MARSHALL DAY Acoustics

SYDNEY INTERNATIONAL CONTAINER TERMINALS

Noise Compliance Assessment – July 2015

Rp002 r02 2014432SY

23 October 2015

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Project:	**SYDNEY INTERNATIONAL CONTAINER TERMINALS**
Prepared for:	**Hutchinson Ports Australia** **Level 2, Operations Building** **SICTL Terminal, Gates B150-153** **Sirius Rd off Foreshore Rd** **Botany NSW 2019**
Attention:	**Jennifer Stevenson**
Report No.:	**Rp002 r01 2014432SY**

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Document control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
Issued		Issued	19/10/15	Alex Stoker	M Ottley
Issued	r01	Updated with new plant info, contours added	22/10/15	Alex Stoker	M Ottley
Issued	r02	Updated appendices	23/10/15	Alex Stoker	M Ottley

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1.0 INTRODUCTION

Sydney International Container Terminals Pty Ltd (SICTL) located on Sirius Road, Botany was given development consent in October 2005 by the NSW Department of Planning and Environment to construct and operate the Hayes Dock site. The current facility commenced operations in November 2013 under the development consent and also under Environment Protection Licence number 20322. The Environment Protection Licence (EPL) requires that noise monitoring and a compliance assessment is to be undertaken every 6 months. Marshall Day Acoustics Pty Ltd (MDA) has been engaged to conduct the noise monitoring and verify compliance (or otherwise) with the noise limits specified in the EPL.

This report provides the results of our noise monitoring undertaken in July 2015. Also detailed is the methodology and results of the noise modelling undertaken to verify compliance with the EPL noise limits (these noise limits are identical to those specified in the development consent document).

Acoustic terminology used in this report is provided in Appendix A. Supporting evidence concerning the port operations and detailed monitoring results are provided in Appendices B-D.

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2.0 NOISE LIMITS

The noise limits applicable to the site as required by the NSW EPA Environment Protection Licence (Licence #20322) are detailed in Section L3 of the licence and reproduced below.

L3.1 Noise from the premises must not exceed the sound pressure level (noise) limits presented in the Table below. Note the limits represent the sound pressure level (noise) contribution, at the nominated receiver locations in the table.

Most affected residential location	*Day*	*Evening*	*Night*	
	$L_{Aeq\ (15\ minute)}$	$L_{Aeq\ (15\ minute)}$	$L_{Aeq\ (15\ minute)}$	$L_{Aeq,\ 9hrs}$
Chelmsford Avenues	*40*	*40*	*40*	*38*
Dent Street	*45*	*45*	*45*	*43*
Jennings Street	*36*	*36*	*36*	*35*
Botany Road (north of Golf Club)	*47*	*47*	*47*	*45*
Australia Avenue	*35*	*35*	*35*	*35*
Military Road	*42*	*42*	*42*	*40*

L3.2 Noise from the premises must not exceed the noise limits presented in the Table below. Note the limits represent the noise contribution at the nominated receiver locations in the table.

Most affected residential location	*Night*
	$L_{A1,(1\ minute)}$
Chelmsford Avenues	*53*
Dent Street	*59*
Jennings Street	*55*
Botany Road (north of Golf Club)	*59*
Australia Avenue	*57*
Military Road	*60*

L3.3 For the purpose of Condition L3.1 and Condition L3.2:

- *Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays,*
- *Evening is defined as the period from 6pm to 10pm*
- *Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sundays and Public Holidays*

L3.4 For the purpose of Conditions L3.1 and L3.2, noise from the premises is to be measured or computed at the most affected point within the residential boundary, or at the most affected point within 30 metres of the dwelling where the dwelling is more than 30 metres from the boundary, to determine compliance with the noise level limits in Conditions L3.1 and L3.2 unless otherwise stated.

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L3.5 Noise from the premises is to be measured at 1m from the dwelling facade to determine compliance with the $L_{A1\ (1minute)}$ noise limits at Condition L3.2

L3.6 Where it can be demonstrated that direct measurement of noise from the premises is impractical, the EPA may accept alternative means of determining compliance (see Chapter 11 of the NSW Industrial Noise Policy (INP)).

L3.7 The modification factors presented in Section 4 of the NSW Industrial Noise Policy shall also be applied to the measured noise level from the premises where applicable.

L3.8 The noise limits specified at Conditions L3.1 and L3.2 apply under the following meteorological conditions:

(a) wind speeds up to 3 m/s at 10 metres above ground level; and

(b) temperature inversion conditions of up to 1.5 C/100m

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3.0 ADHERANCE TO PRESCRIBED METHODOLOGY

- In accordance with Conditions L3.1 and L3.2 (and condition C2.7 of the development consent), both unattended and attended measurements were conducted at the most affected point within the residential boundaries of the nominated residential receivers.
- With reference to Condition L3.5 (and Condition C2.8), LA1 noise levels were measured at the boundaries of the residences, not at 1m from the facade, as it was not possible to access the facade of the dwellings at all times of the day. At such large distances from the subject site, the noise attenuation between the property boundary and a point 1m from the facade is negligible.
- Direct measurement of noise from the operation of the premises at the receiver locations is impractical due to the complex noise environment in the vicinity of the site and receivers. Therefore, in accordance with Condition L3.6 (and Condition C2.9), the unattended and attended noise monitoring was supplemented with an alternative means of determining compliance via the use of a 3-D noise model. This is in accordance with *Chapter 11* of the NSW *Industrial Noise Policy* which allows for measurements to be taken close to the source and then calculated out to the specified receiver locations. Determination of compliance via the use of a 3-D noise model was approved by the NSW EPA on 11 July 2014 (Appendix E) and the NSW EPA requirements were provided to MDA prior to the commencement of the project.
- The assessment receiver locations considered in the noise model are in accordance with the requirements specified in conditions L3.4 and L3.5 (and Conditions C2.7 and C2.8).
- In accordance with Condition L3.7 (and Condition C2.10), the modification factors from Chapter 4 of the NSW *Industrial Noise Policy* are also applied to the measured or calculated noise level from the operation of the premises (where applicable).
- Noise limits used to verify compliance (or otherwise) have been applied under the following meteorological conditions specified in Condition L3.8 (and Condition 2.11) of the EPA Licence:

  (a) wind speeds up to 3m/s at 10m above the ground level; or

  (b) temperature inversion conditions of up to 1.5C/100m.

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4.0 COMPLIANCE VERIFICATION METHODOLOGY

The noise environment around the site is complex, comprising influences from a range of variable factors. Key complicating variables in this respect are:

- the presence of other existing noise generating industries in the area including the Patrick container terminal and DP World container terminal which also influence the noise environment in the vicinity of the SICTL
- frequent traffic movements on Foreshore Road and Botany Road which influence both the underlying background and total ambient noise environment in the surrounding area
- frequent air traffic movements due to the proximity of the site to the Sydney Airport.

The noise environment in the vicinity of the residential receivers is also complex, and comprises influence from a range of noise sources which include the industrial noise sources associated with the port, industrial noise sources associated with other industries in the area and road and air traffic noise.

Given the complexity of environmental noise conditions and the large distances between operational noise sources on the SICTL site and the receiver locations, isolating the contribution of different noise sources is problematic in practice. In recognition of these factors, the following methodology was used to verify compliance with the noise limits detailed in Section 2.0:

- Attended measurements of plant noise were conducted at specific points in the vicinity of the plant. Measurements were undertaken under typical operating conditions. The sound pressure levels measured in the vicinity of each plant item were then used to estimate the sound power level of each plant item.
- A 3-D noise model of site and its receivers was developed and the estimated sound power levels were input into the noise model to calculate the noise contribution from the site at the nearest receivers. Where possible long term measurements of noise from the premises were used to calibrate the noise model.
- The calculated noise levels were compared to the measured noise levels and to the noise limits detailed in Section 2.0.

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5.0 COMPLIANCE SURVEY

5.1 Unattended noise monitoring

It should be noted that the original EPA planning consent denoted six off-site residential locations. The EPA subsequently accepted a proposal from SLR Consulting Australia Pty Ltd to reduce the number of residential receivers to two only as part of an accepted methodology of assessment through computer modelling. As such only two residential locations, 34 Dent Street, Botany and 59 Jennings Street, Matraville have been used for assessment.

Noise loggers were setup at the two selected residential receivers, 34 Dent Street, Botany and 59 Jennings Street, Matraville, from 20 July 2015 to 02 August 2015.

In the INP, the background noise level is termed the Rating Background Level (RBL). The methodologies used to determine the long-term RBL and L_{Aeq} noise levels are from Tables 3.1 and 3.2 of the INP. The RBL and L_{Aeq} noise levels for the Day, Evening and Night-time periods at each monitoring location are summarised below. The survey details and noise level results for the entire survey period are summarised in Appendix B.

In determining the noise levels at the monitoring locations, any data affected by rainfall and high wind speed has been excluded. Data available from the *Bureau of Meteorology*'s Sydney Airport weather station has been used to carry out this analysis.

Table 1: Summary of unattended measurements

Period	dB L_{Aeq}	RBL	Comments
59 Jennings Street, Matraville			
Day	54	44	Background noise levels (dB L_{A90}) measured at this location are in excess of the noise limit for the Day, Evening and Night-time periods. Analysis of the measured data has determined that noise impacts from the SICTL site at this location cannot be isolated due to the presence of other noise sources including traffic, aircraft and other industrial facilities in the vicinity of the receiver.
Evening	53	45	
Night	52	44	
34 Dent Street, Botany			
Day	53	48	Background noise levels (dB L_{A90}) measured at this location
Evening	54	48	

Period	dB L_{Aeq}	RBL	Comments
Night	52	42	are in excess of the noise limit for the Day and Evening periods. Analysis of the measured data has determined that noise impacts from the SICTL site at this location cannot be isolated due to the presence of other noise sources including traffic, aircraft and other industrial facilities in the vicinity of the receiver.

5.2 Attended measurements

Results of the attended noise level measurements conducted at each receiver location are summarised in Table 2 below along with the subjective impression of the author who conducted these measurements.

Table 2: Attended measurements at receiver locations

Period	dB L_{Aeq}	dB L_{A90}	Subjective impression
59 Jennings Street, Matraville			
Day	62	43	Characterised by typical urban residential hum. Intermittent local traffic on Jennings Street was the dominant noise source. Distant constant traffic and intermittent aircraft overhead was audible. Could not perceive any discernible industrial noise source associated with the port. Birds were audible throughout measurement. Distant airport noise was audible throughout measurement period.
Evening	58	39	Dominated by noise from intermittent local traffic along Jennings Street and general urban sounds; birds, constant crickets, dog barking, people etc. Aircraft noise audible. No audible industrial noise perceivable throughout this measurement period.
Night	60	41	Dominated by distant traffic noise. Intermittent vehicle movements on Jennings Street and aircraft movements clearly audible. No industrial noise or any noise associated with the port audible throughout measurement period.
34 Dent Street, Botany			
Day	55	50	Dominated by constant traffic noise from Foreshore Road and Botany Road. Accelerating trucks and aircraft taking off were clearly audible from this location. Little local traffic on Dent Street. Aircraft overhead during measurement. Noise from golfers and children on and around the golf course influenced measurement. No perceivable industrial noise from the port could be heard over the traffic noise.

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Period	dB L_{Aeq}	dB L_{A90}	Subjective impression
Evening	51	47	Dominated by traffic noise from Foreshore Road and frequent aircraft overhead. Some influence from natural sounds, birds etc. Could not perceive any industrial noise at this location.
Night	56	48	Dominated by constant traffic noise from Foreshore Road and Botany Road. Little traffic on Dent Street. Aircraft movements clearly audible. No perceivable industrial noise from the port heard at this time.

5.3 Discussion of results

A review of the unattended monitoring data indicates that the ambient noise levels are significantly above the EPL and Development Consent noise limits at each of the receiver locations. The contribution from the SICTL site at these locations cannot accurately be determined due to the influence of other noise sources in the vicinity of the receivers. Furthermore, the results of the attended monitoring conducted at the two receiver locations as well as the subjective impressions of the author of this report indicate that noise from the SICTL site could not be perceived at these locations. Due to the presence of two other container terminals in the vicinity of the receivers, any audible port related noise at these locations could have been generated at any one of the container terminals.

As compliance cannot be accurately verified based on the unattended and attended monitoring results, noise modelling in accordance with the requirements of the EPA was carried out to determine the noise contribution from the SICTL site the nearest receivers. This noise modelling is discussed in the following sections of this report.

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6.0 ATTENDED ON-SITE NOISE SURVEY

A series of attended measurements were conducted at the SICTL site on 29 July 2015 and 30 July 2015, while the site was operating under typical conditions.

This measurement data was then used to calculate the estimated noise level contribution from each individual plant item/process at the nearest receiver.

6.1 Estimation of operational noise levels

Using the sound pressure level measured in the vicinity of each plant item and the reference distance, at which the measurement was undertaken, the approximate sound power level of each plant item has been calculated and used to model noise emissions from the site.

6.2 Noise prediction model configuration

An environmental noise model for the site has been developed by MDA using SoundPLAN 7.4, a commercially available computer modelling package. For this project, our noise model for predication of sound levels has used ISO 9613-2 Acoustics - *Attenuation of sound during propagation outdoors* as the propagation algorithm methodology.

Calculations are based on commonly adopted geometric divergence of noise sources in addition to a range of factors affecting the attenuation of sound, including:

- The magnitude of the noise source in terms of sound power
- The distance between the source and receiver
- The presence of obstacles such as screens or barriers in the propagation path including any buildings on site, and terrain data
- The presence of reflecting surfaces such as building facades
- The ground absorption, defined by hardness of the ground between the source and receiver (100% hard ground assumed to be conservative)
- Attenuation due to atmospheric absorption.

  Meteorological effects such as wind gradient, temperature gradient, humidity (these generally have significant impact at distances greater than approximately 400m. The ISO-9613 method deals with the meteorological conditions favourable to propagation of sound). Over large distances (>400m), meteorological conditions can have a significant influence on noise level propagation. The environmental noise model has assumed worst case meteorological conditions for non-arid areas i.e. moderate (F-class stability category) temperature inversion or downwind conditions with wind speeds less than 3m/s. It is assumed that drainage airflow does not occur at this site, as the source level is not elevated relative to the residential receiver level.

6.3 Noise model calibration

For the purpose of calibrating the noise model results, two noise loggers were placed on site concurrent with the off-site monitoring. The locations of the calibration loggers are shown in Figure 1 below. The on-site calibration loggers were 01dB Duo smart monitors which have the capability to record audio. Noise levels were measured during the entire survey period in one second intervals and the loggers were also used to make audio recordings at both locations. The measurements obtained were used to determine the noise levels experienced

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at each calibration position for comparison to the noise level predicted via the use of calculations.

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Figure 1: Location of calibration loggers (Figure courtesy Six Maps)

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6.4 Calibration results

The noise levels measured at both calibration locations were heavily impacted by extraneous noise sources, predominantly aircraft due to the proximity of the site to the Sydney Airport, but also operations from adjacent sites. Direct examination of the calibration loggers results therefore does not immediately identify the noise generated by the site. The audio recordings taken at this location were analysed, with a representative sample chosen and all 1 second measurements affected by aircraft noise and some road traffic noise eliminated as far as practicable in order to determine the L_{Aeq} noise level contribution from the site operations only. Night time measurements at the calibration locations were not affected by aircraft noise due to the Sydney Airport curfew. Therefore, representative samples between 0000-0200hrs were chosen and these were directly compared to the predicted noise levels for the night-time period.

The noise levels derived at the calibration points (with extraneous data eliminated) are compared to the predicted noise levels in Table 3 below. Calibration point 1 was in close proximity to the wharf and therefore the periods chosen for analysis contained a vessel being unloaded at the wharf. Similarly, Calibration point 2 was closer to the ASC area and Trains area, and therefore the periods chosen for analysis contained a train arrival and unloading. In addition, samples during the Night time period, where extraneous noise from aircraft was not present were also analysed and the noise levels are also presented below. We note that extraneous noise events from adjacent sites could not be identified and isolated, and therefore the derived noise levels at the calibration points still have the potential to be influenced by adjacent sites.

Table 3: Noise model calibration results

Location	Time period	Derived levels from measurements	Predicted noise level[1]
Calibration Point 1	Day	58dB $L_{Aeq\ (15min)}$	55-57dB $L_{Aeq\ (15min)}$
Calibration Point 2	Day	62dB $L_{Aeq\ (15min)}$	60-69dB $L_{Aeq\ (15min)}$
Calibration Point 1	Night	55dB $L_{Aeq\ (15min)}$[2]	55-57dB $L_{Aeq\ (15min)}$
Calibration Point 2	Night	68dB $L_{Aeq\ (15min)}$[2]	61-69dB $L_{Aeq\ (15min)}$

Note 1: Range from typical to worst case predicted noise level.

Note 2: Highest $L_{eq(15min)}$ noise level measured between 0000-0200hrs on 27 July 2015

At Calibration Point 1, the derived noise levels appear to be in close correlation with the predicted noise levels. As an example, a review of the LAeq, 15min noise levels between 1300-1400hrson 21 July 2015 indicates that the directly measured LAeq, 15min noise levels range between 55-58dBA. All of these measurements have been influenced by extraneous noise events. Therefore, based on the derived and measured noise levels for the Day and Night time periods presented in the table above, and the range of measured noise levels, we consider our predictions to be conservative.

At Calibration Point 2, the predicted noise levels closely correlate with the derived and measured noise levels for the Day and Night time periods as such we consider our predictions to be representative of the site operations.

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6.5 Noise modelling results

Noise emissions from the site have been estimated via calculation at the nearest receivers and are presented in Table 4. Details of the operating scenarios considered and assumptions regarding typical and worst case plant operation are detailed in Appendix D.

Table 4: Calculated noise contribution from SICTL site at nearest receivers

	Day		Evening		Night		
	Calculated noise level	**Noise limit, dB $L_{Aeq\ (15min)}$**	**Calculated noise level**	**Noise limit, dB $L_{Aeq\ (15min)}$**	**Calculated noise level**	**Noise limit, dB $L_{Aeq\ (15min)}$**	**Noise limit, dB $L_{Aeq\ (9\ hours)}$**
59 Jennings St							
Typical operation	31	36	31	36	25	36	35
Worst case operation	32	36	32	36	27	36	35
34 Dent St							
Typical operation	42	45	42	45	41	45	43
Worst case operation	44	45	44	45	43	45	43

Calculated noise levels for both typical and worst case operation of the site comply with the noise limits at the nominated sensitive receivers.

Based on the above the current operations on site comply with the EPL and Development Consent L_{eq} noise criteria.

Summarised in Table 5 is the contribution from high noise generating sources that are impulsive in nature and generate noise levels closest to the Night time maximum/$L_{A1(1min)}$ noise limits.

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Table 5: Calculated L_{A1}/maximum noise level contribution from SICTL site

Source description	59 Jennings St	Noise limit, dB $L_{A1,(1min)}$	Compliance?	34 Dent St	Noise limit, dB $L_{A1,(1min)}$	Compliance?
Spreader engaging with ship's hatch cover	49	55	✓	59	59	✓
Hatch cover being landed on vessel	47	55	✓	59	59	✓
Container landing within Quay Apron	35	55	✓	48	59	✓

During our site surveys we did observe hatch cover plates being landed and the spreader engaging with these plates landside but did not observe these activities occurring shipside. The container landing within the Quay Apron was observed however measurements on-site were lower than those observed during our 2014 survey. In order to present a conservative assessment we have used the higher maximum levels for these activities observed during the 2014 survey.

Calculated maximum noise levels associated with impulsive noise generating activities on the site comply with the noise limits at the nominated sensitive receivers. Based on the above the current operations on site comply with the EPL and Development Consent noise criteria for sleep arousal.

7.0 SUMMARY

- To satisfy the requirements of the EPL for the operation of the SICTL site, Marshall Day Acoustics conducted short term attended and long-term unattended noise monitoring at 34 Dent Street and 59 Jennings Street.
- Assessment of the SICTL site noise compliance is complicated by a range of variables affecting the derivation of the noise contribution from activities conducted on the site.
- As compliance could not be accurately determined on the basis of monitoring conducted at the receiver locations, MDA developed a 3-D noise model to determine the noise contribution from the site at the nearest receivers via calculation. In order to develop the noise model, attended measurements were conducted on site in the vicinity of operational noise sources. These measurements were used to establish sound power levels for all equipment which were then incorporated into the noise model and the noise contribution of each plant item was calculated back to the receiver locations.
- The results of the noise model have been compared with the noise levels measured at two on-site calibration points. The predicted noise levels correlate closely with the measured noise levels and therefore we consider the noise model to be representative of the site operations.
- The results of the noise model indicate the noise emissions from the site comply with the noise limits at 34 Dent Street and 59 Jennings Street.

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APPENDIX A GLOSSARY OF TERMINOLOGY

Ambient	The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
SPL or L_P	Sound Pressure Level A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 µPa RMS) and expressed in decibels.
SWL or L_W	Sound Power Level A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
dB	Decibel The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 µPa i.e. dB = 20 x log(P/Pr)
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
$L_{Aeq\ (t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{A90}	The A-weighted noise level equalled or exceeded for 90% of the measurement period. This is commonly referred to as the background noise level.

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L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
L_{A01}	The A-weighted noise level which is equalled or exceeded for 1% of the measurement period. This is sometimes referred to as the typical maximum noise level.

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APPENDIX B UNATTENDED MONITORING DATA

B1 59 Jennings Street, Matraville

A noise logger was setup on the Level 1 deck of the residential receiver located at 59 Jennings Street, Matraville.

Figure B1: Noise logger installed at 59 Jennings St, Matraville

Noise levels were continuously logged in 15 minute intervals at this location using a 01dB Duo noise logger (Serial number 10457) between 20 July 2015 and 02 August 2015. The noise logger was calibrated before and after conducting the measurements and no significant drift was observed.

The noise survey results are presented graphically overleaf:

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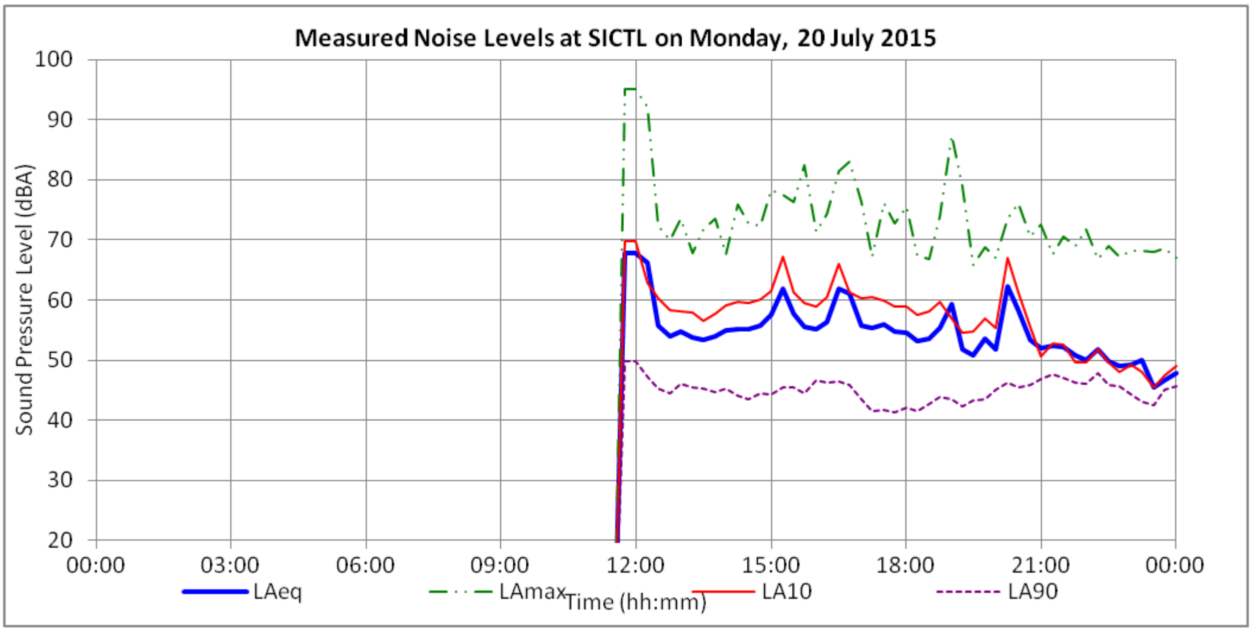

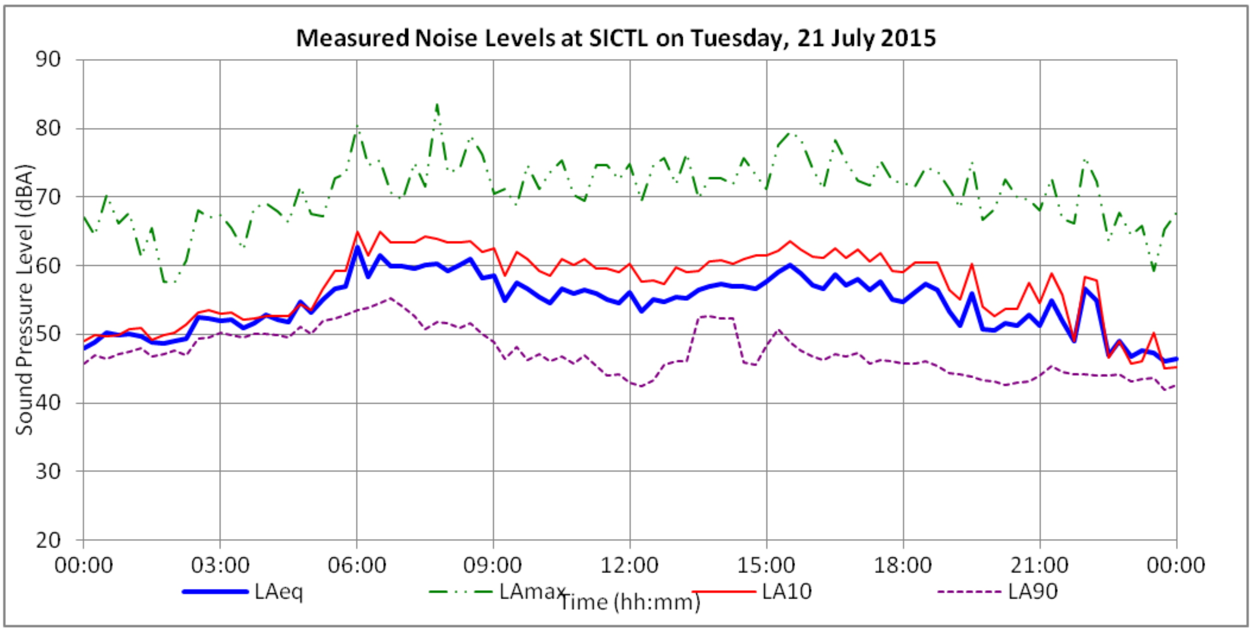

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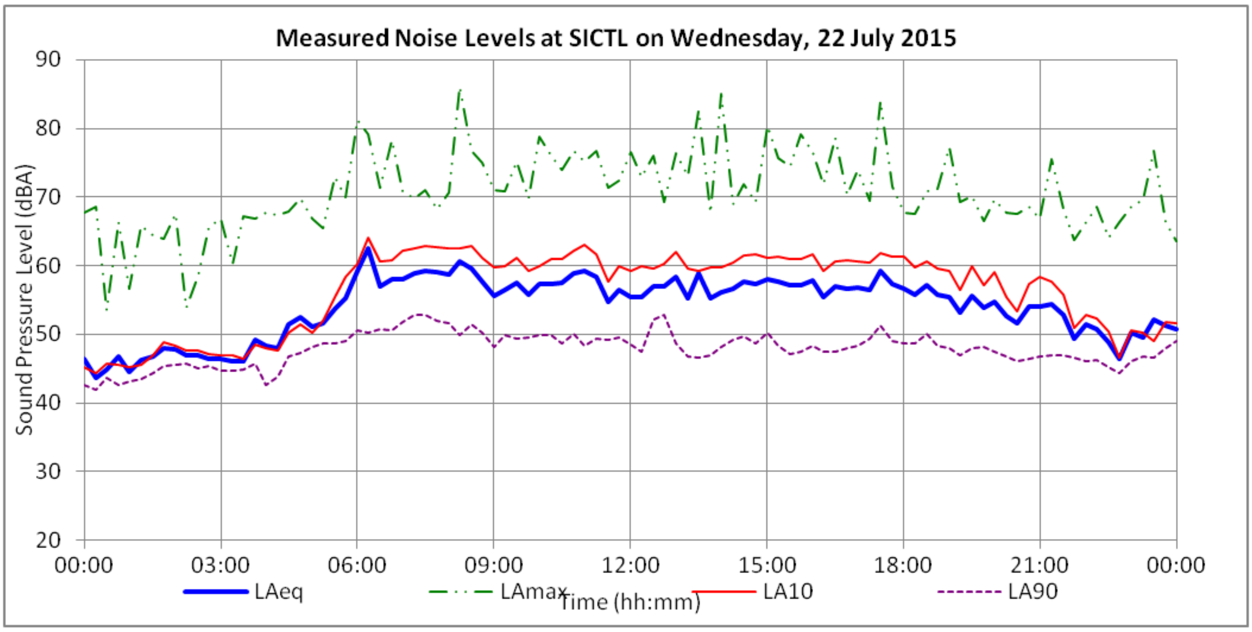

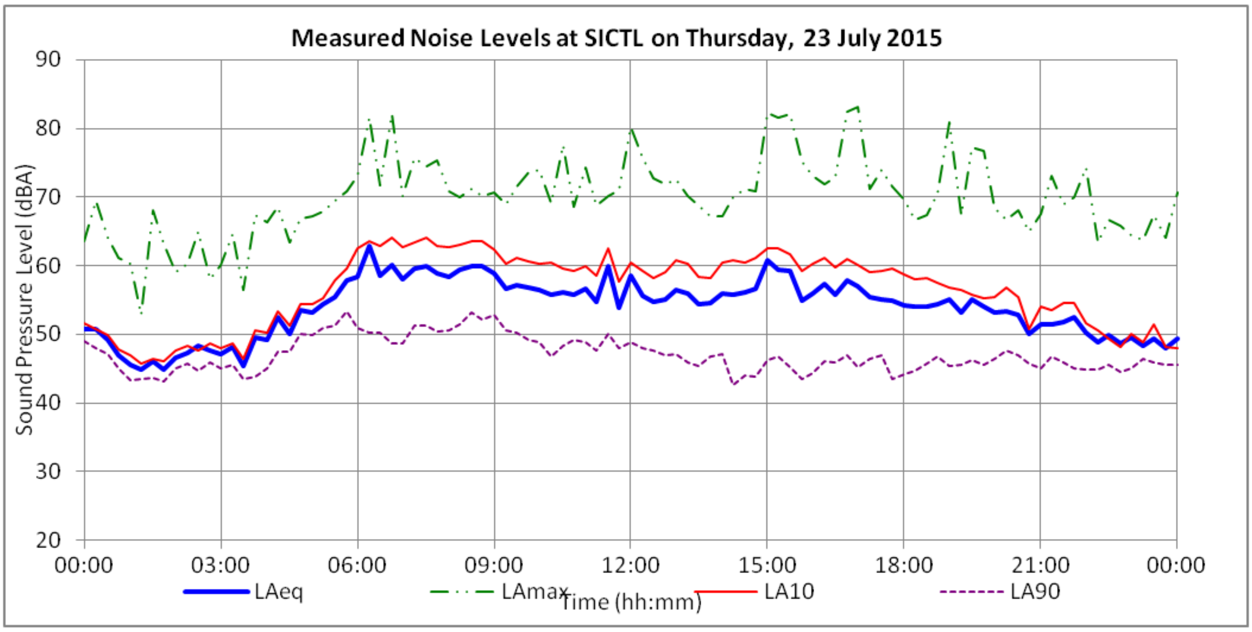

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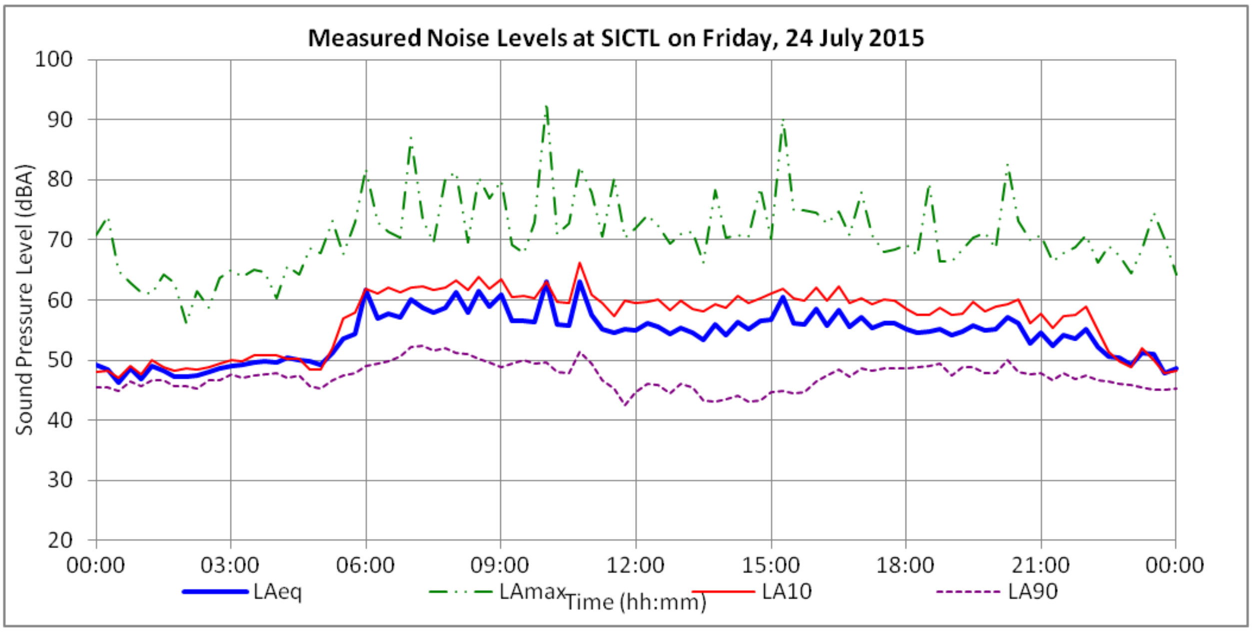

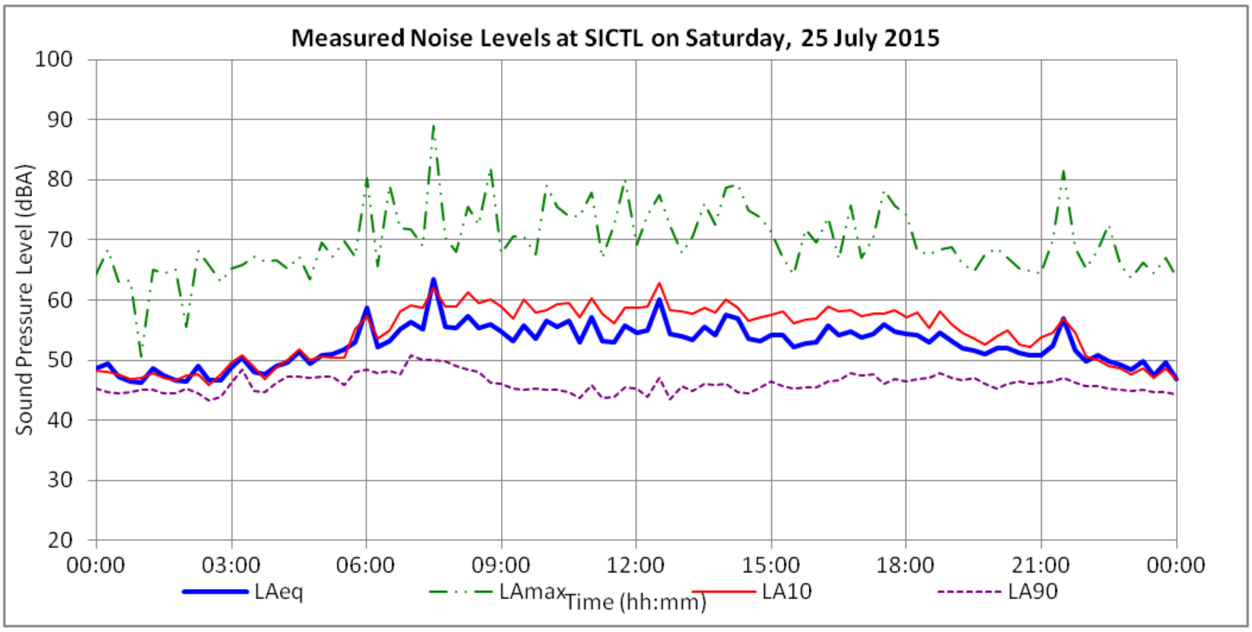

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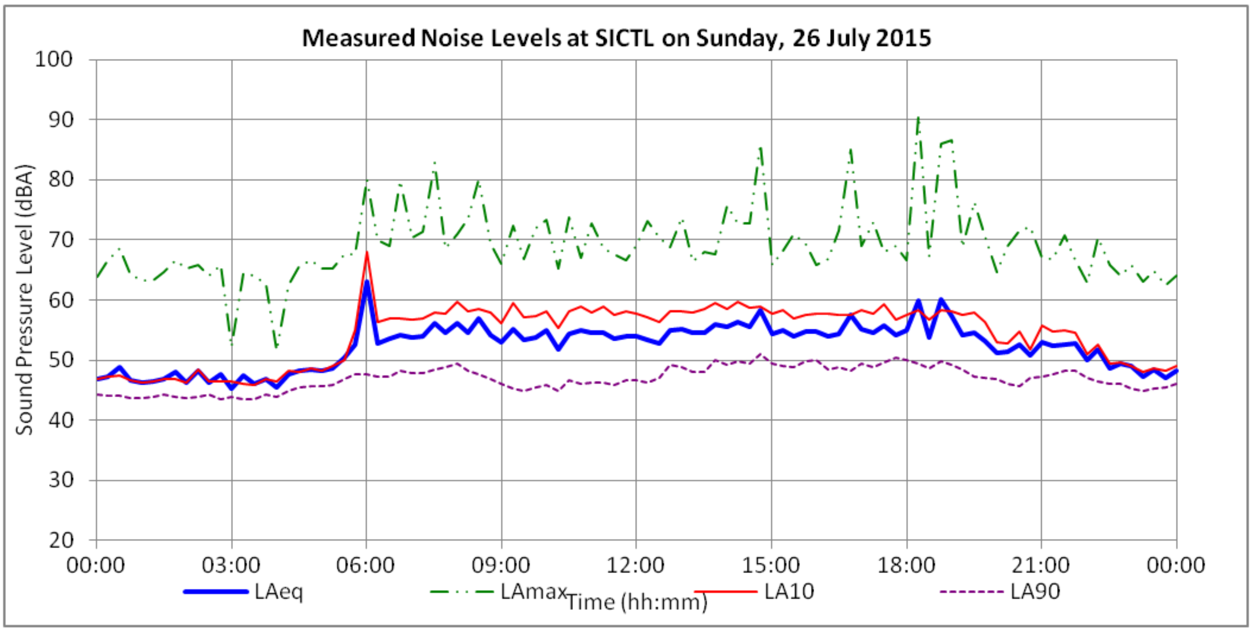

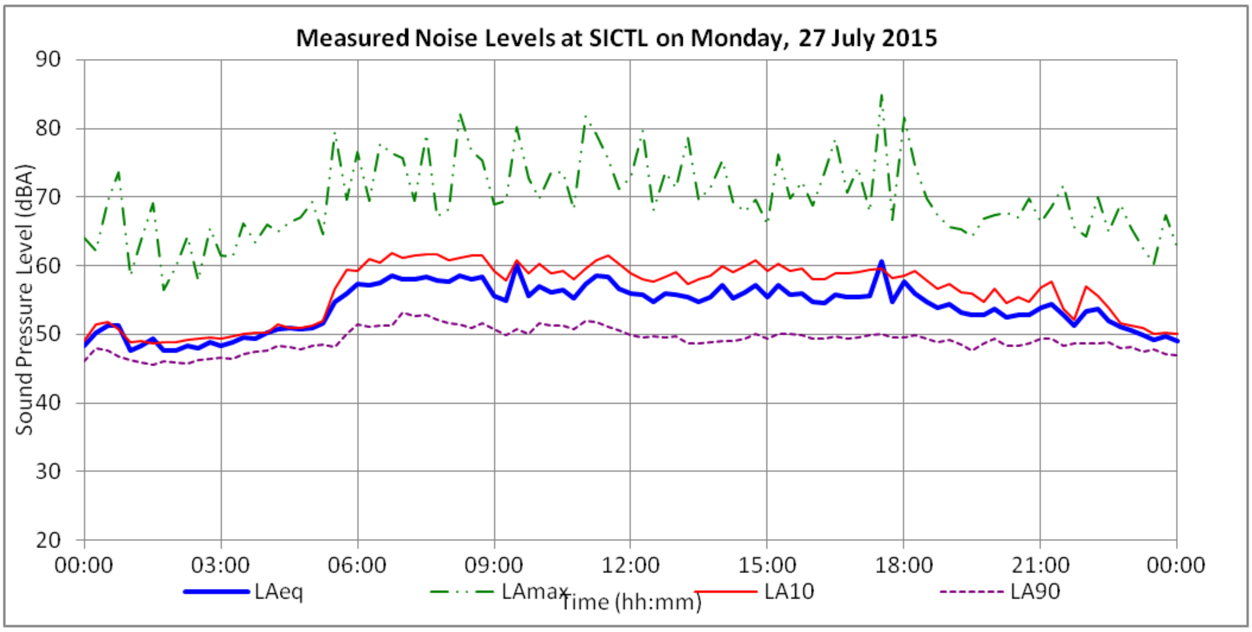

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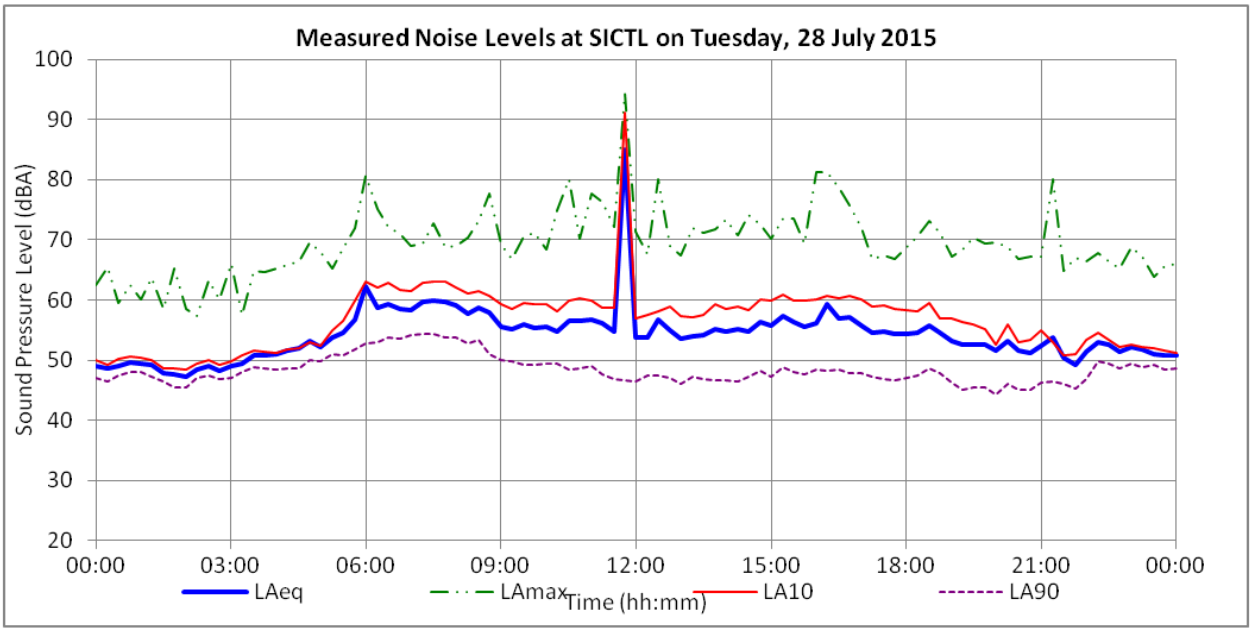
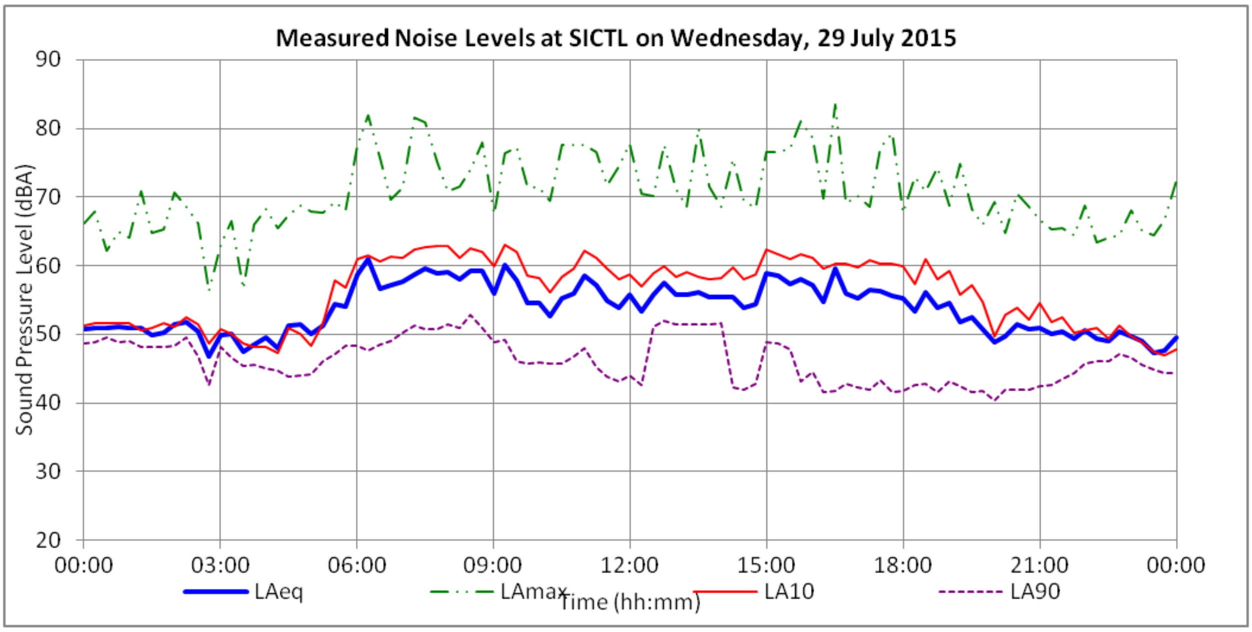
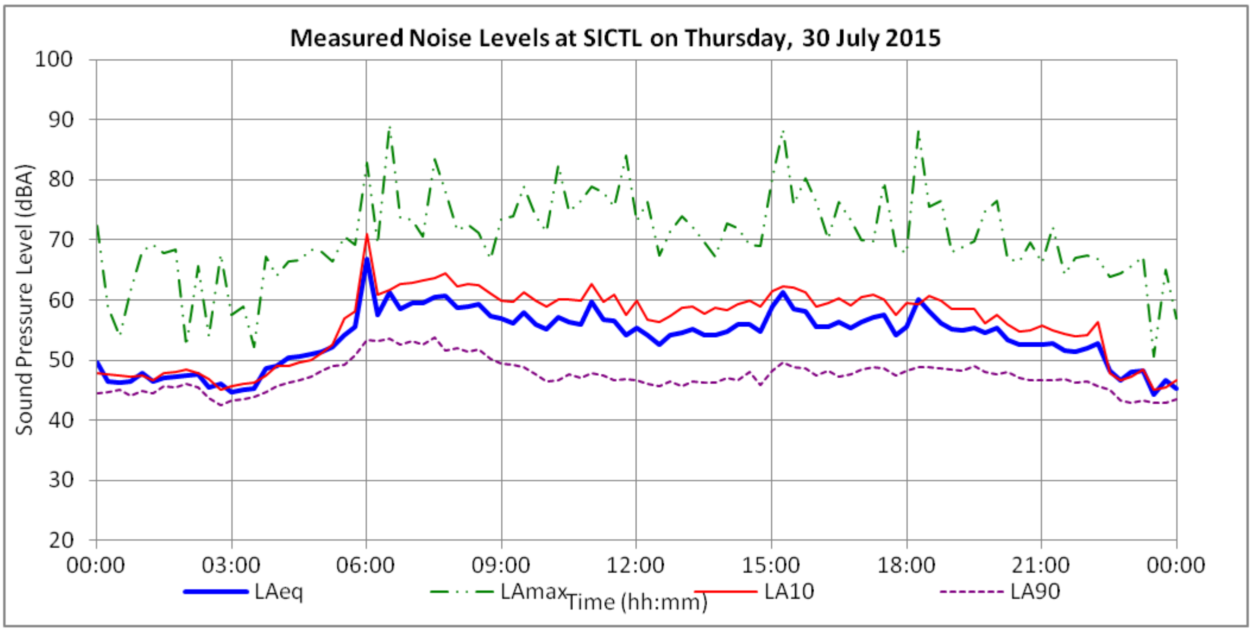
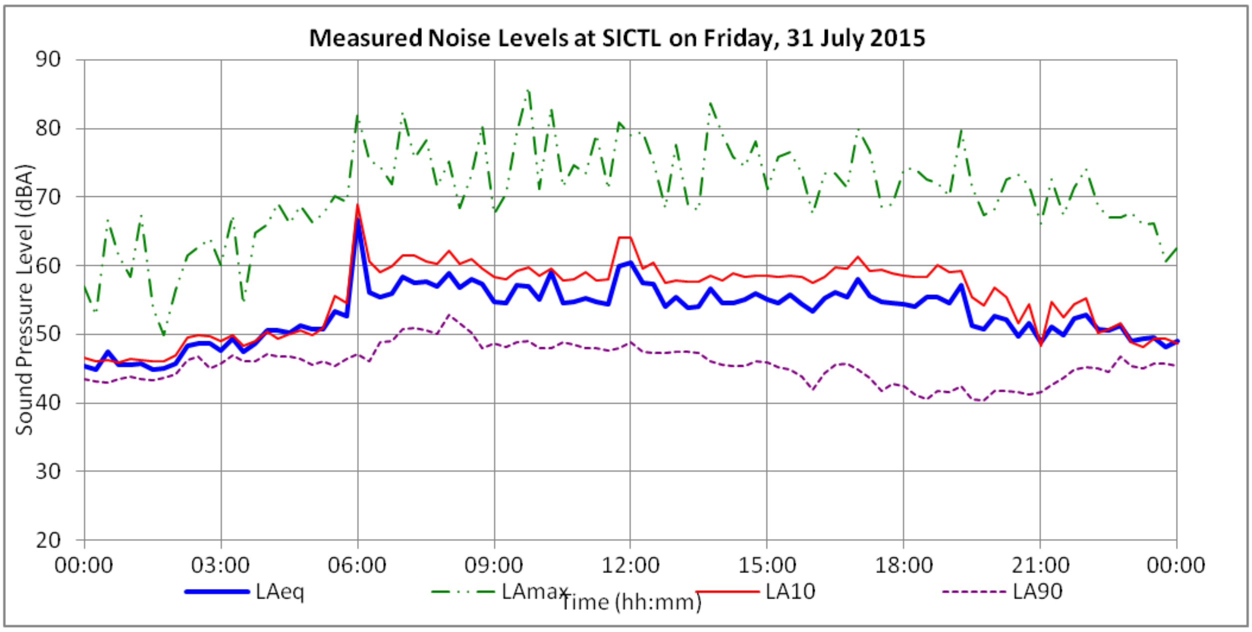

Measured Noise Levels at SICTL on Tuesday, 28 July 2015
Sound Pressure Level (dBA)
100
90
80
70
60
50
40
30
20
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time (hh:mm)
LAeq
LAmax
LA10
LA90


Measured Noise Levels at SICTL on Wednesday, 29 July 2015
Sound Pressure Level (dBA)
90
80
70
60
50
40
30
20
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time (hh:mm)
LAeq
LAmax
LA10
LA90





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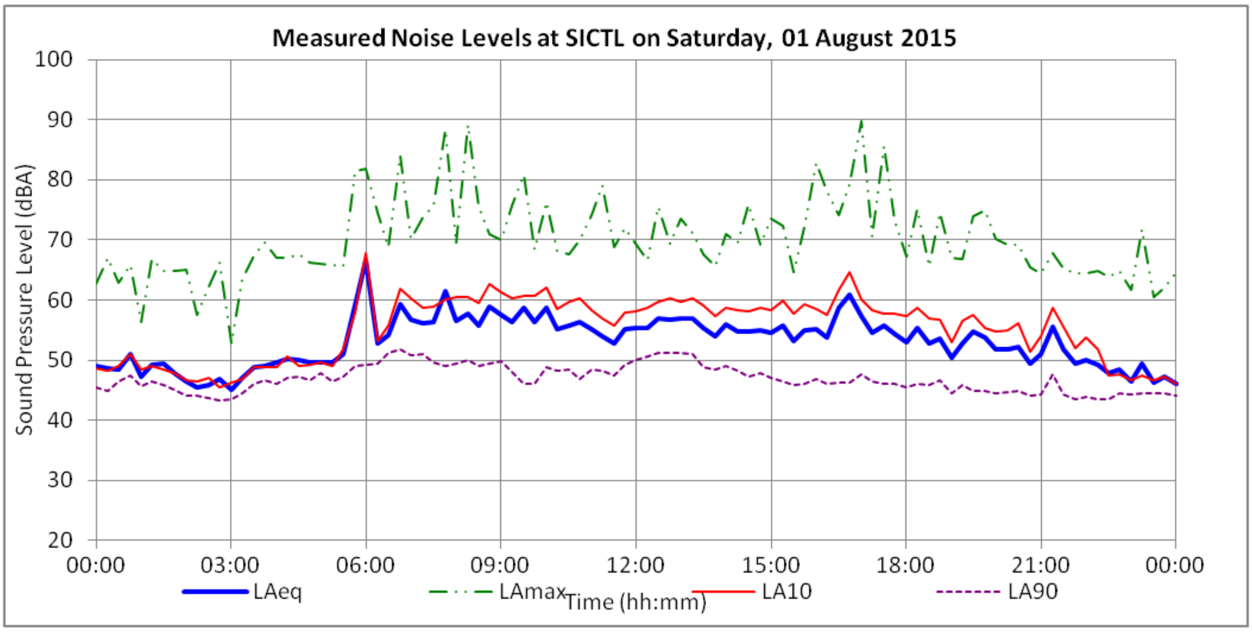

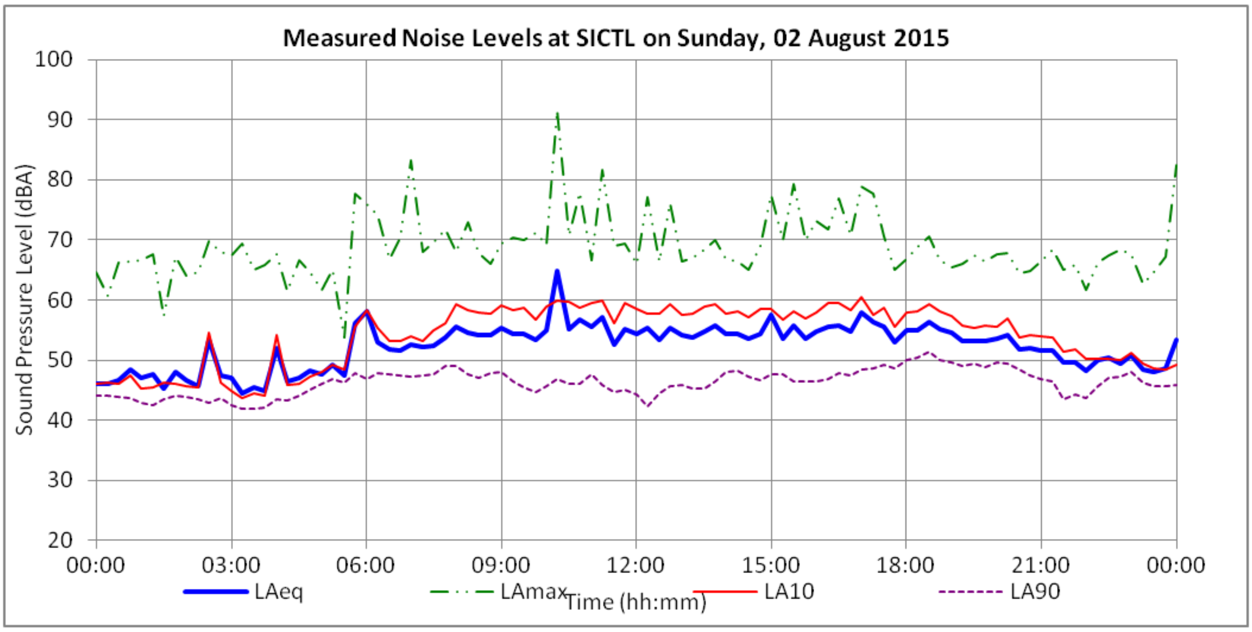

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B2 34 Dent Street

A noise logger was setup at the rear boundary of the residential receiver located at 34 Dent Street, Botany.

Figure B2: Noise logger installed at 34 Dent Street, Botany

Noise levels were continuously logged in 15 minute intervals at this location using a 01dB Cube noise logger (Serial number 10516) between 20 July 2015 and 02 August 2015. The noise logger was calibrated before and after conducting the measurements and no significant drift was observed.

The noise survey results are presented graphically overleaf.

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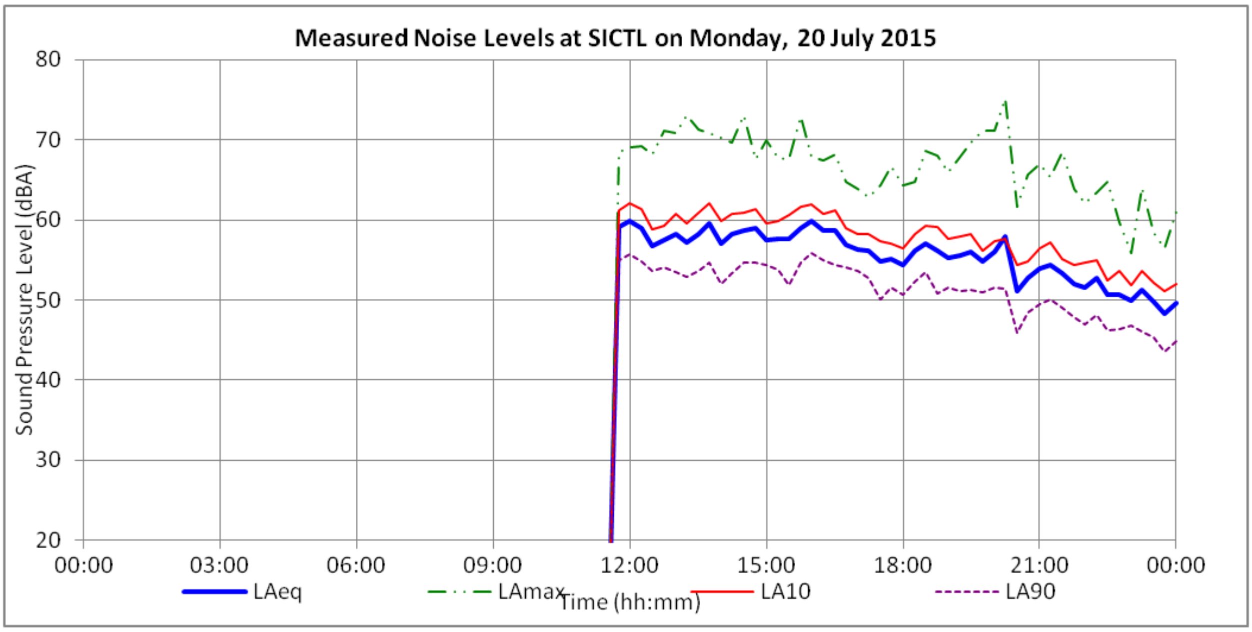

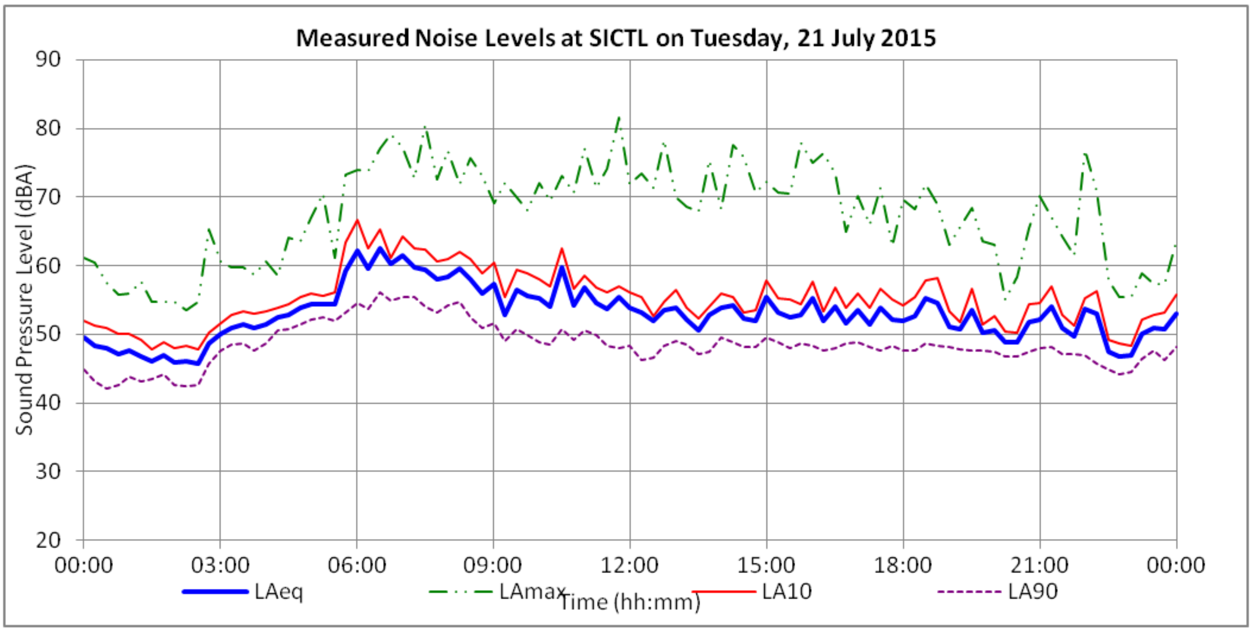

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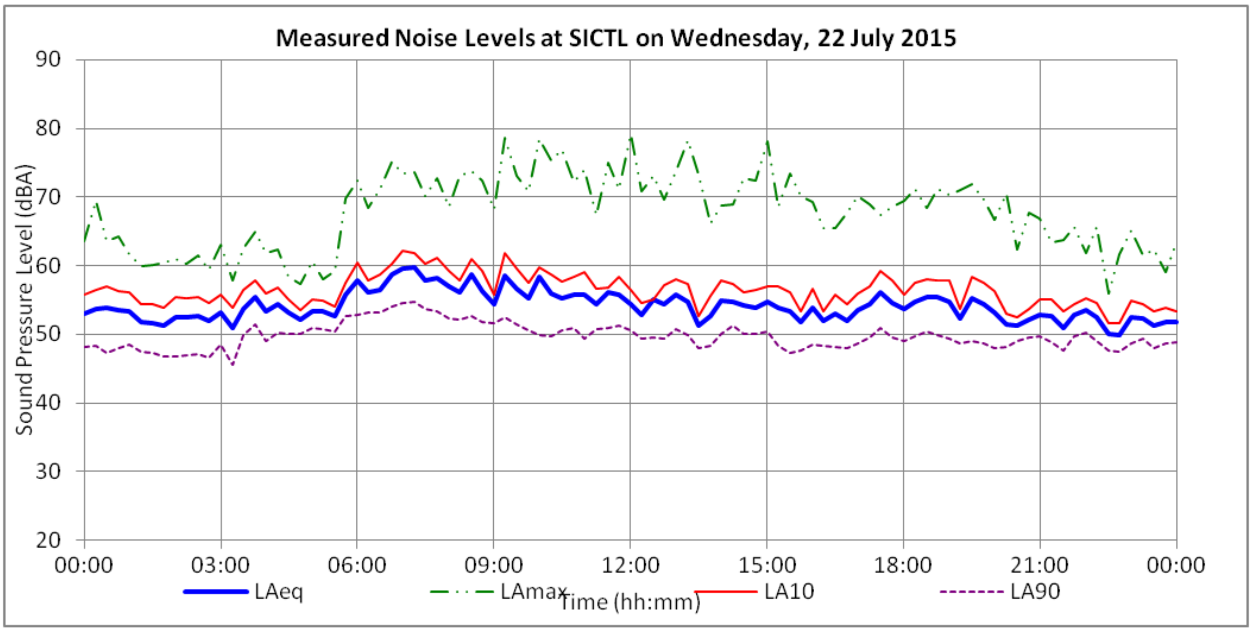

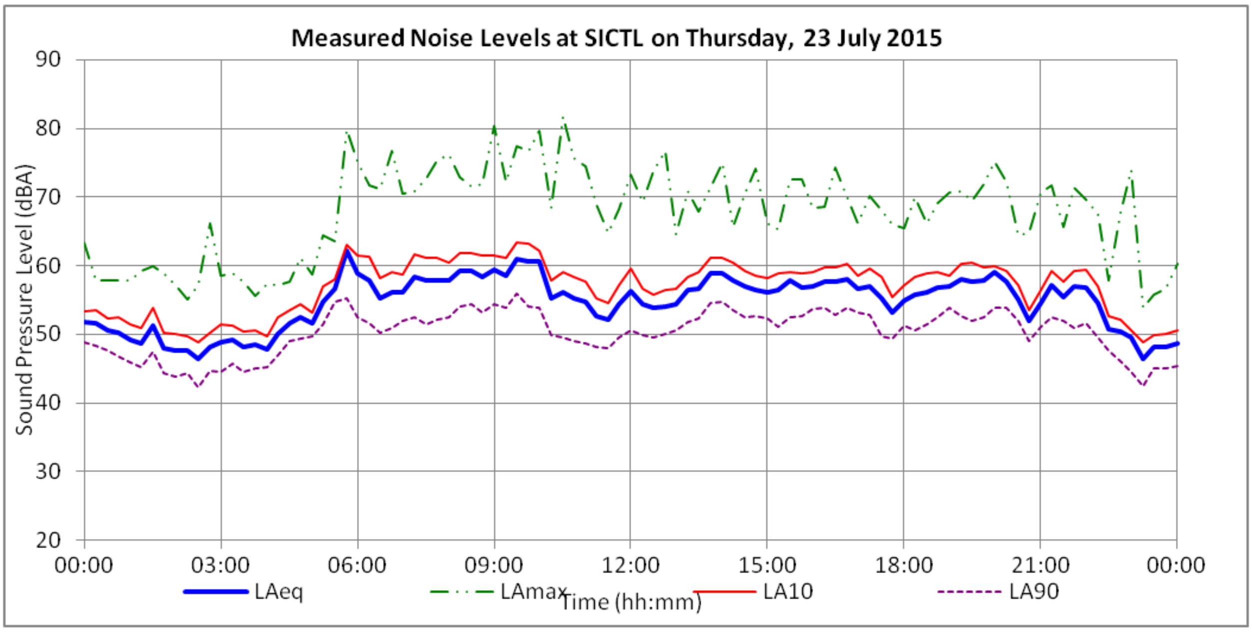

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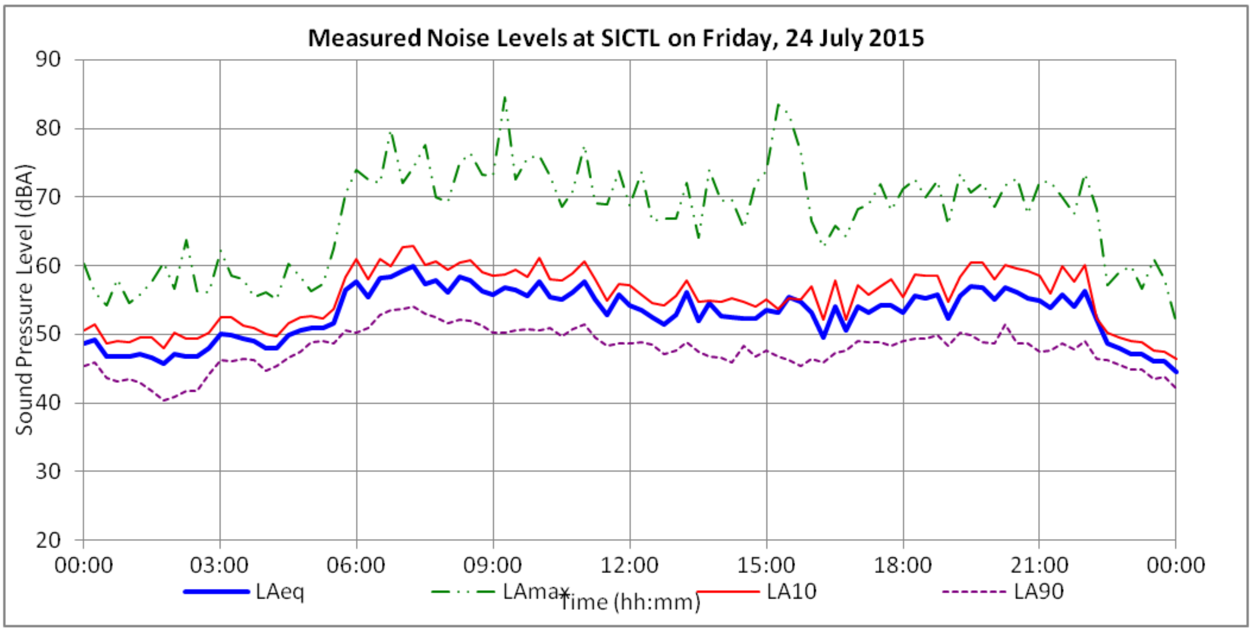

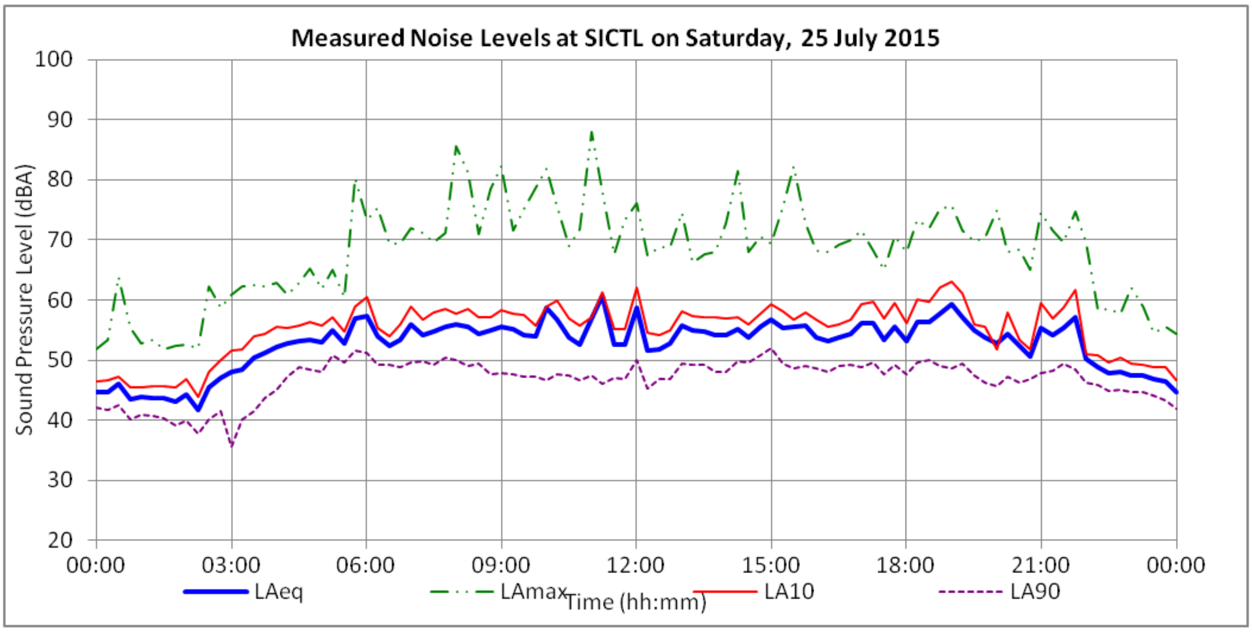

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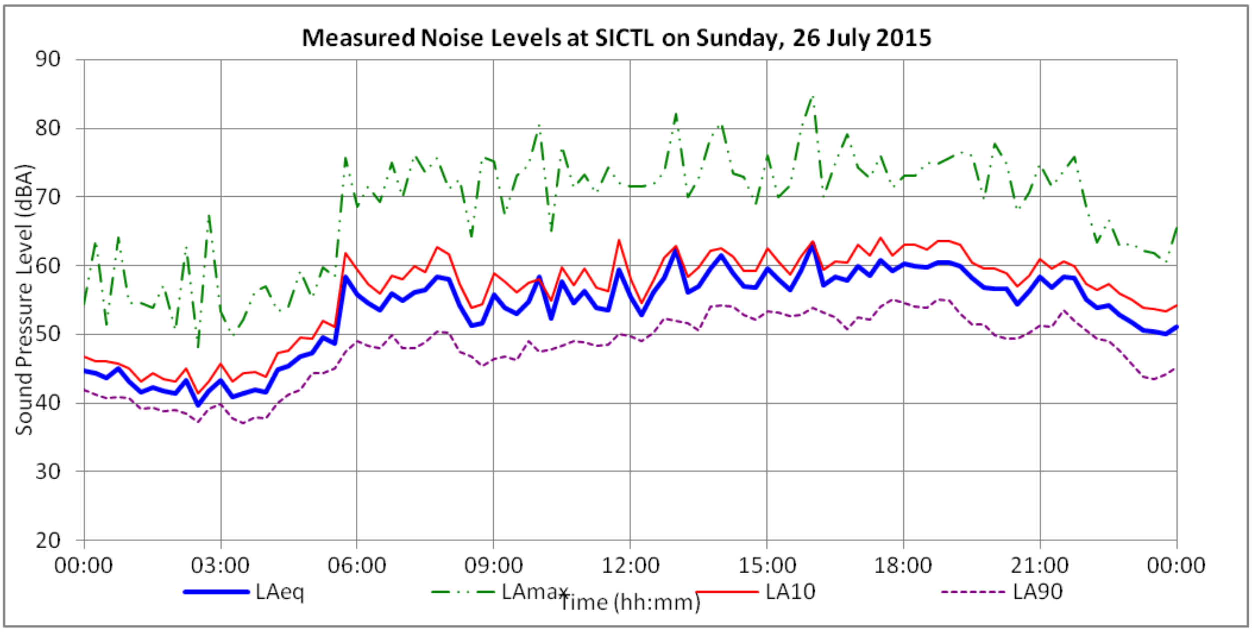
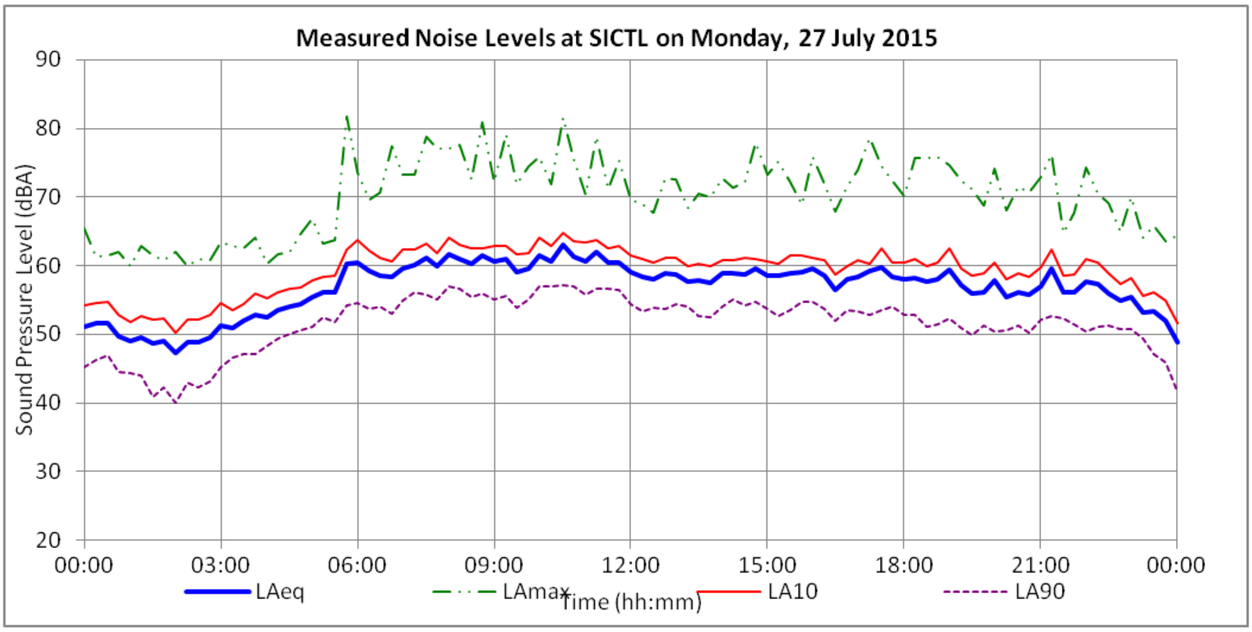
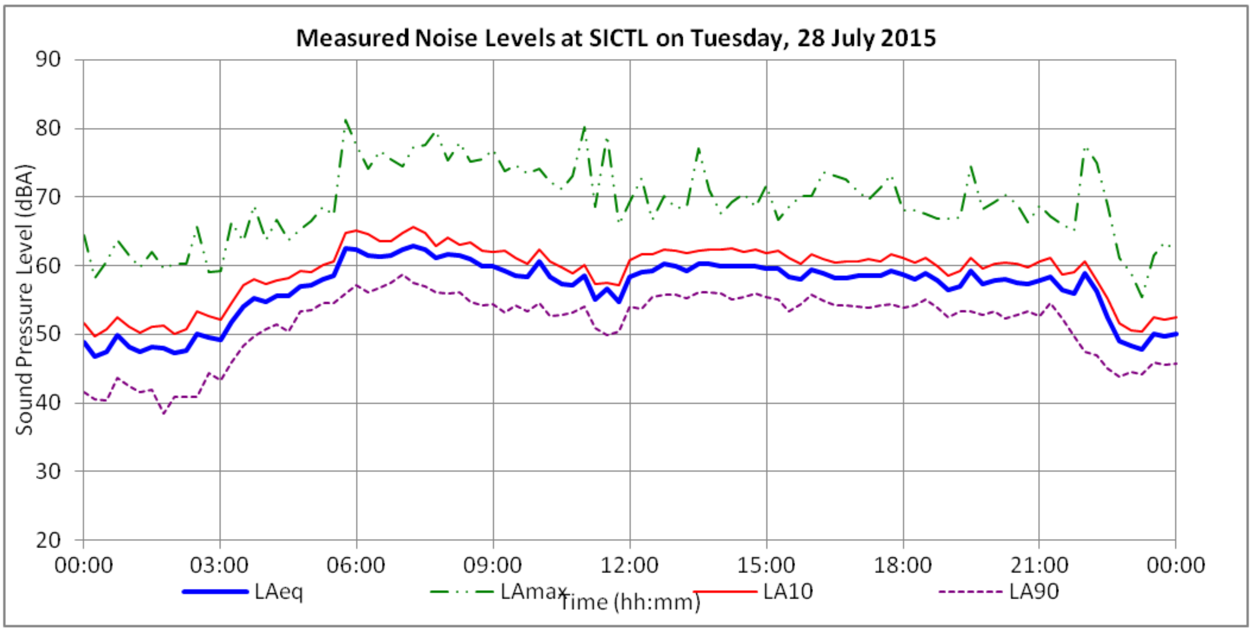
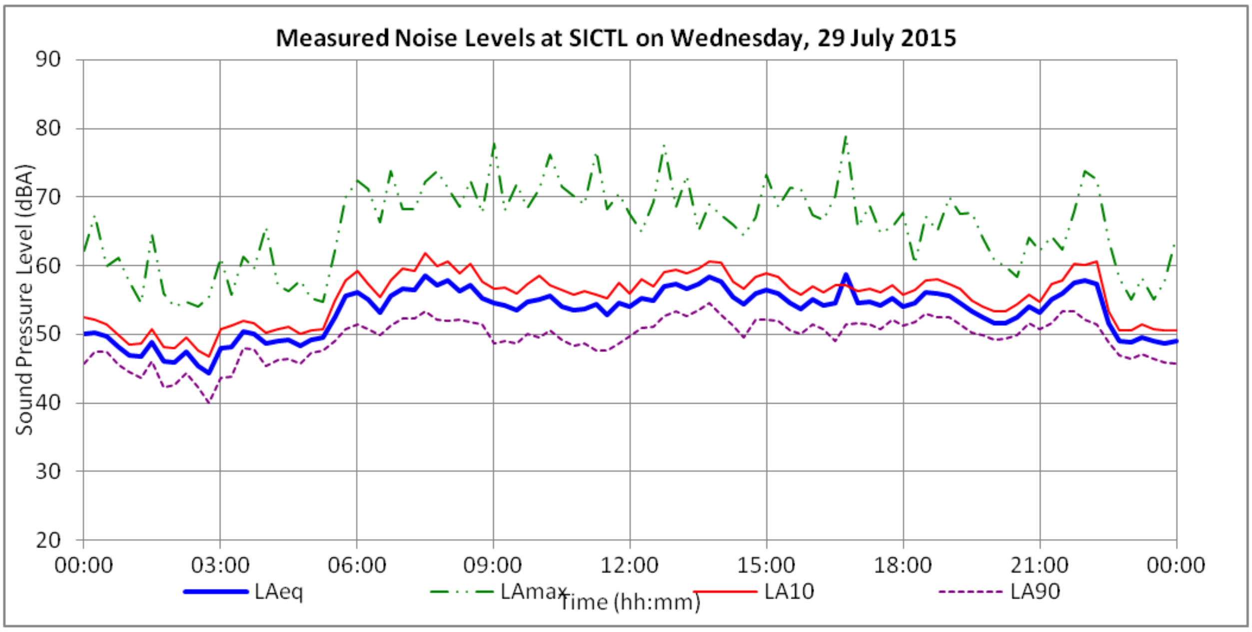


Measured Noise Levels at SICTL on Sunday, 26 July 2015
90
80
70
60
50
40
30
20
Sound Pressure Level (dBA)
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time (hh:mm)
LAeq
LAmax
LA10
LA90



Measured Noise Levels at SICTL on Monday, 27 July 2015
90
80
70
60
50
40
30
20
Sound Pressure Level (dBA)
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time (hh:mm)
LAeq
LAmax
LA10
LA90





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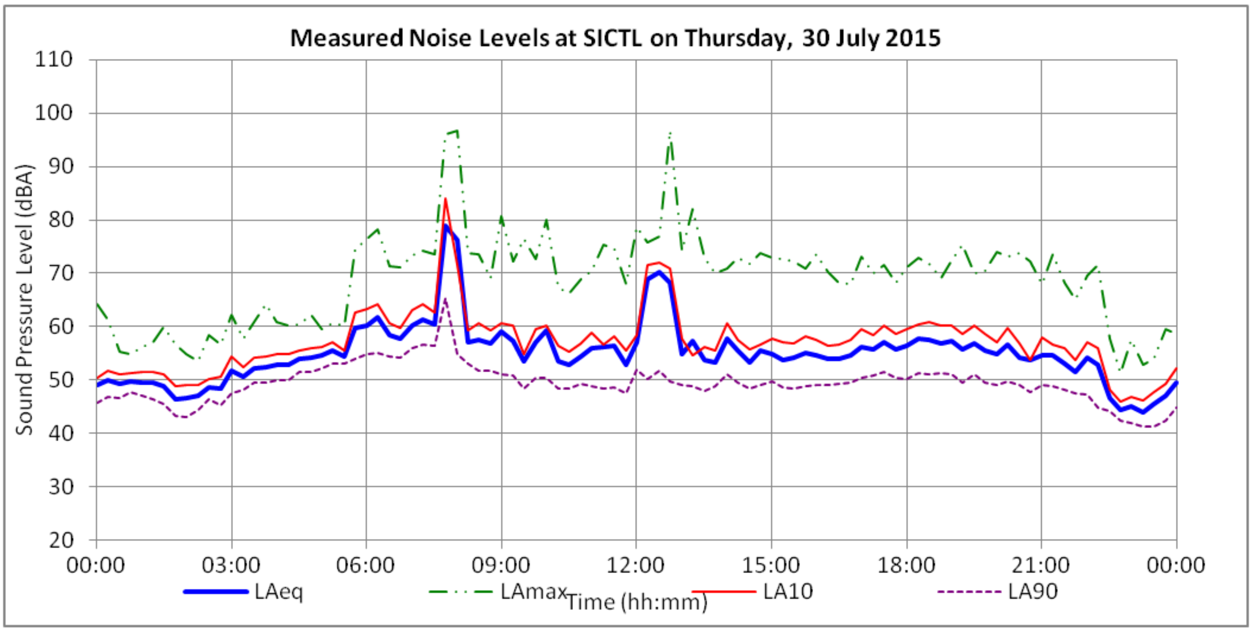

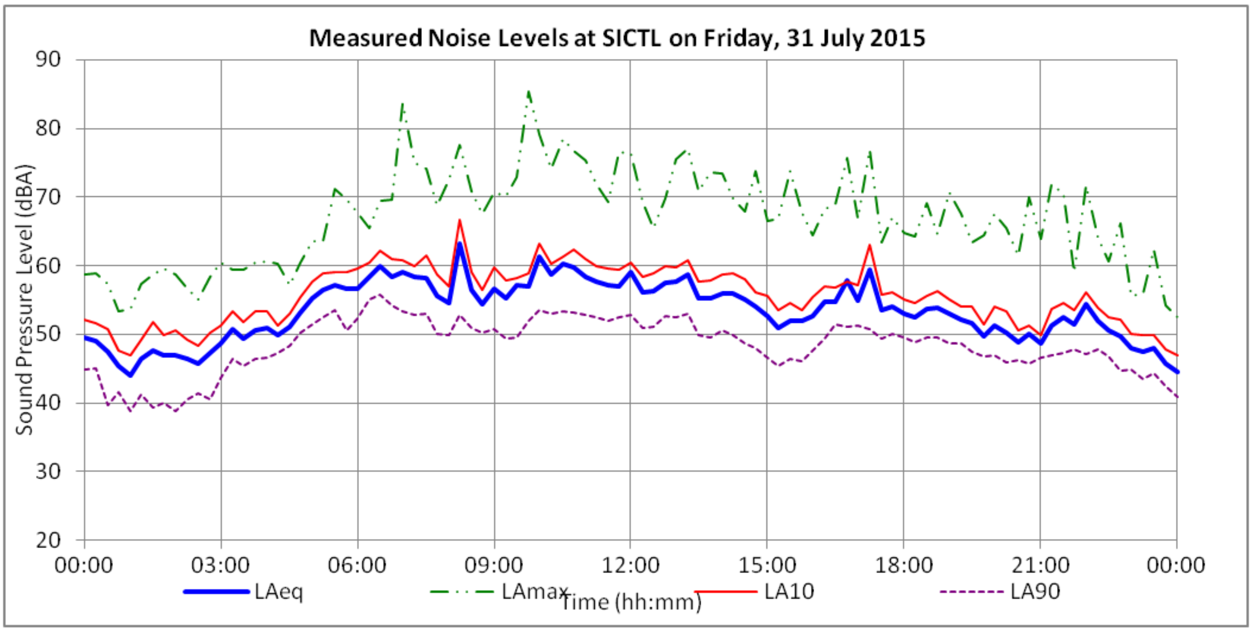

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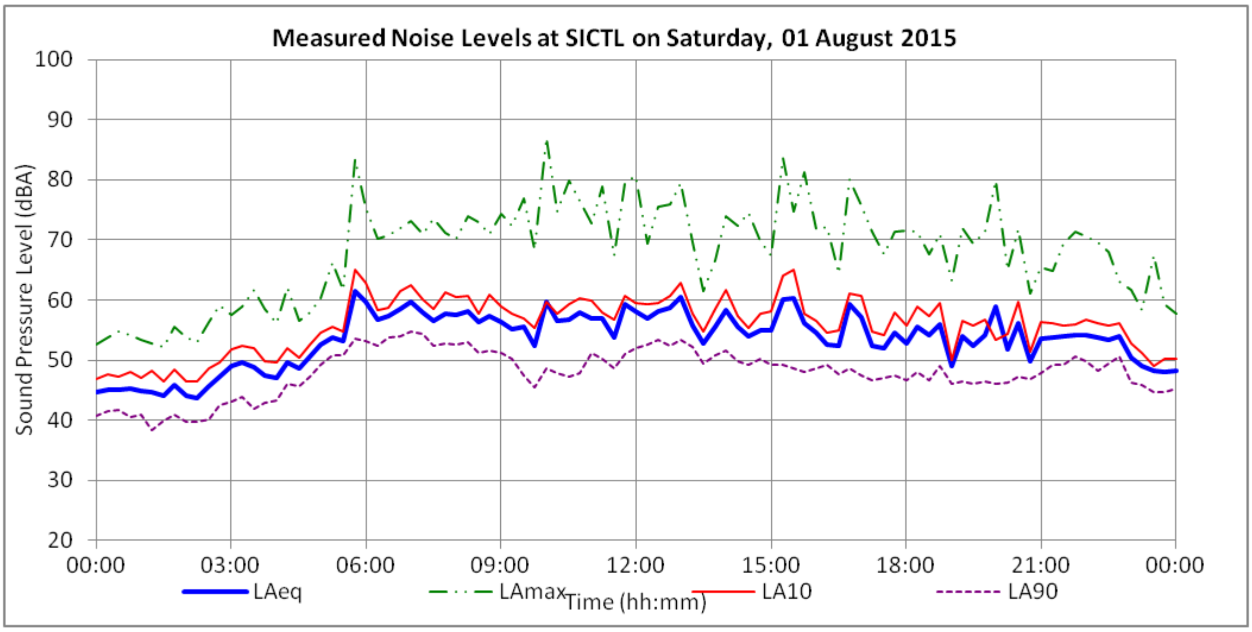

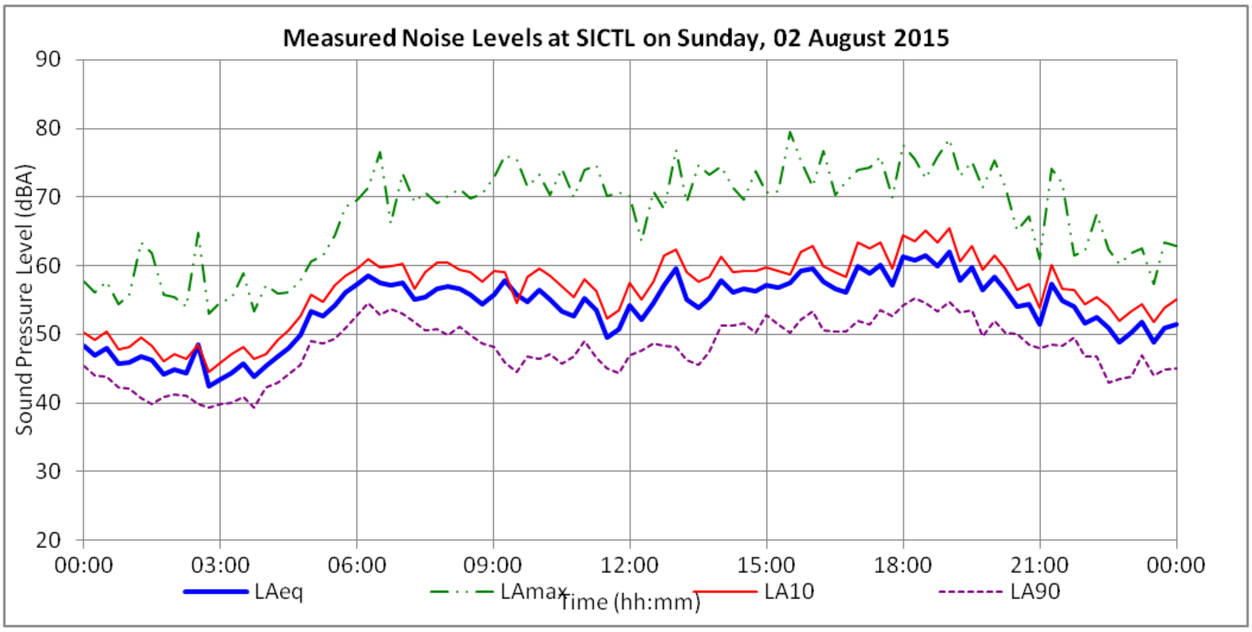

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APPENDIX C PLANT INVENTORY AND SOUND POWER LEVELS

The following inventory of large plant was provided by SICTL.

Table C1: SICTL Inventory of Large Plant

Active / Inactive	Master Asset ID	Description	Serial No	Build Year	Type	Manufacturer / OEM	Comments
A	QC01	Quay Crane	1661-1	2012	Shuttle Boom Crane	ZPMC	Height = 55m total, ~37m to ropes
A	QC02	Quay Crane	1661-2	2012	Shuttle Boom Crane	ZPMC	Height = 55m total, ~37m to ropes
A	QC03	Quay Crane	1715-1	2012	Shuttle Boom Crane	ZPMC	Height = 55m total, ~37m to ropes
A	QC04	Quay Crane	1715-2	2012	Shuttle Boom Crane	ZPMC	Height = 55m total, ~37m to ropes
A	ASC01L	Automated Stacking Crane	ASC-G1334	2013	-	Kone Cranes	Height = 24m total, ~22m to hoisting motor
A	ASC01W	Automated Stacking Crane	ASC-G1335	2013	-	Kone Cranes	Height = 24m total, ~22m to hoisting motor
A	ASC02L	Automated Stacking Crane	ASC-G1336	2013	-	Kone Cranes	Height = 24m total, ~22m to hoisting motor
A	ASC02W	Automated Stacking Crane	ASC-G1337	2013	-	Kone Cranes	Height = 24m total, ~22m to hoisting motor
A	ASC03L	Automated Stacking Crane	ASC-G1338	2013	-	Kone Cranes	Height = 24m total, ~22m to hoisting motor
A	ASC03W	Automated Stacking Crane	ASC-G1339	2013	-	Kone Cranes	Height = 24m total, ~22m to hoisting motor
A	ASC04L	Automated Stacking Crane	ASC-G1550	2015	-	Kone Cranes	Height = 24m total, ~22m to hoisting motor
A	ASC04W	Automated Stacking Crane	ASC-G1551	2015	-	Kone Cranes	Height = 24m total, ~22m to hoisting motor
A	ASC05L	Automated	ASC-G1552	2015	-	Kone Cranes	Height = 24m total,

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		Stacking Crane					~22m to hoisting motor
A	ASC05W	Automated Stacking Crane	ASC-G1553	2015	-	Kone Cranes	Height = 24m total, ~22m to hoisting motor
A	ASC06L	Automated Stacking Crane	ASC-G1554	2015	-	Kone Cranes	Height = 24m total, ~22m to hoisting motor
A	ASC06W	Automated Stacking Crane	ASC-G1555	2015	-	Kone Cranes	Height = 24m total, ~22m to hoisting motor
A	SC01	Shuttle Carrier	4927	2013	SHC250H	Cargotec	Height ~9m to engine
A	SC02	Shuttle Carrier	4928	2013	SHC250H	Cargotec	Height ~9m to engine
A	SC03	Shuttle Carrier	4929	2013	SHC250H	Cargotec	Height ~9m to engine
A	SC04	Shuttle Carrier	4930	2013	SHC250H	Cargotec	Height ~9m to engine
A	SC05	Shuttle Carrier	4931	2013	SHC250H	Cargotec	Height ~9m to engine
A	SC06	Shuttle Carrier	4932	2013	SHC250H	Cargotec	Height ~9m to engine
A	SC07	Shuttle Carrier	4933	2013	SHC250H	Cargotec	Height ~9m to engine
A	SC08	Shuttle Carrier	4934	2013	SHC250H	Cargotec	Height ~9m to engine
A	RS01	Reach Stacker	13RS45020090	2013	SRSC45C2	Sany	Height of engine ~ 1.5m
A	RS02	Reach Stacker	13RS45020091	2013	SRSC45C2	Sany	Height of engine ~ 1.5m
	RS03	Reach Stacker	14RS45450058	2014	SRSC4545	Sany	Height of engine ~ 1.5m
	RS04	Reach Stacker	14RS45450059	2014	SRSC4545	Sany	Height of engine ~ 1.5m
A	EH01	Empty Handler	13DG1080030	2013	SDCY100K8-T	Sany	Not In Use
A	FL01	Fork Lift 16 T	13CP16010015	2013	SCP160C	Sany	Not measured
A	FL02	Fork Lift 5T	P455D 006 9888CNF	2013	C50SD / V3800T	Clark	Not measured
A	FL03	Fork Lift 2.5T	P232D 1419 9843CNF	2013	C25D	Clark	Not measured
A	FL04	Fork Lift 2.5T	P232D 1352 9843CNF	2013	C25D	Clark	Not measured
I	FL05	Fork Lift 2.5T	NA	NA	GEX25	Clark	Not measured
A	EWP01	Elevated workplatform	300171339	2013	JLG 800AJ	JLG	Not In Use

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A	EWP02	Elevated workplatform	B200013419	2013	JLG324ES	JLG	Not In Use
A	TT01	Terminal Tractor	NA	2013	Terberg	Terberg	Not In Use
A	NSG 02	Reefer Generator 02 (25 Plug)	NA	NA	Rental Waterfront	NA	Not In Use
A	NSG 03	Reefer Generator 03 (25 Plug)	NA	NA	Rental Waterfront	NA	Not In Use
A	NSG 04	Reefer Generator 04(30 Plug)	NA	NA	Rental Waterfront	NA	Not In Use

Photos of each plant type referenced above are provided overleaf

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Figure C1: Reach Stacker

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Figure C2: Shuttle Carrier

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Figure C3: Quay Crane

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Figure C4: ASC unloading container

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The octave band sound power level derived for each plant item is detailed in Table C2 below.

Table C2: Octave Band Sound Power Level

	Octave Band Centre Frequency (Hz)							
Source	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**dBA**
ASC Roller and Quacker	104	106	101	101	101	101	95	106
Quay Crane Quacker	90	89	96	94	95	93	86	99
Quay Crane Rollers	105	101	102	104	102	101	93	107
Truck reversing in ASC area	99	94	89	92	94	93	84	98
Truck idling in ASC area	101	96	89	94	94	92	84	98
Truck accelerating from idling and driving out of ASC lane	100	94	90	92	96	94	87	100
Truck movement	97	96	88	88	89	87	83	93
Train locomotive (C509)	107	106	102	100	97	98	92	104
Train locomotive idling	108	104	101	101	95	88	81	101
Train shunting LA1 Lw	104	105	112	109	111	108	106	115
Shuttle in Quay Crane area	105	104	102	102	99	95	93	104
Hatch Cover plate landing L_{A1} Lw	136	132	124	125	116	111	100	125
Spreader attempting to engage with hatch cover plate L_{A1} Lw	139	135	132	130	126	122	113	132

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	Octave Band Centre Frequency (Hz)							
Source	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**dBA**
Container landing L_{A1} Lw	118	121	116	114	110	104	99	116
Shuttle carrier movement in ASC Area	101	99	98	102	101	99	90	105
Reach stacker in Train Area	104	106	105	100	98	96	92	104
Reach stacker movement in Exchange pad area	101	99	98	102	101	99	90	105

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APPENDIX D SUMMARY OF MODELLING ASSUMPTIONS

SICTL has provided the following typical and worst case operational scenarios. SICTL have reported that not all worst cast scenarios are underway at once as there is not enough plant to do this. Yard, quay and rail operations are managed for efficient usage of plant – this system is colour-coded below. Additionally, the differences between the INP noise periods and the SICTL shift times are explained in the table below.

Table D1: SICTL Typical and Worst Case Operating Scenarios

Area	Governing INP Period	SICTL work times within each INP period	TYPICAL Operating Scenario	WORST-CASE Operating Scenario
QUAY	Day	Part of Day shift 0700 - 1400 & Part of Evening shift 1400 - 1800	2 Quay Cranes working one ship 6 Shuttle Carriers (3 per Quay Crane 2 Small forklifts & 4 light vehicles	3 Quay Cranes working two ships 8 Shuttle Carriers (3 per Quay Crane) 2 Small forklifts & 6 light vehicles
	Evening	Part of Evening shift 1800 - 2200	2 Quay Cranes working one ship 6 Shuttle Carriers (3 per Quay Crane 2 Small forklifts & 4 light vehicles	3 Quay Cranes working two ships 8 Shuttle Carriers (3 per Quay Crane 2 Small forklifts & 6 light vehicles
	Night	All of Night shift 2200 - 0600 & Part of Day shift 0600 - 0700	2 Quay Cranes working one ship 6 Shuttle Carriers (3 per Quay Crane 2 Small forklifts & 4 light vehicles	3 Quay Cranes working two ships 8 Shuttle Carriers (3 per Quay Crane 2 Small forklifts & 6 light vehicles
YARD	Day	Part of Day shift 0700 - 1400 & Part of Evening shift 1400 - 1800	6 Automated Stacking Cranes (always working) 1 Reach Stacker 1 Shuttle Carriers 27 trucks per hour	10 Automated Stacking Cranes (always working) 1 Reach Stackers 2 Shuttle Carriers 50 trucks per hour
	Evening	Part of Evening shift 1800 - 2200	6 Automated Stacking Cranes (always working) 1 Reach Stacker 1 Shuttle Carriers 27 trucks per hour	10 Automated Stacking Cranes (always working) 1 Reach Stackers 2 Shuttle Carriers 50 trucks per hour

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	Night	All of Night shift 2200 - 0600 & Part of Day shift 0600 - 0700	6 Automated Stacking Cranes (always working) 1 Reach Stacker 1 Shuttle Carriers 27 trucks per hour	10 Automated Stacking Cranes (always working) 1 Reach Stackers 2 Shuttle Carriers 50 trucks per hour
RAIL	Day	Part of Day shift 0700 - 1400 & Part of Evening shift 1400 - 1800	2 Reach Stackers 2 trains per shift	3 Reach Stackers 5 trains per shift
	Evening	Part of Evening shift 1800 - 2200	2 Reach Stackers 2 trains per shift	3 Reach Stackers 3 trains per shift
	Night	All of Night shift 2200 - 0600 & Part of Day shift 0600 - 0700	No trains scheduled	No trains scheduled

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Based on the above schedule Marshall Day has incorporated the following assumptions to model the typical and worst case noise operations of the site. As a worst case scenario we have assumed that the Quay, Yard and Rail operations will all occur concurrently. However, in reality it is understood that typically only 2 of the three areas will be operating at full capacity simultaneously.

Table D2: Noise model assumptions

DAY TIME TYPICAL	DAY TIME WORST CASE	EVENING TIME TYPICAL	EVENING TIME WORST CASE	NIGHT TIME TYPICAL	NIGHT TIME WORST CASE
Quay Area					
Quay Crane x 2 Operating for 50% of the time. Speed is 5km/h. Assumed that quay crane rollers operate for 25% of the time.	Quay Crane x 3 Operating for 50% of the time. Speed is 5km/h. Assumed that quay crane rollers operate for 25% of the time.	Quay Crane x 2 Operating for 50% of the time. Speed is 5km/h. Assumed that quay crane rollers operate for 25% of the time.	Quay Crane x 3 Operating for 50% of the time. Speed is 5km/h. Assumed that quay crane rollers operate for 25% of the time.	Quay Crane x 2 Operating for 50% of the time. Speed is 5km/h. Assumed that quay crane rollers operate for 25% of the time.	Quay Crane x 3 Operating for 50% of the time. Speed is 5km/h. Assumed that quay crane rollers operate for 25% of the time.
Shuttle Carrier x 6 4 x picking up containers at crane Unloading/loading for 25% of the time.	Shuttle Carrier x 8 6 x picking up containers at crane Unloading/loading for 25% of the time.	Shuttle Carrier x 6 4 x picking up containers at crane Unloading/loading for 25% of the time.	Shuttle Carrier x 8 6 x picking up containers at crane Unloading/loading for 25% of the time.	Shuttle Carrier x 6 4 x picking up containers at crane Unloading/loading for 25% of the time.	Shuttle Carrier x 8 6 x picking up containers at crane Unloading/loading for 25% of the time.
ASC Area and Exchange Pad/Yard					
6 x ASC Crane. 7 movements in a 15 minute period.	10 x ASC Crane. 12 movements in a 15 min period.	6 x ASC Crane. 7 movements in a 15 minute period.	10 x ASC Crane. 12 movements in a 15 min period.	6 x ASC Crane. 7 movements in a 15 minute period.	10 x ASC Crane. 12 movements in a 15 min period.
1 x Reach Stacker. Moves for 20% of time.	1 x ASC Reach Stacker. Each moves for 20% of the time.	1 x Reach Stacker. Moves for 20% of time.	1 x Reach Stacker. Each moves for 20% of the time.	1 x Reach Stacker. Moves for 20% of time.	1 x Reach Stacker. Each moves for 20% of the time.
1 x Shuttle Carrier Moves for 33.33% of time.	2 x Shuttle Carriers. Each moves for 33.33% of the time.	1 x Shuttle Carrier Moves for 33.33% of time.	2 x Shuttle Carriers. Each moves for 33.33% of the time.	1 x Shuttle Carrier Moves for 33.33% of time.	2 x Shuttle Carriers. Each moves for 33.33% of the time.

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7 truck movements in 15 minute period at 5km/h speed. 7 container landings in 15 min period	12 Truck movements in 15 min period at 5km/h speed. 12 container landings in 15 min period	7 truck movements in 15 minute period at 5km/h speed. 7 container landings in 15 min period	12 Truck movements in 15 min period at 5km/h speed. 12 container landings in 15 min period	7 truck movements in 15 minute period at 5km/h speed. 7 container landings in 15 min period	12 Truck movements in 15 min period at 5km/h speed. 12 container landings in 15 min period
Rail Area					
2 x Reach Stackers. Each moves for 50% of the time.	3 x Reach Stackers. Each moves for 50% of the time.	2 x Reach Stackers. Each moves for 50% of the time.	3 x Reach Stackers. Each moves for 50% of the time.	No trains or unloading/loading activity	No trains or unloading/loading activity
1 x Train movement i.e. 3 locomotives in 15 min period. 1 x Shunting	1 x Train movement i.e. 3 locomotives in 15 min period. 1 x Shunting	1 x Train movement i.e. 3 locomotives in 15 min period. 1 x Shunting	1 x Train movement i.e. 3 locomotives in 15 min period. 1 x Shunting	No trains or unloading/loading activity	No trains or unloading/loading activity

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APPENDIX E EPA RESPONSE LETTER

NSW EPA

Our reference: DOC14/127781
Contact: Jacqueline Roberts

Mr John Ieroklis
Environmental & Safety Compliance Engineer
Hutchison Ports Australia
PO Box 734
Botany NSW 1455

Dear John

Re: Sydney International Container Terminals
Port Botany Terminal 3 – Operational Compliance Measurements
SLR Proposed Scope of Works

The Environment Protection Authority (EPA) has reviewed correspondence from SLR Consulting Australia Pty Ltd ("SLR") dated 5 June 2014 submitted on behalf of Hutchison Ports Australia ("HPA") detailing a proposed methodology for conducting noise measurements and modelling at the Sydney International Container Terminal ("SICTL") as an alternative to conducting environmental noise monitoring at all six noise monitoring locations outlined in the SICTL environment protection licence (EPL No. 20322).

The EPA does not object to the use of a calibrated noise model in this case to demonstrate compliance with the noise limits specified on EPL No. 20322. However, it is noted that the EPA's position may change in the future due to technological, physical or operational changes in and around the licensed premises.

The following aspects of the proposed modelling approach should be addressed:

- Input Sound Power Levels (SWL) will need to be updated from time to time to reflect any deterioration in the noise performance of the plant and equipment used on site, and any additions or replacements;
- A detailed inventory must be maintained, and provided with model results, to enable tracking of plant and equipment introduction and replacement, as well as any deterioration in noise performance. This inventory should include:
  - Source noise levels (for example SWL or Sound Pressure Levels measured at a specified distance) for each individual item of plant and equipment;
  - Details, including source noise levels, of each item during each activity undertaken by that item (for example, for the ASC this includes during winching, rolling noise, movement alarms and when unloading containers to trucks); and
  - Service and replacement date and description for each item.
- Representative source heights and locations will need to be chosen carefully as they will significantly affect any barrier attenuation and the resulting predicted noise contribution of the site at both the calibration point and receiver locations. This will be especially important in the case of

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unshielded sources such as locomotive exhausts, likely to be above the 3m high barrier which is adjacent to the rail siding; and

- The methodology used, scenarios modelled and uncertainties will need to be described in detail in any noise compliance reports, so that the EPA can have confidence that the predicted noise levels at receiver locations are representative of the likely actual received noise levels.

Particular care will be needed in calibrating the model against measurements made at the proposed calibration point, which will be affected by road traffic noise from Foreshore Road as well as other sources in the area including ships in port, the existing Patrick container terminal, an adjoining construction site and Sydney Airport. The EPA requires at least two on-site calibration points which is likely to provide a more reliable result, by allowing measurements to be shielded from road traffic and airport noise and to allow the effect of local sources to be accounted for.

If you have any questions or queries in regards the above, please do not hesitate to contact Jacqueline Roberts on (02) 9995 5259.

Yours sincerely

11 July 2014

JAMES GOODWIN
Unit Head – Sydney Industry
Environment Protection Authority

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APPENDIX F NOISE CONTOUR PLOTS

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