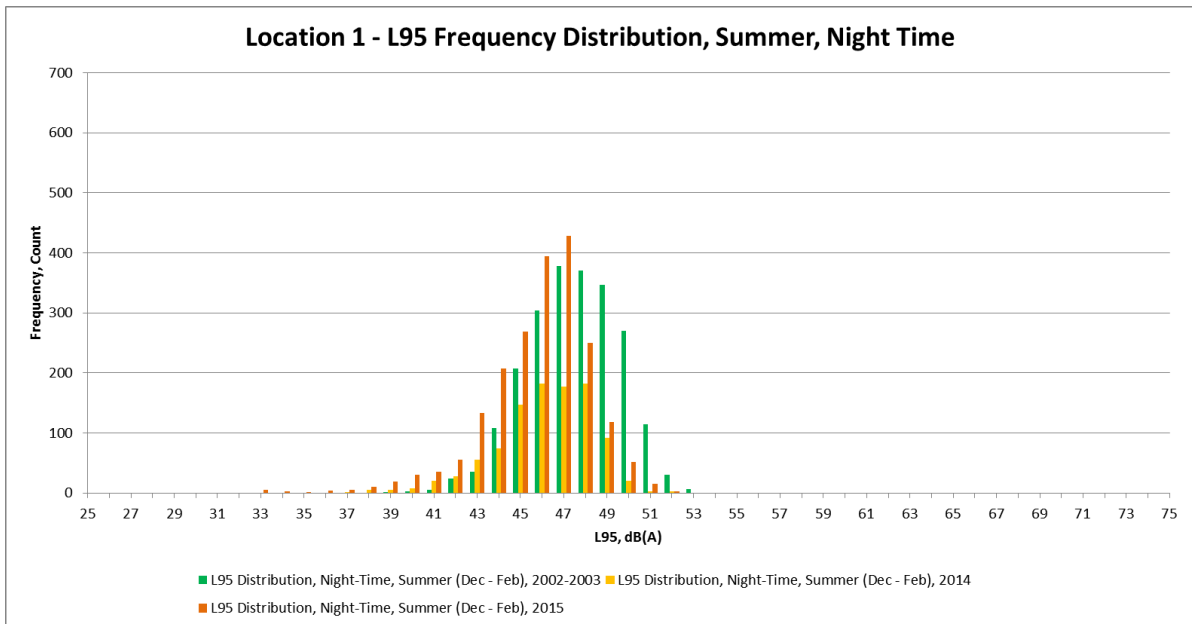
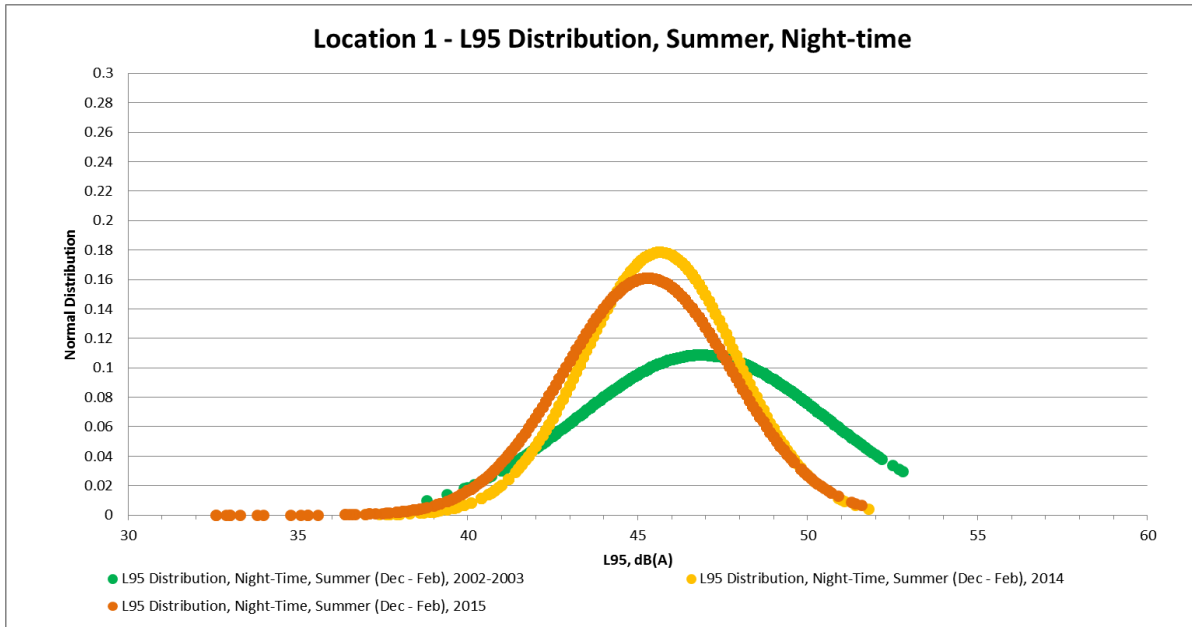
Appendix B-1.2 Location 1 – Spring Data (September – November)



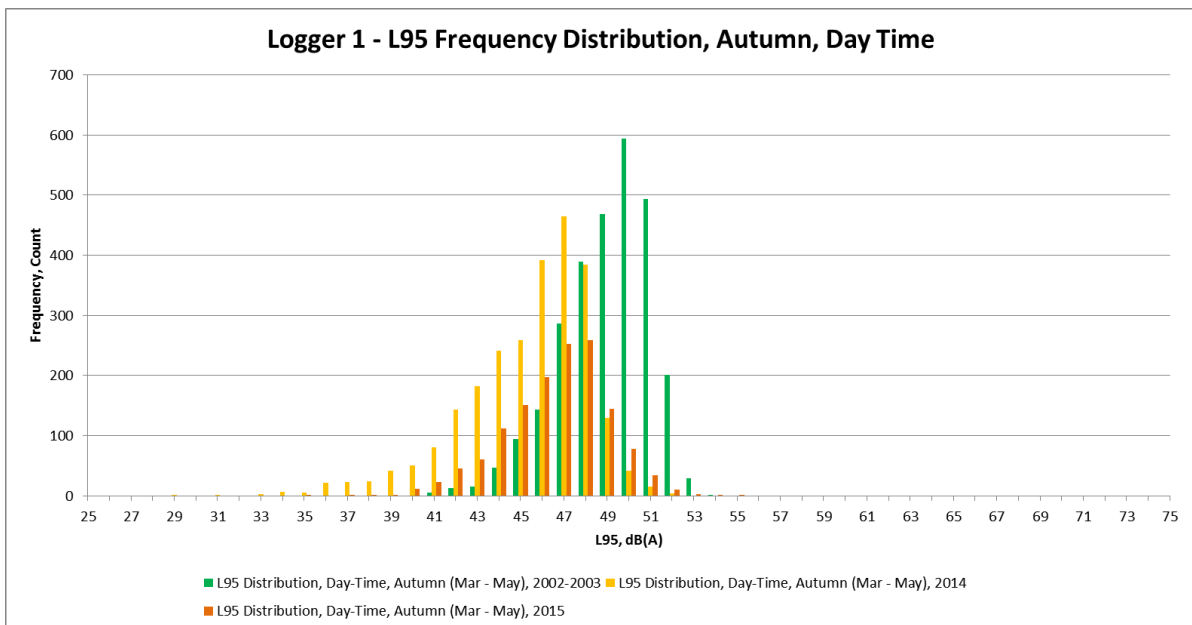
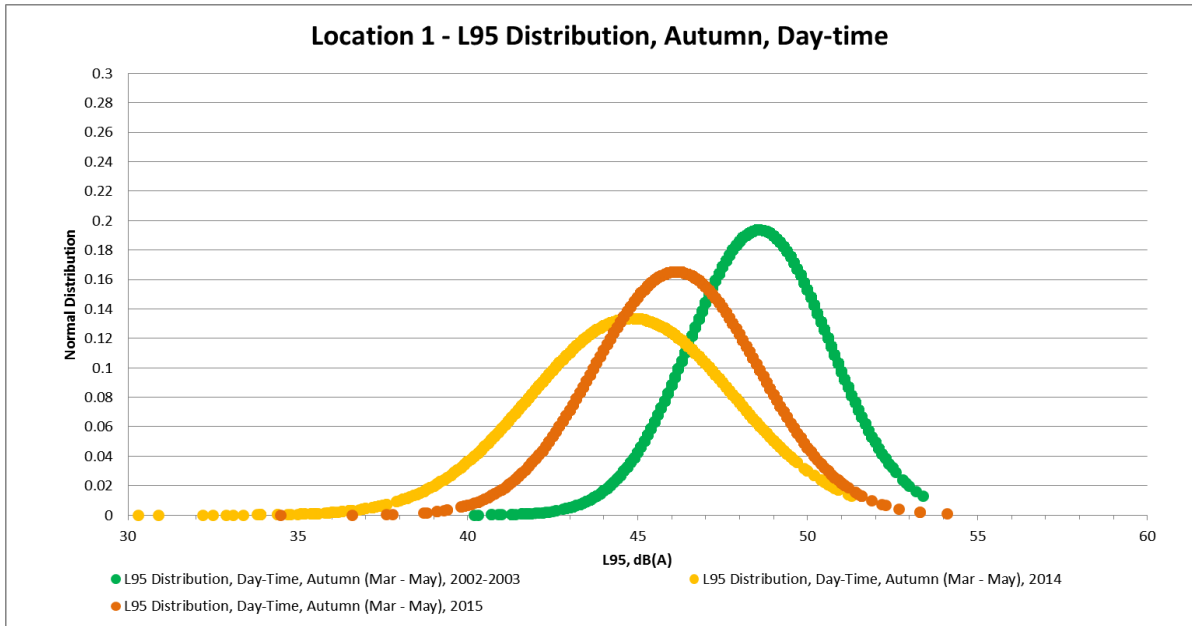


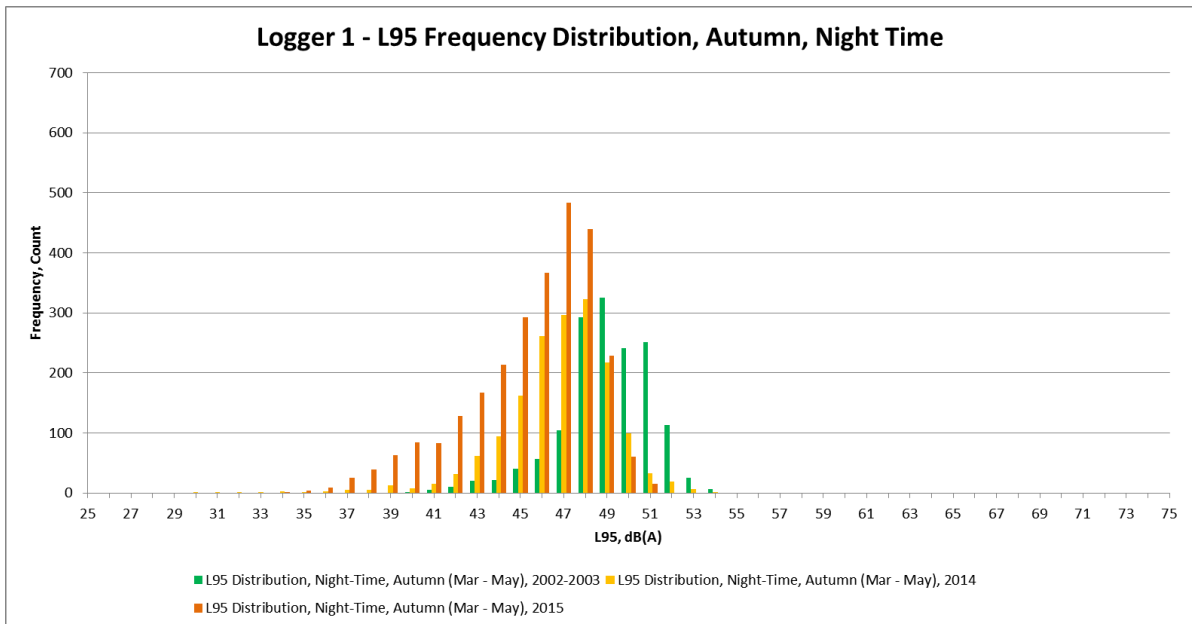
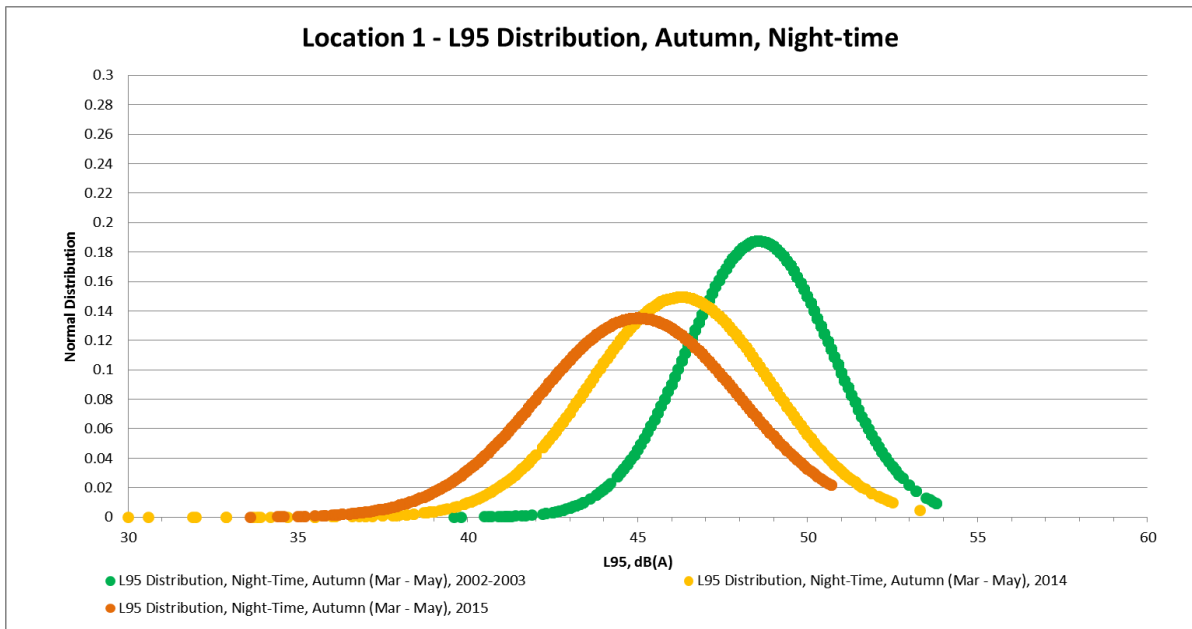
Appendix B-1.3 Location 1 – Summer Data (December – February)



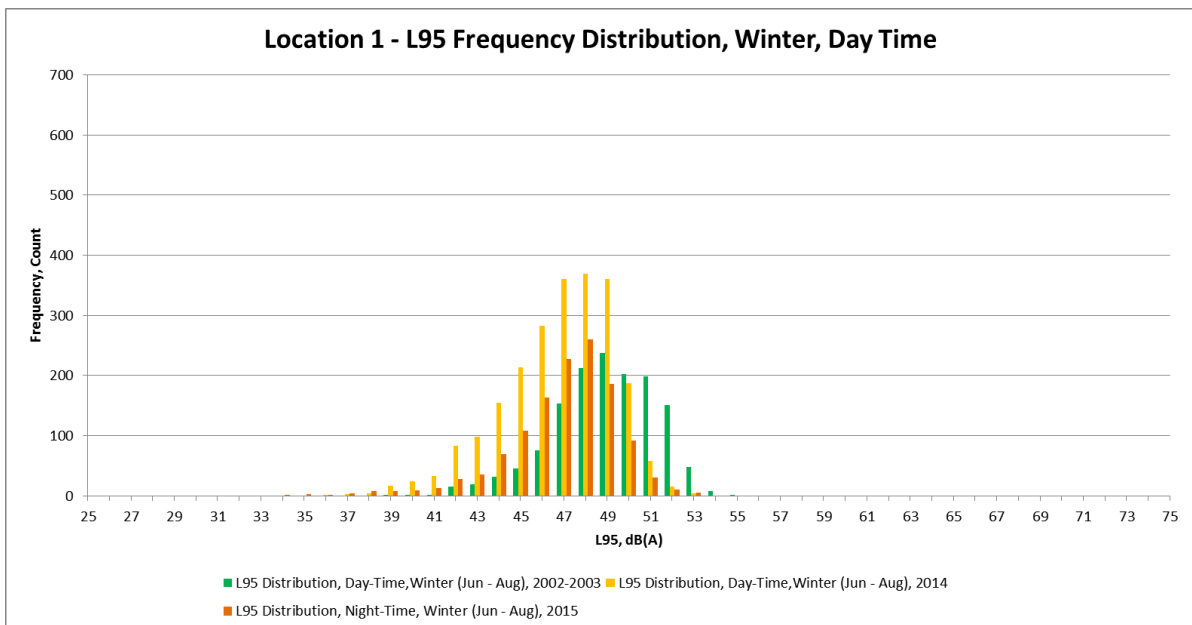
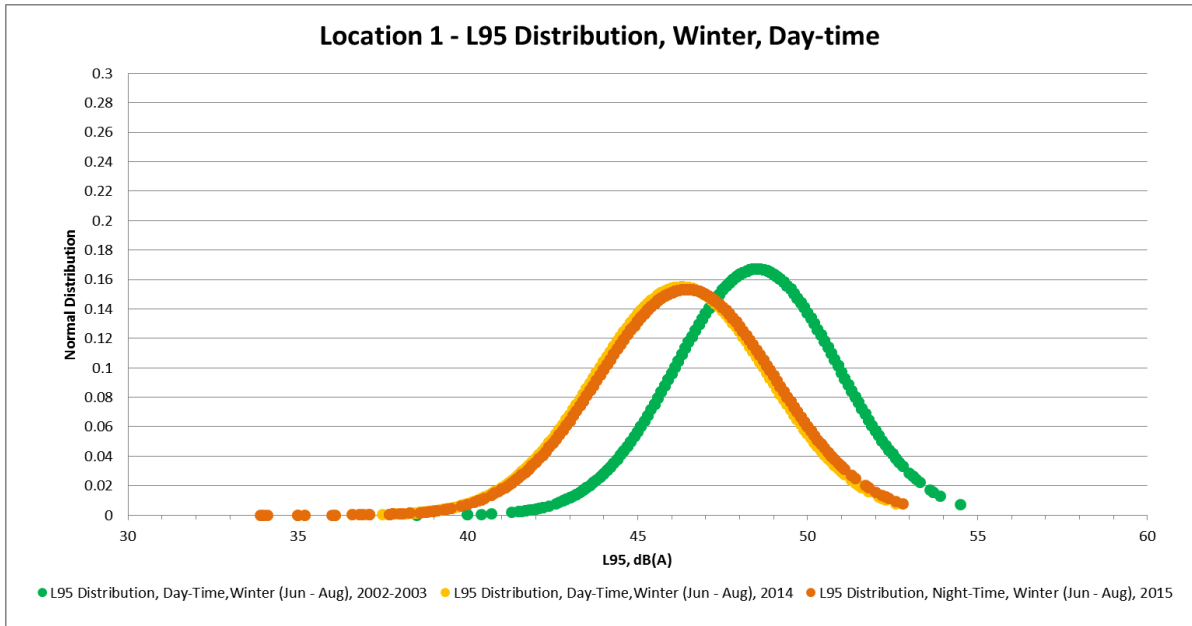


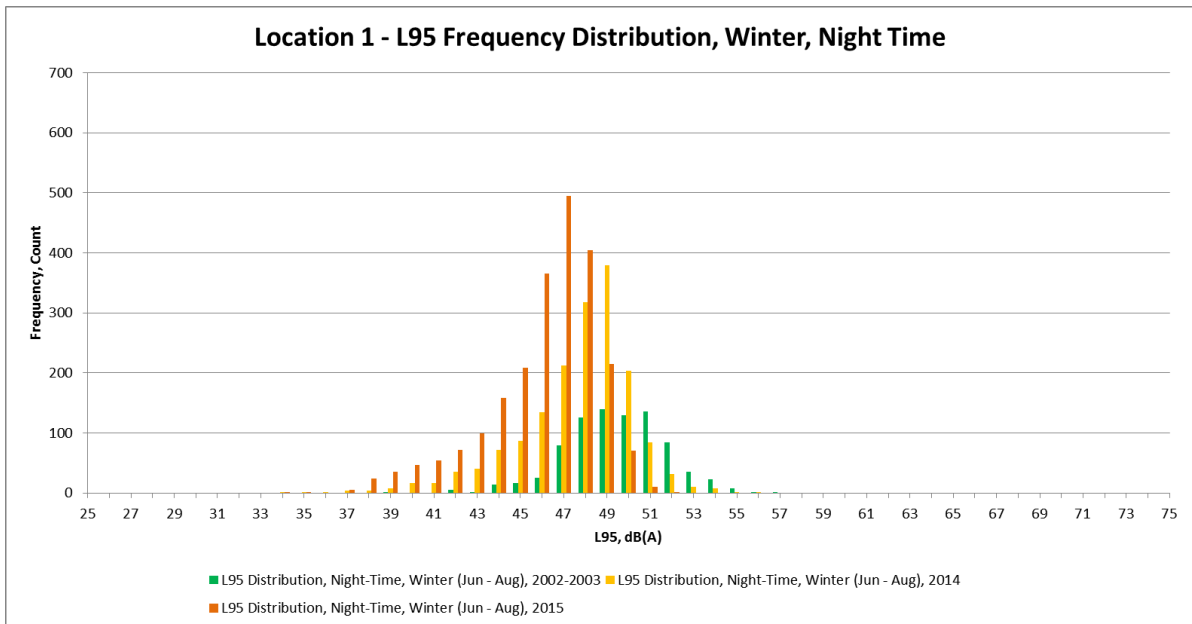
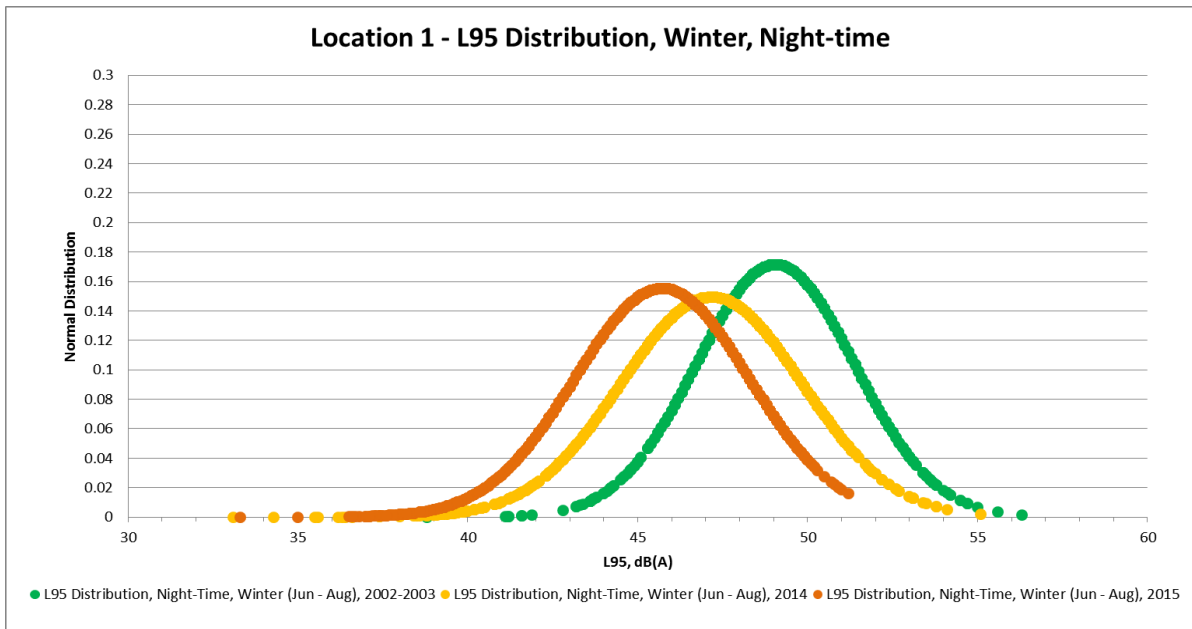
Appendix B-1.4 Location 1 – Autumn Data (March – May)





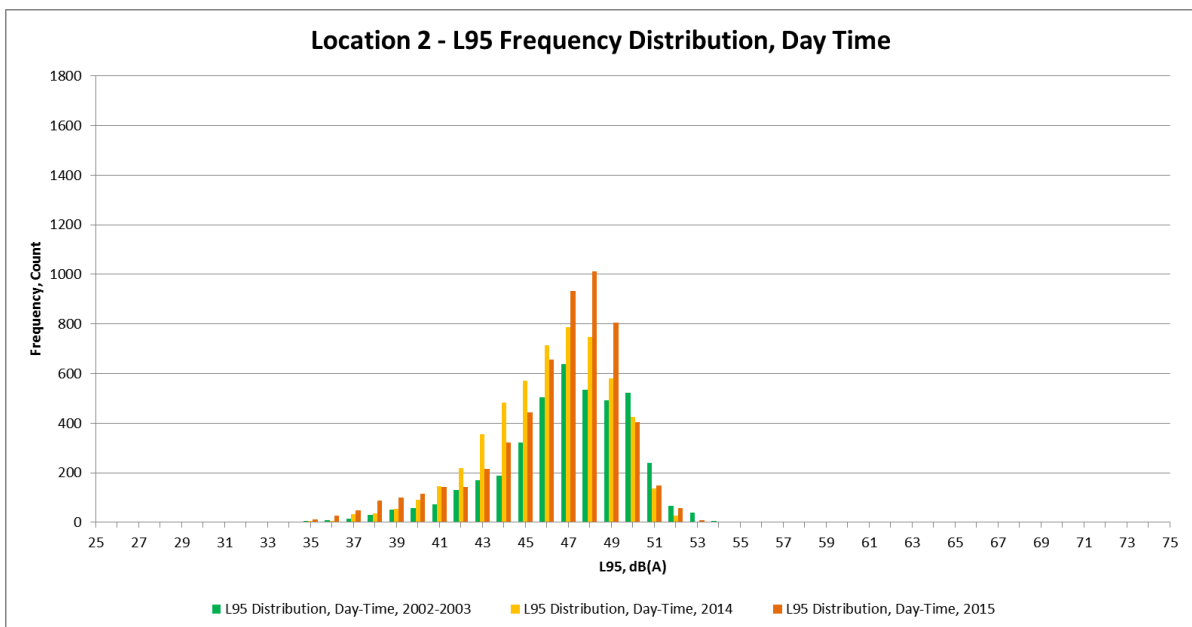
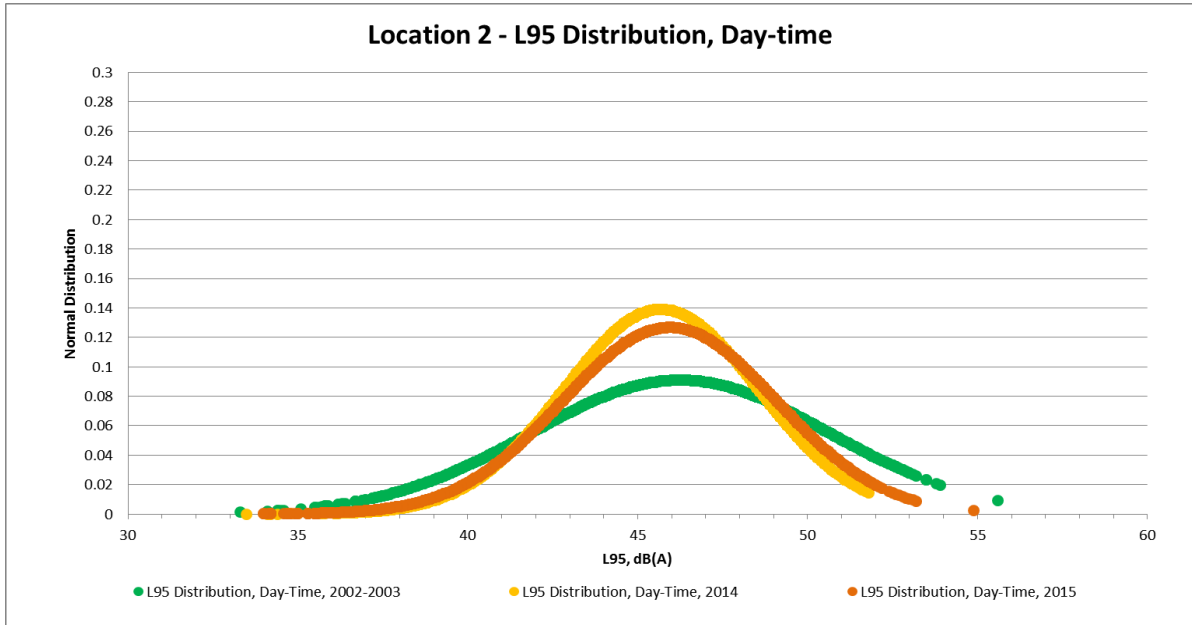
Appendix B-1.5 Location 1 – Winter Data (June – August)

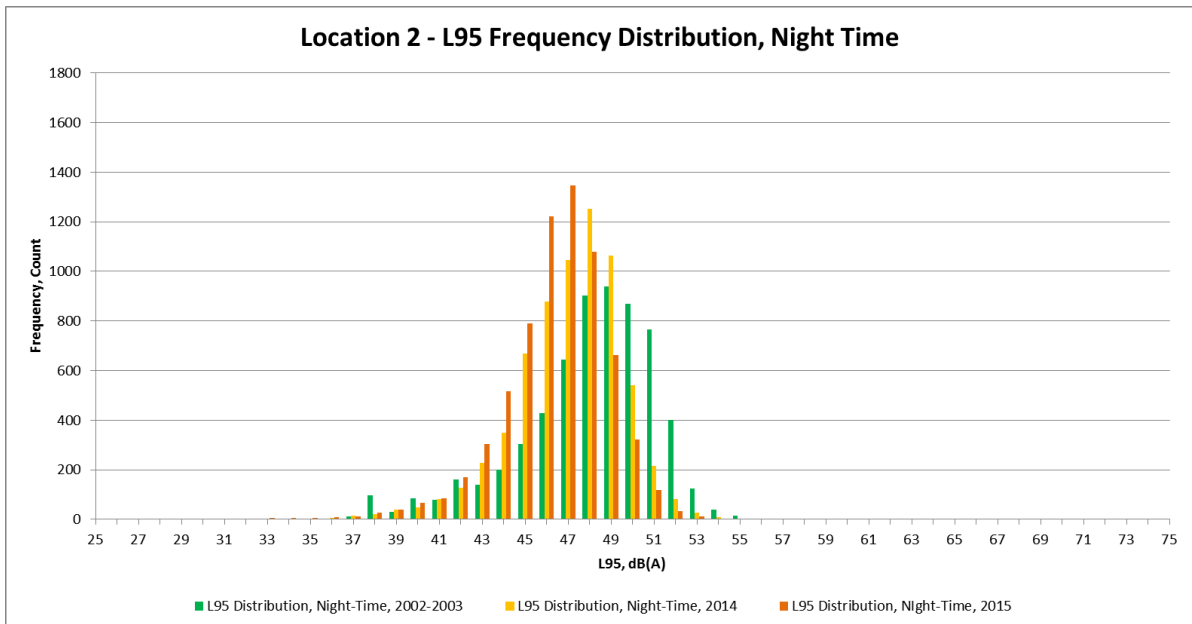
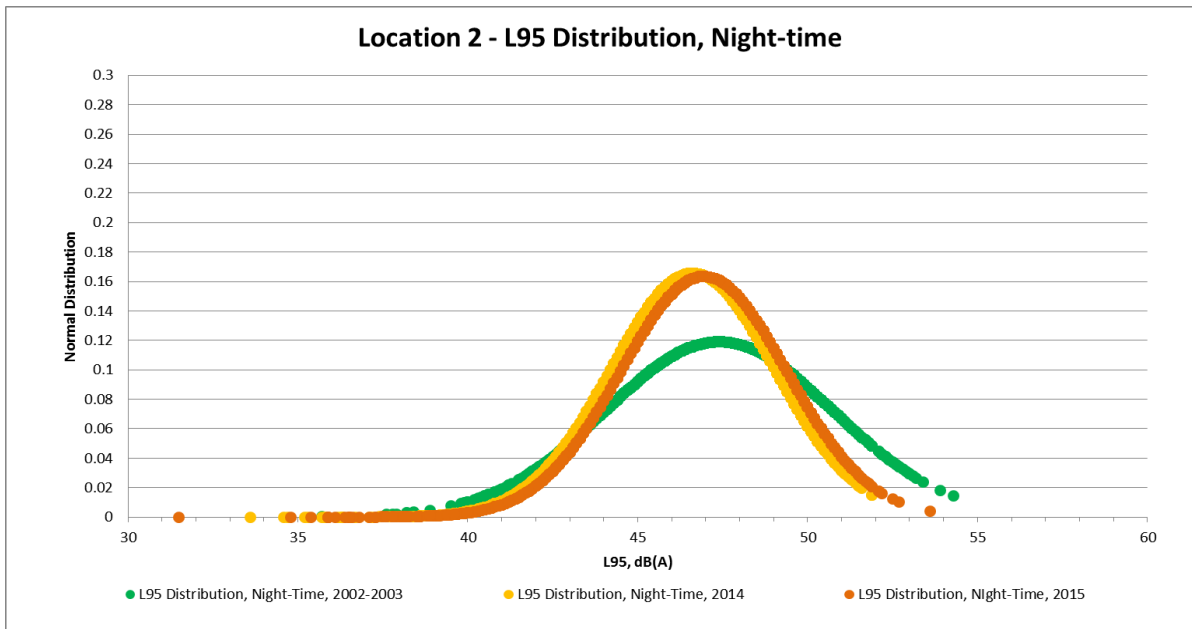




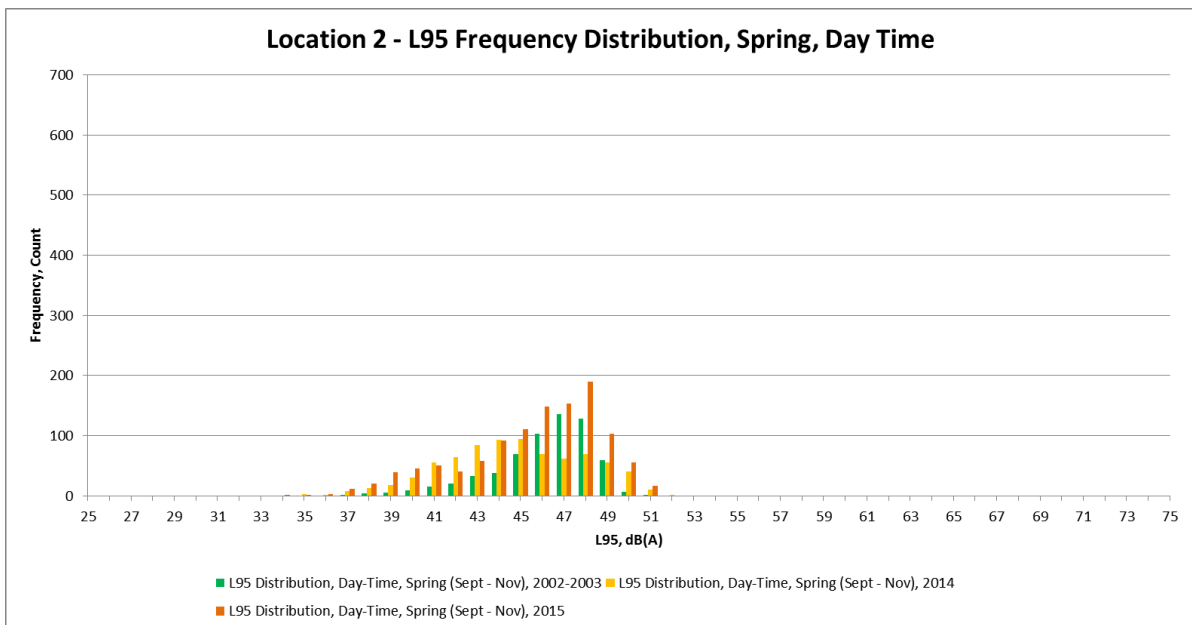
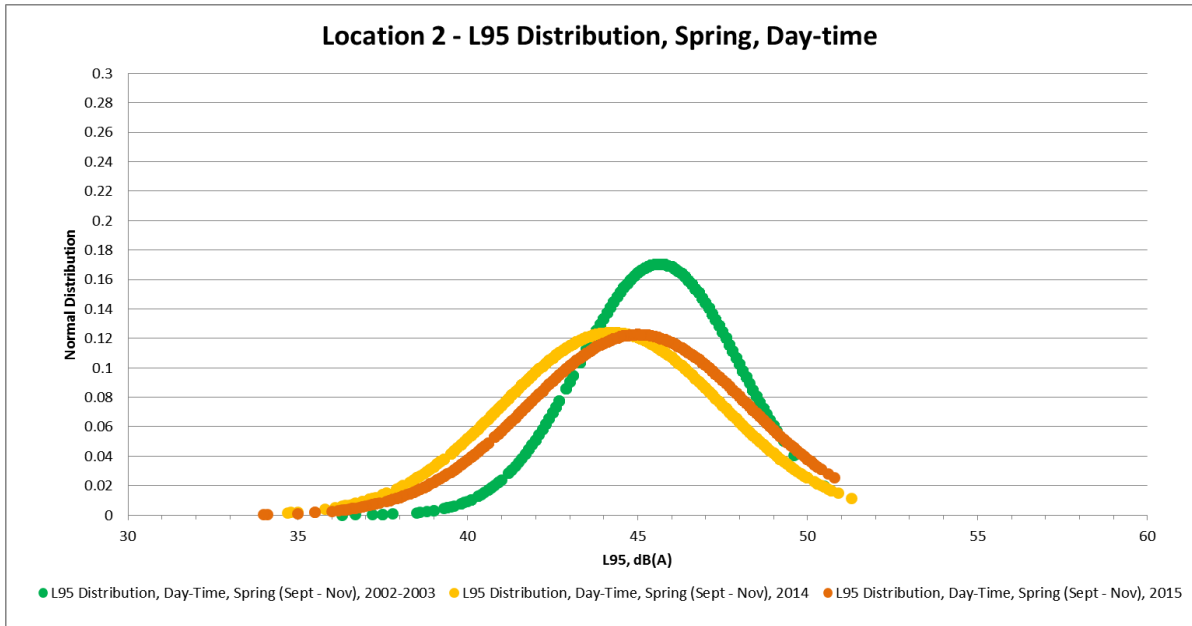
Appendix B-2 Location 2

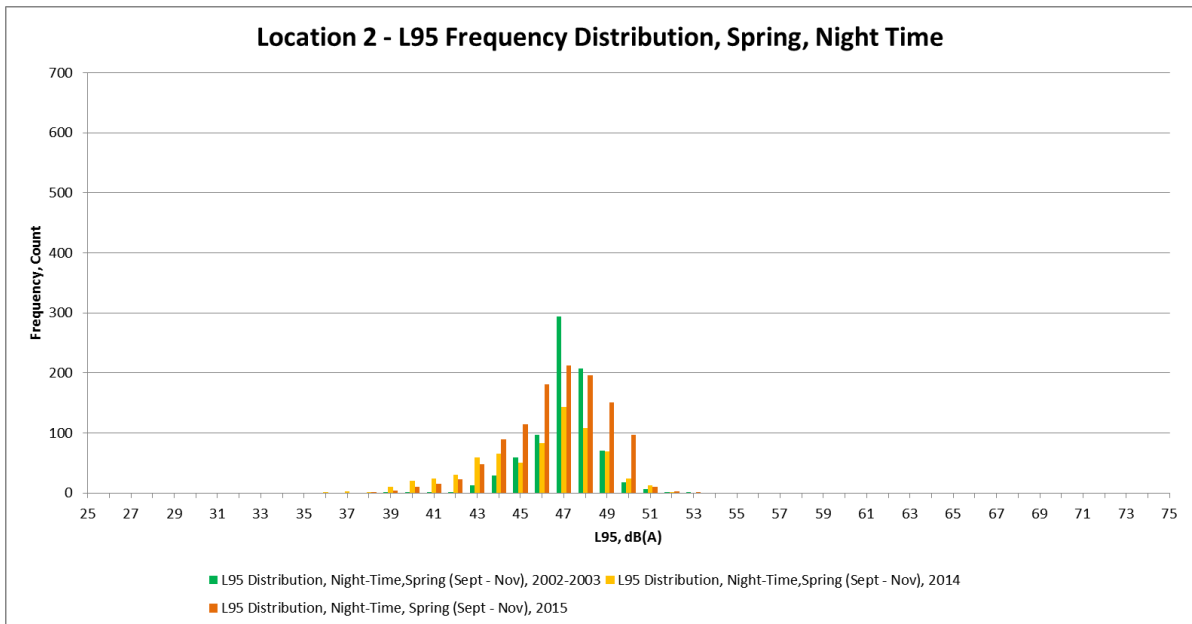
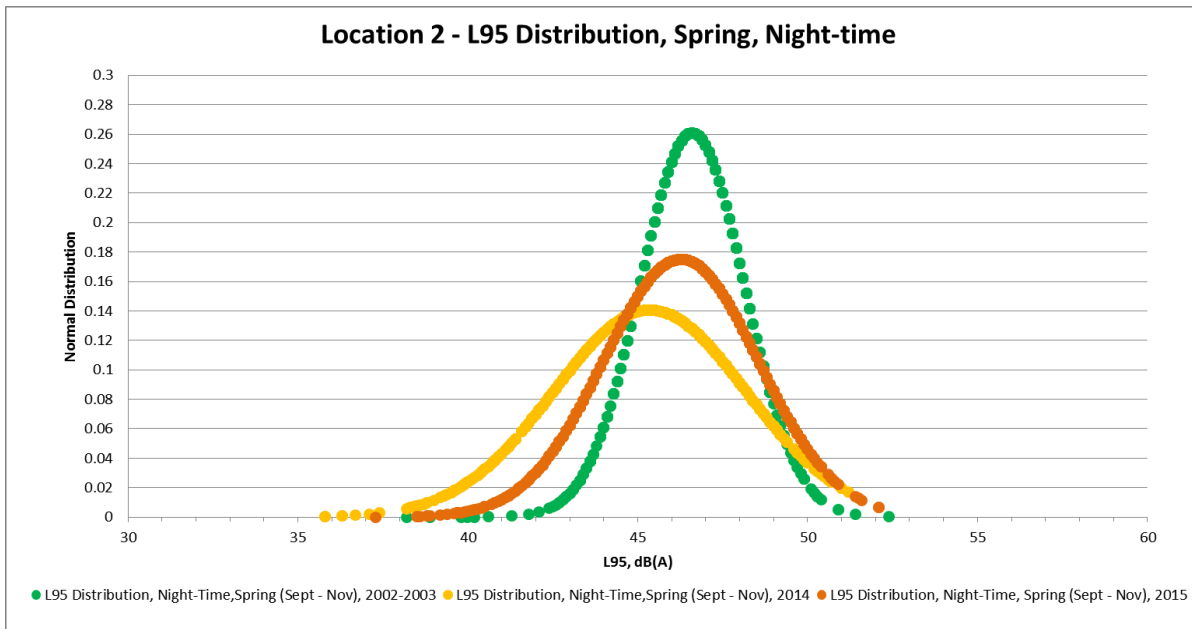
Appendix B-2.1 Location 2 – Annual Data



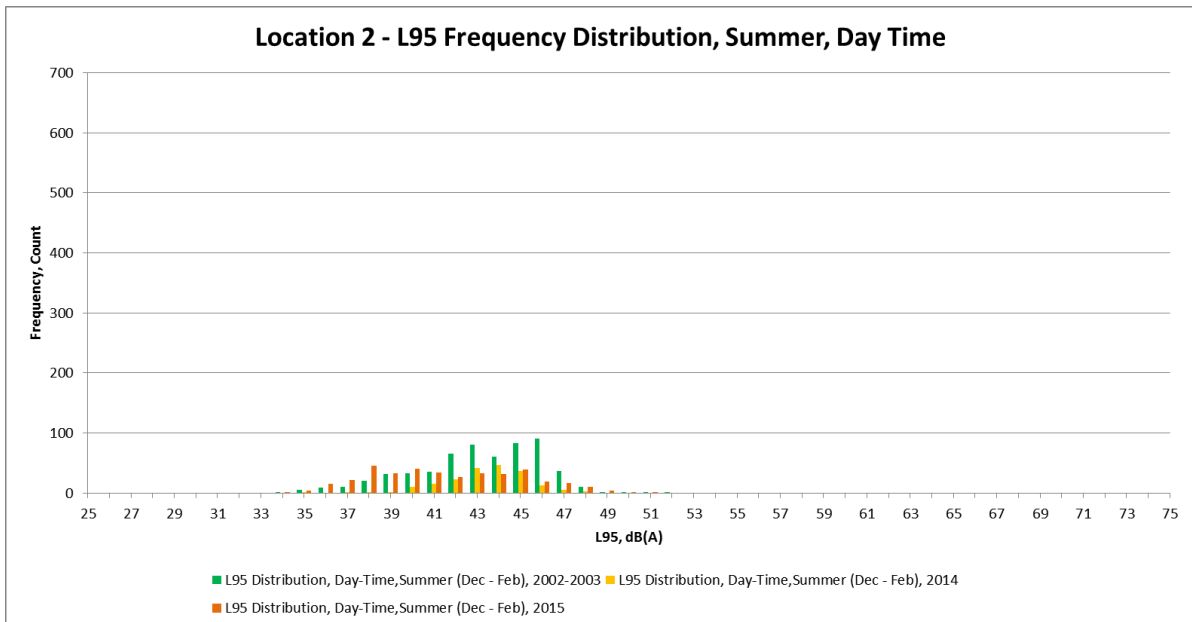
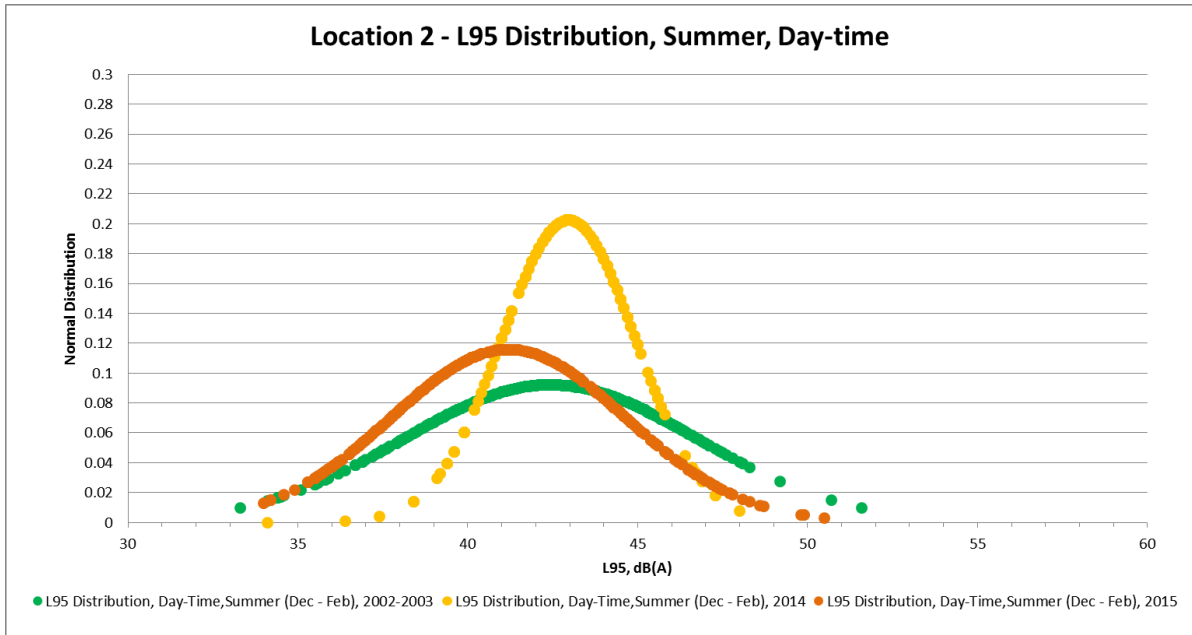


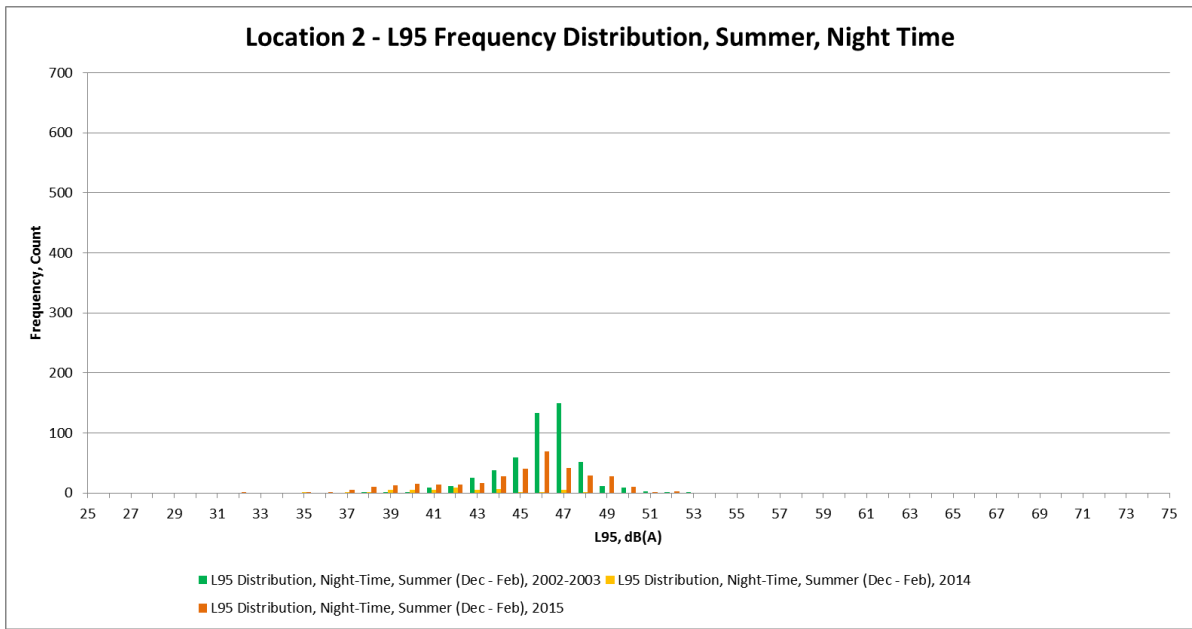
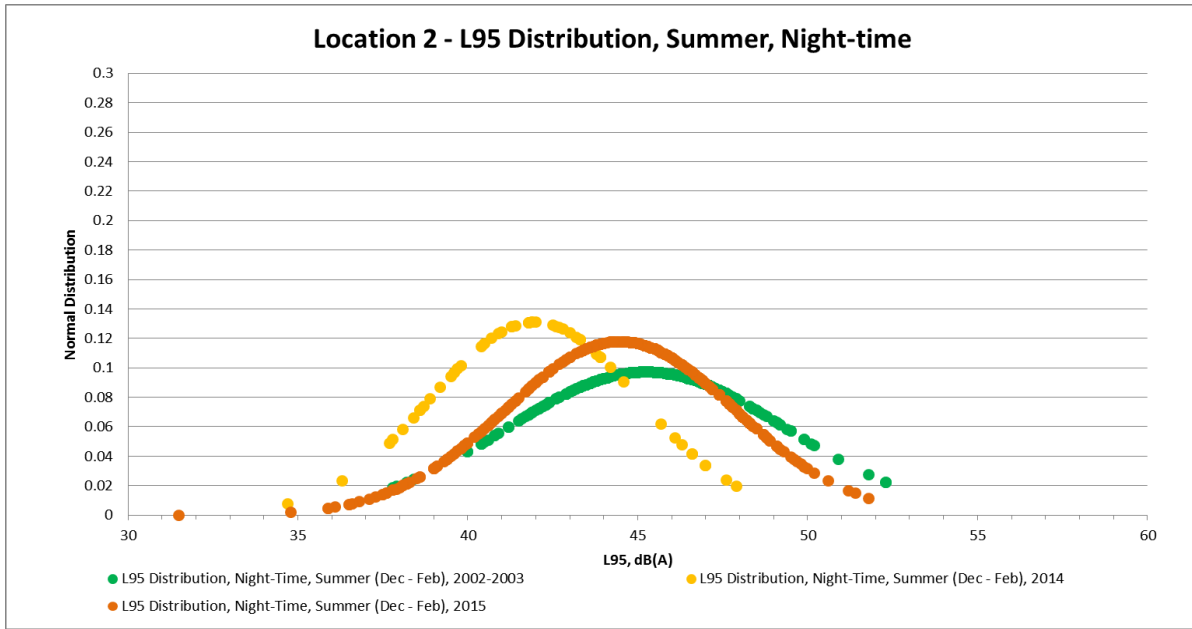
Appendix B-2.2 Location 2 – Spring Data (September – November)



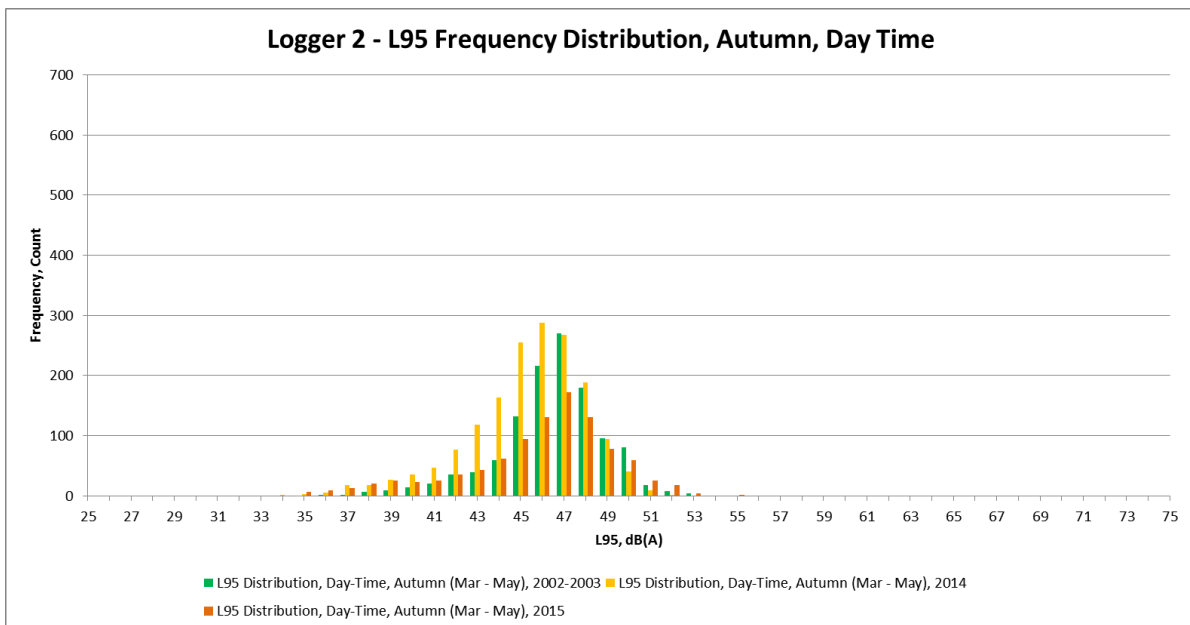
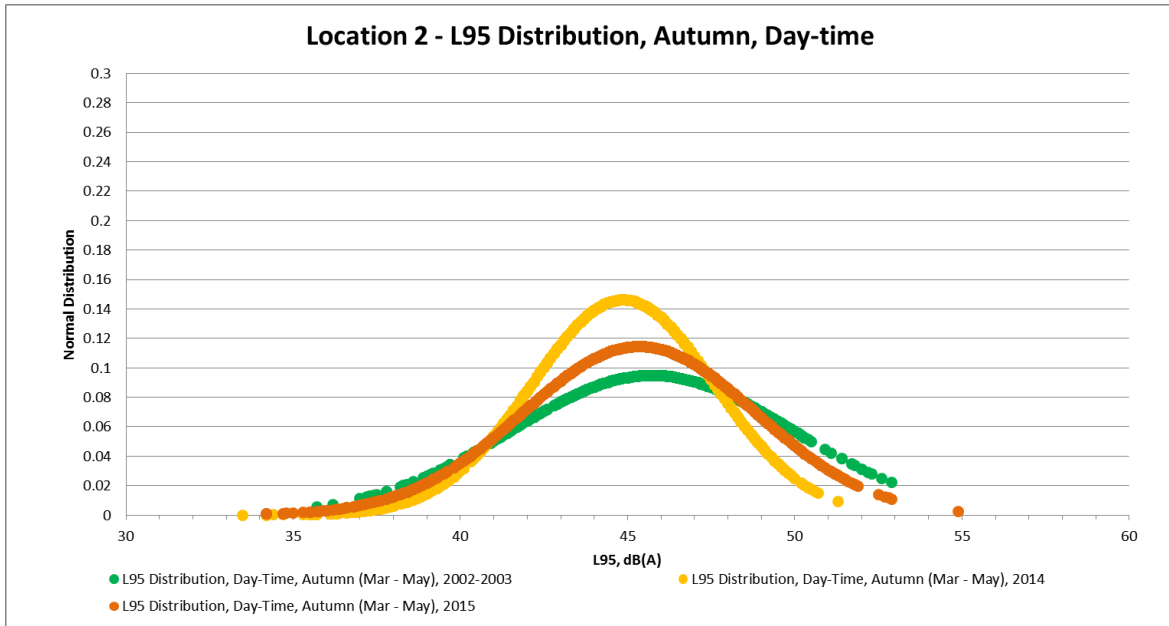


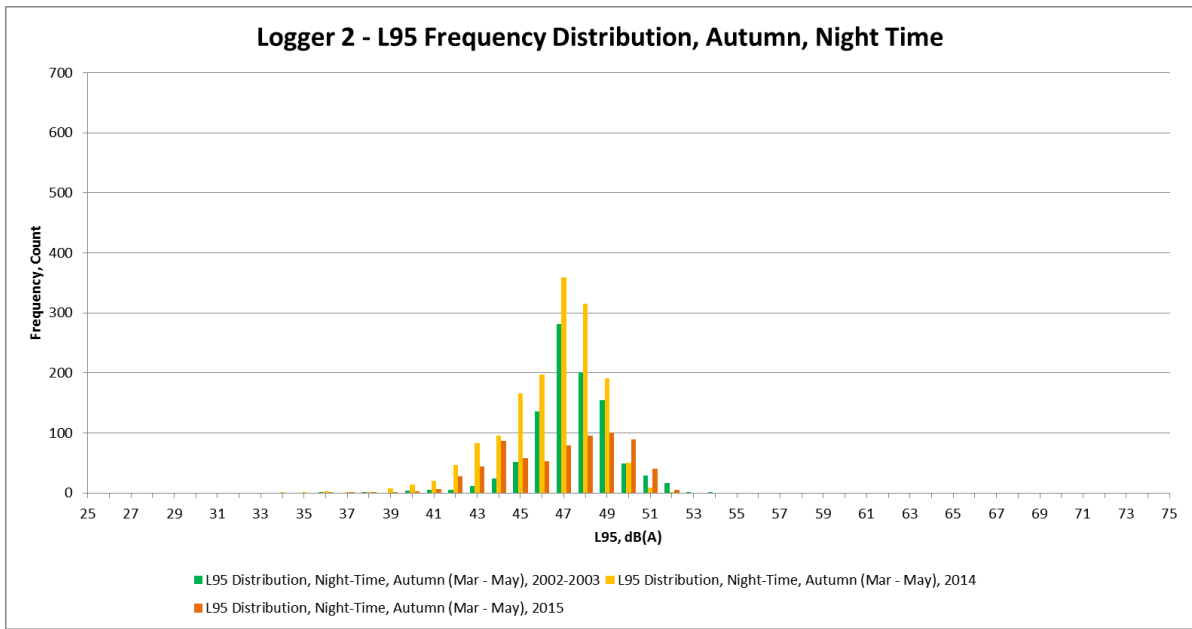
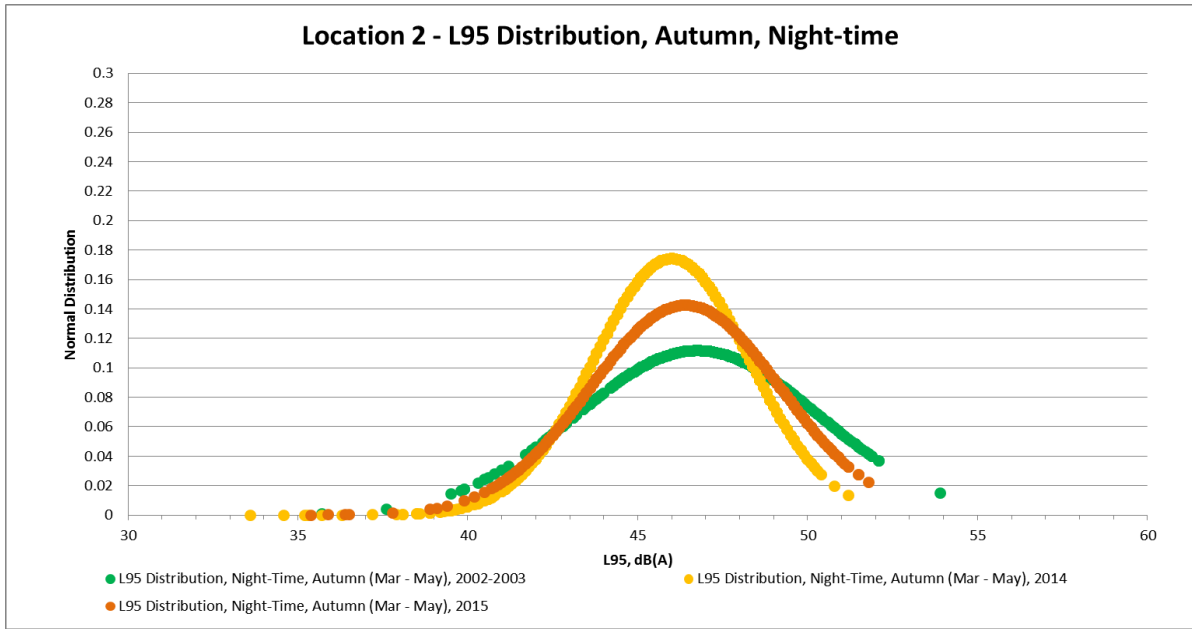
Appendix B-2.3 Location 2 – Summer Data (December – February)





Appendix B-2.4 Location 2 – Autumn Data (March – May)





Appendix B-2.5 Location 2 – Winter Data (June – August)

