TRAFFIC · PARKING · ACOUSTICS

13SYA0003 R03
Lot 4, Penrith Lakes, Castlereagh Road, Cranebrook
Acoustic Assessment for Subdivision

Penrith Lakes Development Corporation

Reference: 13SYA0001 R03
26 February 2014

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1	Keith Hewett	Alan Subkey		Report	
2	Keith Hewett			Report update of traffic volume data	25/02/2014
3	Keith Hewett			Report update of traffic volume data	26/02/2014
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Executive Summary

Soundmatters has been engaged by Penrith Lakes Development Corporation (PLDC) to carry out an acoustic assessment for a development application of the site known as 'Lot 4' on the east of the Penrith Lakes Site that is subject to a proposed subdivision into 141 lots. The lots consist of 138 two hectare rural residential lots and three open space lots.

Road traffic noise from Castlereagh Road is the only significant source of noise that affects the proposed site.

Unattended and attended noise measurements were undertaken at two locations on the site.

Location 1 was in the south east of the site close to McCarthy's Lane. Measurements were taken between 26th October and 1st November 2013.

Location 2 was in the north east of the site at the closest point where the subdivisions get to within 25m of Castlereagh road. Measurements were taken between 4th and 10th November 2013.

The existing noise levels are significantly below the applicable *NSW Road Noise Policy* criteria, even when accounting for a noise level increase corresponding to the projected traffic increase to 2025.

All noise criteria are expected to be met except for a possible exceedance of the sleep disturbance maximum noise level criteria depending on the number of truck pass-by events and whether windows are open.

A noise barrier is not recommended along this part of the north eastern boundary as the main source of sleep disturbance would likely be from truck exhausts which are located high off the ground, which will render the noise barrier ineffective.

Providing care is taken during the design and space planning of any new residences on the site is duly considered, then the sleep disturbance criteria and internal noise criterion given in Clause 102 of the Infrastructure *State Environmental Planning Policy* (*SEPP*) is expected to be met using typical construction methods and materials.

1. Introduction

1.1. Background

TTM Soundmatters Consulting has been engaged by Penrith Lakes Development Corporation (PLDC) to undertake an acoustic assessment with regard to the proposed subdivision of land at the Penrith Lakes quarry. The subdivision is known as 'Lot 4' and is located adjacent to Castlereagh Road, Cranebrook. A Development Application (DA) will be lodged with Penrith City Council and this acoustic assessment will form part of the DA documentation.

1.2. Scope

This report identifies and assesses potential noise impacts on the proposed subdivision from the local environment and potential noise impacts on the environment from the subdivision. To appropriately assess any likely adverse acoustic impacts this report has considered:

1. Background noise levels;
2. relevant noise criteria to assess noise sources against;
3. existing and future traffic flows on Castlereagh Road;
4. existing noise mitigation and site conditions; and
5. practical and appropriate noise mitigation where required.

A glossary of acoustic terminology used in this report is given in Appendix 2.

2. Site

2.1. Location and Description

The site is named by PLDC as 'Lot 4' and consists of 141 lots consisting of 138 two hectare lots and three open space lots on land on the remediated Penrith Lakes site. Castlereagh Road is adjacent to the east of the proposed subdivision and McCarthys Lane, Penrith White Water Centre and Regatta Centre to the south, with open ground on the Penrith Lakes site to the north and west as shown in Figure 1.

At the northern end of the proposed sub division Castlereagh Road is approximately 25m from the boundary of approximately 15 lots. At the south of the site the distance between the proposed lot boundaries and Castlereagh road is much greater at 200m to 300m and is separated by a lake.

The site is typically at the same or near the level of Castlereagh road.

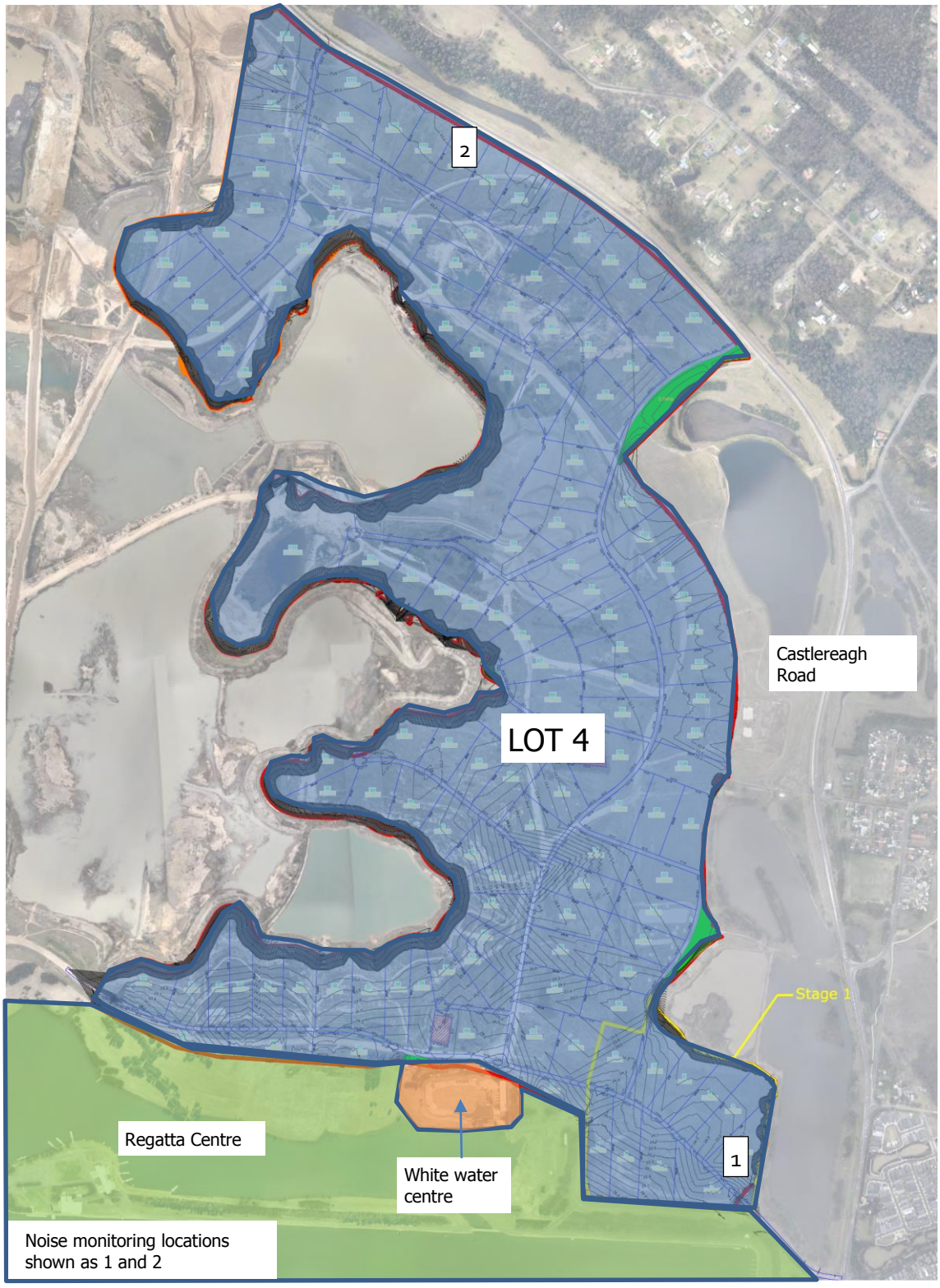


Figure 1: Site and Noise Monitoring Locations

3. Noise Measurements

3.1. Existing Acoustic Environment

Traffic noise from Castlereagh Road is the dominant noise source on the proposed subdivision site. Other noise sources include natural sources such as birds and the rustle of leaves during the wind. Occasional noise from trucks and equipment on the PLDC site is also audible. However, this noise will not exist when the PLDC's activities cease on the site in 2015/16 and residences are occupied on the proposed subdivision. Therefore, noise impact from this source has not been considered.

Penrith white water and regatta centre are located to the south of Lot 4. Noise from these locations was inaudible during the site visits. However, on event days noise from public address announcements may be audible. Nevertheless, this is unlikely to significantly adversely affect the acoustic amenity on the subdivisions.

3.2. Measurements

Unattended noise measurements were recorded for a period of seven consecutive days at two locations on the site (see Figure 1).

Location 1 was in the south east of the site close to McCarthy's Lane (Gate 9). Unattended measurements were taken between 26th October and 1st November 2013.

Location 2 was in the north east of the site at the closest point where the subdivisions get to within 25m of Castlereagh Road (close to Gate 12). Unattended measurements were taken between 4th and 10th November 2013.

These sites were chosen as they represent the worst case locations for traffic noise impact to Lot 4.

Average, maximum and statistical noise parameters were recorded at 15 minute intervals. Where appropriate recorded noise levels affected by adverse weather have been removed from this assessment.

The unattended noise levels have been presented as daily graphs for each location and are located in Appendix A.

Attended noise measurements were also taken on-site to verify and supplement the unattended noise logger data. All measurements were taken generally in accordance with AS1055[1].

[1] AS 1055 - Description and measurement of environmental noise

Location	Date	Time	L_{Aeq} dB	L_{A10} dB	L_{A90} dB	L_{Amax} dB	Comments
1	25/10/13	14:15 - 14:30	48	50	43	64	Traffic noise dominant although at low level. Other noise was the rustle of leaves in trees. The L_{Amax} was a localised natural sound and not traffic.
2	4/11/13	13:55 - 14:10	57	61	41	72	Traffic noise dominant, but free flowing and periods of up to 30 secs or a minute without traffic in either direction

Table 1: Attended noise measurements on-site

4. Noise Criteria

4.1. NSW Department of Planning - Development near Rail Corridors and Busy Roads – Interim Guideline

The *Department of Planning - Development near Rail Corridors and Busy Roads – Interim Guideline*, must be taken into account under Clause 102 of the *State Environmental Planning Policy (SEPP)* for Infrastructure, 2007.

Clause 102 requires that residential and other specified developments on land adjacent to a road with an annual average daily traffic volume of more than 40,000 vehicles and the consent authority considers it likely to be adversely affected by road noise or vibration.

For Clause 102 (road) the following internal noise levels are not to be exceeded:

- 35 dB L_{Aeq} in any bedroom in the building between 10pm-7am
- 40 dB L_{Aeq} anywhere else in the building (other than a garage, kitchen, bathroom or hallway) at any time.

4.2. NSW Road Noise Policy

The *NSW Road Policy* states the following noise criteria for residential land uses close to sub-arterial roads, which Castlereagh Road is considered to be for this assessment.

Road category	Type of land use	Assessment criteria dB(A)	
		Day (7am – 10pm)	Night (10pm -7am)
Freeway/arterial/ sub-arterial roads	Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads	$L_{Aeq,15hour}$ 60 (external)	$L_{Aeq,9hour}$ 55 (external)

Table 2: External noise criteria

The *NSW Road Policy* also provides additional considerations of a noise criterion for the passive use of open space for contemplative activities. This is considered to be an appropriate noise criterion for back yards and gardens.

Existing sensitive land use	Type of land use	Assessment criteria dB(A)	
		Day (7am – 10pm)	Night (10pm -7am)
Open space (passive use)	Passive use is characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, e.g. playing chess and reading	$L_{Aeq,15hour}$ 55 (external) When in use	-

Table 3: Noise criteria for the passive use of open space

5. Assessment of noise affecting the development subdivision

Road traffic noise from Castlereagh Road is the only significant noise source impacting the 'Lot 4' subdivision on the Penrith Lakes site. There will be access roads built to provide entry to the subdivisions as part of the redevelopment at three locations along Castlereagh Road. These are shown and discussed in TTM's Traffic Impact Report 13SYT0024. However, this additional traffic is highly unlikely to cause an adverse impact on the acoustic amenity of the residential sub-divisions due to the low numbers over the day and low speeds.

Another minor noise source is from the trucks and plant operating on the existing Penrith Lake quarry. However, operations on the quarry are due to cease in 2015/16 when the whole site is expected to be rezoned into residential and recreational use. Therefore, this source of noise is not relevant to future housing on the Penrith Lakes site and has not been assessed.

Other sources of human activity noise may come from public address systems used at the regatta and white water venues to the south of McCarthys Lane. However, this has not been observed and is not expected to cause an adverse impact to the proposed residential subdivisions.

The only other sources of noise are natural, such as birds and insects.

This assessment will therefore focus on the road traffic noise from Castlereagh Road.

5.1. Road traffic noise

5.1.1. Measured

Castlereagh Road has been redeveloped and realigned in recent years and was completed in 2007. No major changes are expected other than three new intersections proposed for future housing on the Penrith Lakes site.

$L_{Aeq,15hour}$ and $L_{Aeq,9hour}$ noise levels affecting the proposed subdivision site were measured at Location 1 close to McCarthys Lane at the south of the site from 26th October to 1st November 2013, and at Location 2 at the northern end of the site close to Castlereagh Road from 4th – 10th November 2013. These are given in Table 4 and Table 5 below and compared directly against the *Road Noise Policy* criteria.

Date Location 1 (McCarthys Lane)	Measured Noise Levels dB(A)		Assessment criteria dB(A)		Meets Criteria? ✓/×	
	Day (7am – 10pm) $L_{Aeq,15hour}$ (external)	Night (10pm - 7am) $L_{Aeq,9hour}$ (external)	Day (7am – 10pm) $L_{Aeq,15hour}$ (external)	Night (10pm - 7am) $L_{Aeq,9hour}$ (external)	Day (7am – 10pm) $L_{Aeq,15hour}$ (external)	Night (10pm - 7am) $L_{Aeq,9hour}$ (external)
Sat 26 Oct	46	41	60	55	✓	✓
Sun 27 Oct	46	39			✓	✓
Mon 28 Oct	46	39			✓	✓
Tues 29 Oct	49	41			✓	✓
Weds 30 Oct	47	41			✓	✓
Thurs 31 Oct	48	39			✓	✓
Fri 1 Nov	46	42			✓	✓
Average week	**47**	**40**			✓	✓

Table 4: Existing measured traffic noise levels at Location 1 versus RNP criteria

Table 4 shows that the external noise criteria is met already on the site with no noise control required. The existing traffic noise affecting the site is 13 dB(A) below the daytime criterion and 15 dB(A) below the night time criterion.

Date Location 2 (North end of site)	Measured Noise Levels dB(A)		Assessment criteria dB(A)		Meets Criteria? ✓/×	
	Day (7am – 10pm) $L_{Aeq,15hour}$ (external)	Night (10pm - 7am) $L_{Aeq,9hour}$ (external)	Day (7am – 10pm) $L_{Aeq,15hour}$ (external)	Night (10pm - 7am) $L_{Aeq,9hour}$ (external)	Day (7am – 10pm) $L_{Aeq,15hour}$ (external)	Night (10pm - 7am) $L_{Aeq,9hour}$ (external)
Mon 4 Nov	54	46	60	55	✓	✓
Tues 5 Nov	53	45			✓	✓
Weds 6 Nov	53	48			✓	✓
Thurs 7 Nov	54	48			✓	✓
Fri 8 Nov	54	48			✓	✓
Sat 9 Nov	53	49			✓	✓
Sun 10 Nov	53	44			✓	✓
Average week	**53**	**47**			✓	✓

Table 5: Existing measured traffic noise levels at Location 2 versus RNP criteria

Table 5 shows that the external noise criteria is met already on the site with no noise control required. The existing traffic noise affecting the site is 7 dB(A) below the daytime criterion and 8 dB(A) below the night time criterion.

5.1.2. Traffic Volumes

Table 6 below shows existing and future predicted traffic flows to 2025 on Castlereagh Road as it passes the Lot 4 site, where unattended noise measurements were taken. The 2012 Average weekly Traffic (AWT) volume on Castlereagh Road, north of Nepean Street was taken from the *'Section 75W application environmental assessment - for the Importation of VENM Modification'*, produced by Arup and dated 30 August 2012. The traffic count was undertaken in May 2012.

TTM has assumed a 3% growth per annum in traffic along Castlereagh Road as a typical growth factor where some development takes place. TTM has also estimated traffic volumes as they pass the two noise logger locations, which represent the worst case scenarios in terms or traffic volume or proximity to Castlereagh Road.

Road	Arup report – S75W VENM modification 2012	Opening year 2015	10 years after opening 2025
	Average Weekday Traffic	Average Weekday Traffic	Average Weekday Traffic
Castlereagh Road (North of Nepean Street)	18,343* including 7% Heavy Goods Vehicles	20,043	26,937#
Castlereagh Road (passing McCarthy's Lane)	21,343**	23,322	31,343#
Castlereagh Road (north of Cranebrook Road)	7,337***	8,018	10,775#

Table 6: Forecast traffic volumes on Castlereagh Road (North of Nepean Street)

*** Does not include the projected increase in HGV's due to PLDC's Virgin Excavated Natural Material (VENM) programme as part of the Penrith Lakes remediation program, as this will be complete by the time any new buildings on Lot 4 are ready for occupation.**

**** Estimated from Arup data north of Nepean Street (+ 3,000)**

***** Estimated from Arup data north of Nepean Street (40% of flow north of Nepean Street – 60% takes Cranebrook Road)**

 # Represents an approximate 34% increase in traffic volume in 10 years from opening year.

In 10 years' time the projected increase in traffic flow on Castlereagh Road where it passes Lot 4 will be approximately 34%. This equates to an increase in noise of approximately 1.3 decibels.

This increase in noise will be typically unnoticeable to the average person and the overall traffic noise levels will still be significantly under the criteria. Therefore, a traffic noise impact is not expected on the site and no noise mitigation is required.

5.1.3. Internal noise for future residences

Given the existing low traffic noise impact on the site the internal noise criteria for future residential buildings on the site given by Clause 102 of the *Infrastructure SEPP* is expected to be met with typical construction methods and materials.

5.1.4. Sleep Disturbance

A small proportion of the traffic on Castlereagh Road north of McCarthys Lane consists of heavy goods vehicles (HGV's). HGV's typically generate higher noise levels than other forms of traffic due to larger engines, pneumatic brakes and noisier exhausts which, are often located at high level above the cab height, which reduces the benefit of any noise barriers or earth bunds.

Sleep disturbance is complex and can be affected by average noise levels through the night, but also maximum noise levels by individual truck pass-bys and the number of pass-by events. However, the 35 dB L_{Aeq} in bedrooms criterion given by Clause 102 of the *Infrastructure SEPP* is

consistent with that recommended by the World Health Organisation (WHO). Providing this can be met during construction, sleep disturbance is unlikely to be an issue for most people.

The world Health organisation also recommend a maximum internal noise level of **45 dB L_{Amax}**, whilst the *NSW Road Noise Policy suggests* that, internal noise levels below **50 dB L_{Amax}** to **55 dB L_{Amax}** are unlikely to awaken people from sleep, and one or two events per night of **65 dB L_{Amax}** to **70 dB L_{Amax}** are not likely to affect health and wellbeing significantly.

Noise measurements of truck by passes were carried out on site adjacent to each of the two noise logger locations. The location of logger 2 represents a worst case location as it is located on the boundary closest to Castlereagh Road in the north of Lot 4. Building footprints are unlikely to be placed right on the boundary, but rather being set back providing a garden or yard that extends up to the boundary.

The pass by measurements are presented in Table 7.

Location	Maximum repeatable $L_{Aeq,15\ min}$ from noise logger	Observed maximum sound pressure level L_{Amax} dB	Comments
Beside noise logger 1 (approx. 200m from Road)	51	51	Flat bed truck – clatter from flatbed over uneven road surface
		61	B-double exhaust dominant and bouncing trailer over uneven rad surface
		50	Several small/medium sized vans and trucks
Beside noise logger 2 (Approx. 25m from road)	57	72	B-double
		71	Single truck
		67	Single truck
		66	motorbike

Table 7 Truck pass-by noise measurements

Providing windows and doors are closed then the internal noise criteria for future residential buildings (35 dB L_{Aeq}) can be met at both locations with typical building methods and materials, which would need to provide a sound reduction of approximately 22 dB(A) for residential buildings closest to Castlereagh Road. However, assuming a 10 decibel reduction of sound through an open window the internal criterion is unlikely to be met with the windows open.

From the measured maximum noise levels of truck pass-bys at the southern end of the site (noise logger 1) and assuming a typical 10 decibel reduction in noise through an open window the sleep disturbance criteria suggested by the *NSW Road Noise Policy* will be met.

Where the subdivisions are much closer to the road in the north of the site the L_{Amax} sleep disturbance criteria suggested by the *NSW Road Noise Policy* is likely to be exceeded if the windows are open, depending on the number and type of events.

5.1.5. Passive use of open space

There are no criteria specifically for gardens and back yards. However, the *NSW Road Noise Policy* recommends a criterion of 55dB $L_{Aeq,15hour}$ the passive use of open space for quiet activities such as reading. This considered an appropriate criterion for gardens and backyards. Table 4 and Table 5 show that this is also met by the existing traffic noise levels on the site.

6. Recommendations

The noise criteria for the site is expected to be met for traffic noise impact on the site.

However, the sleep disturbance criteria, are unlikely to be met for subdivisions that are located near the boundary with Castlereagh Road in the north of the site, if windows are open. This concerns only a small percentage of the proposed subdivisions. Good acoustic space planning in relation to locating the least noise sensitive rooms closest to Castlereagh Road, such as bedrooms, is expected to enable the sleep disturbance criteria to be met.

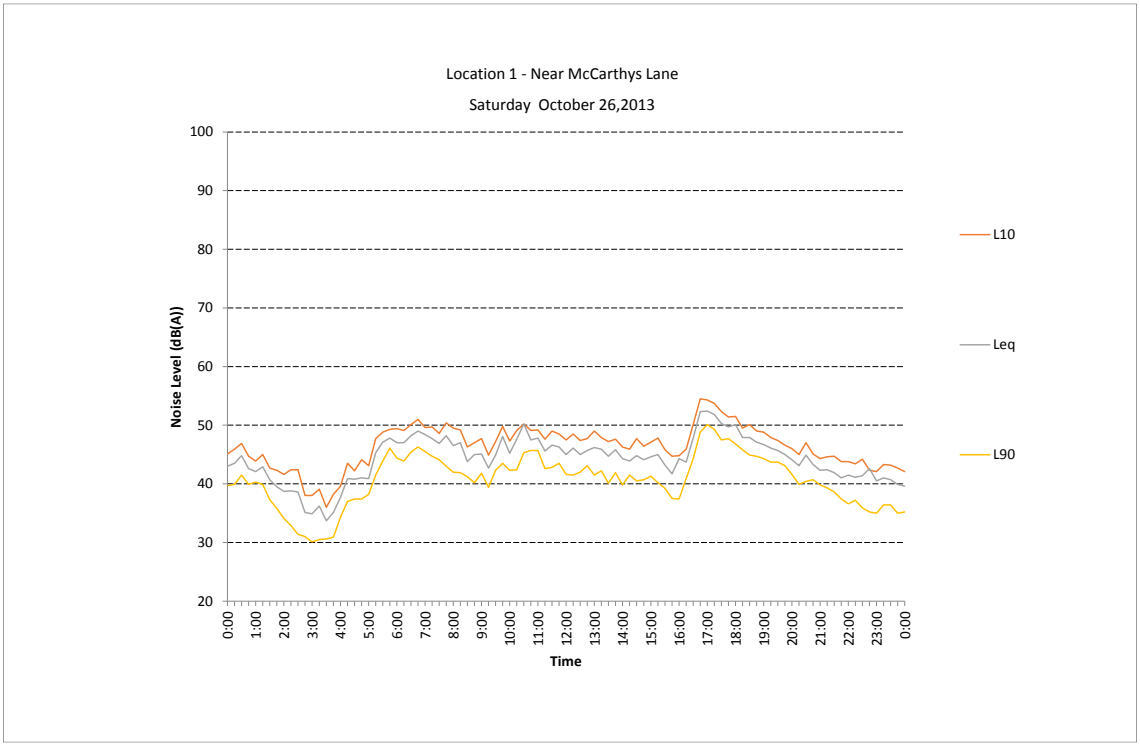
The sleep disturbance is expected to be met at all locations by using typical building materials and methods, providing the windows are closed.

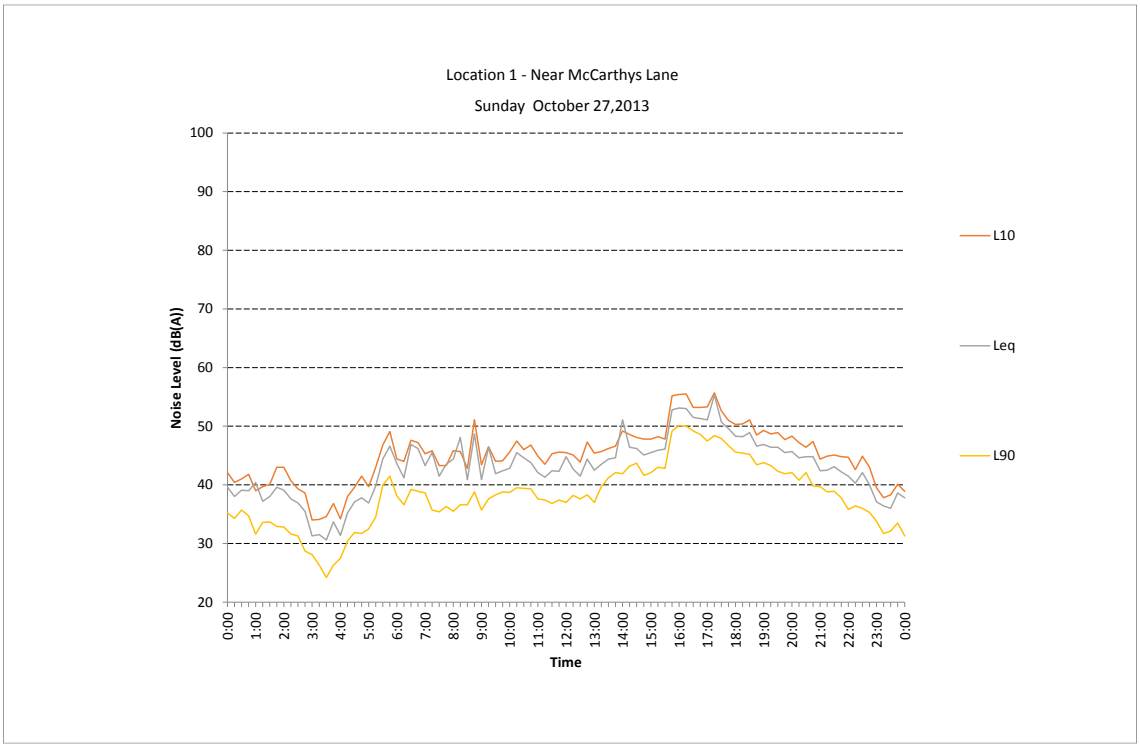
A noise barrier along the north eastern boundary of the site is an option, but is not considered necessary or practical, as the only criterion that is exceeded is sleep disturbance, which is largely caused by truck exhausts that are located high off the ground. This would greatly reduce the effective height of the barrier and do little to reduce the maximum noise levels caused by truck pass-bys.

Providing care and attention to noise impact is considered during the design of the building, including materials and acoustic space planning the internal noise criteria is expected to be met.

7. Appendix A – Unattended Noise Measurements

7.1. Location 1 – Near McCarthy's Lane






Location 1 - Near McCarthys Lane
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Noise Level (dB(A))
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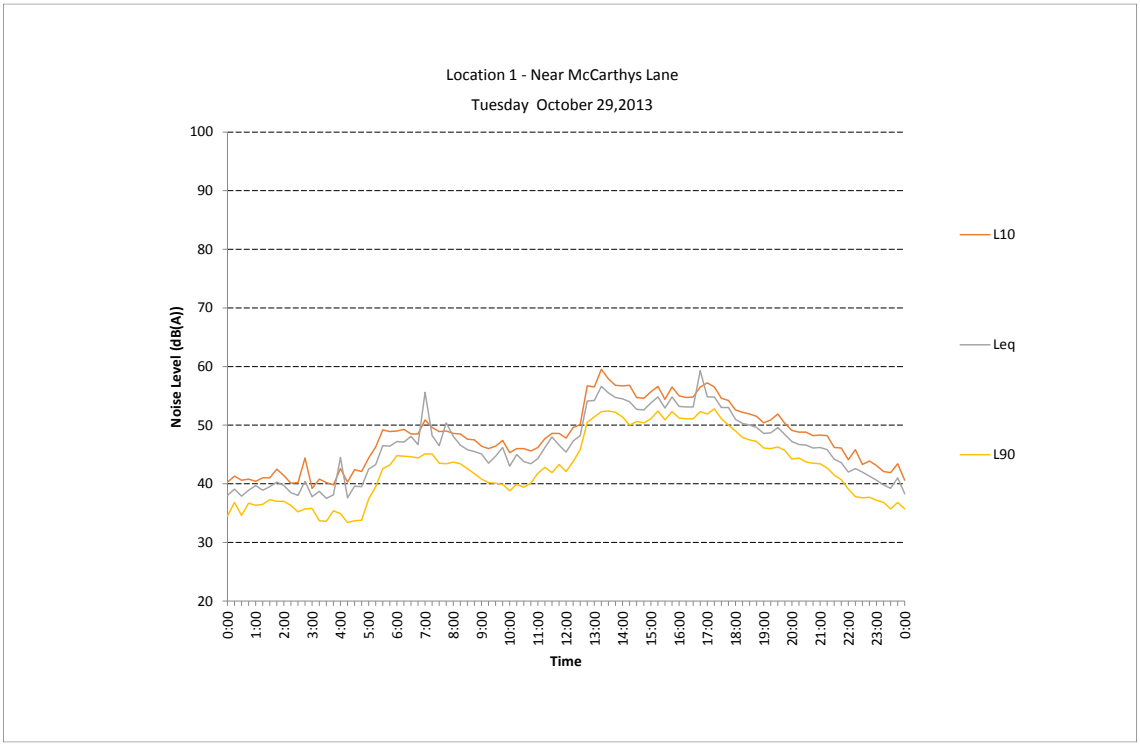
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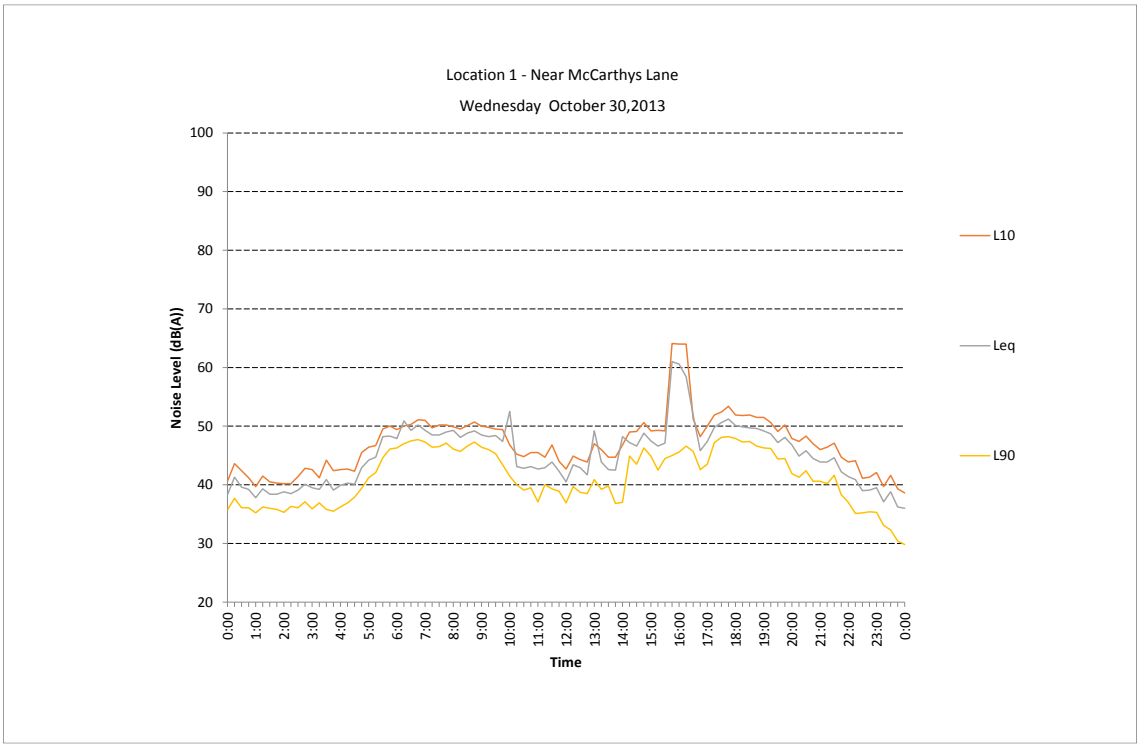
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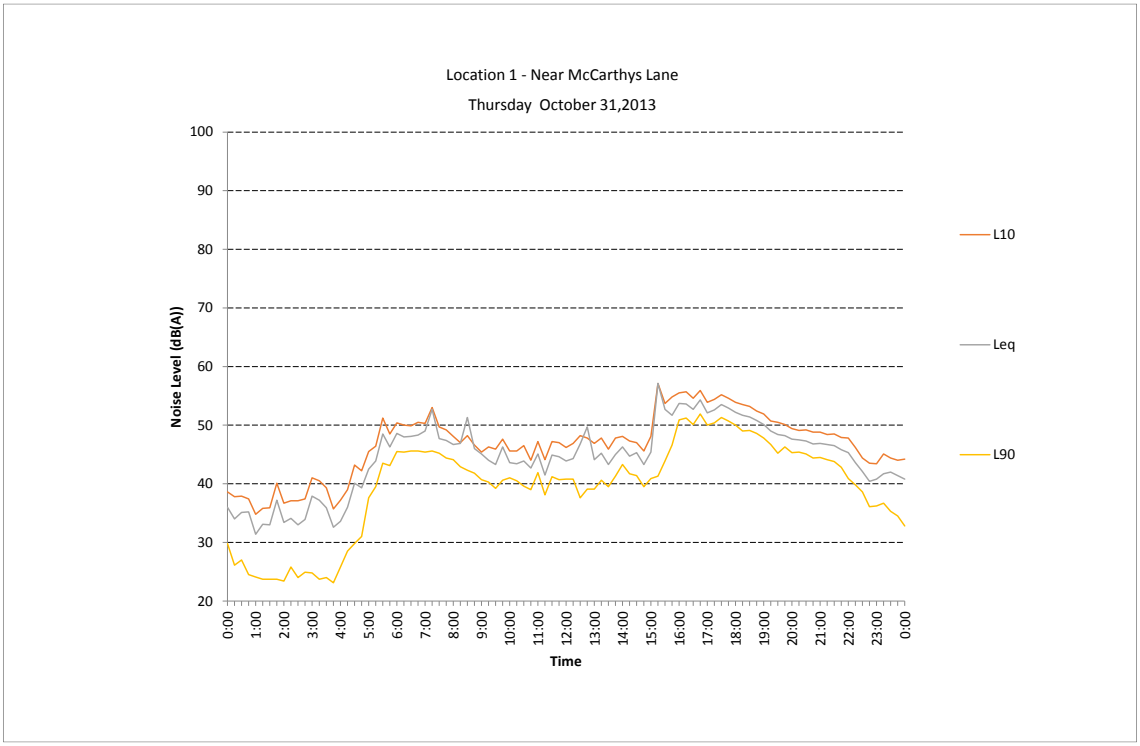
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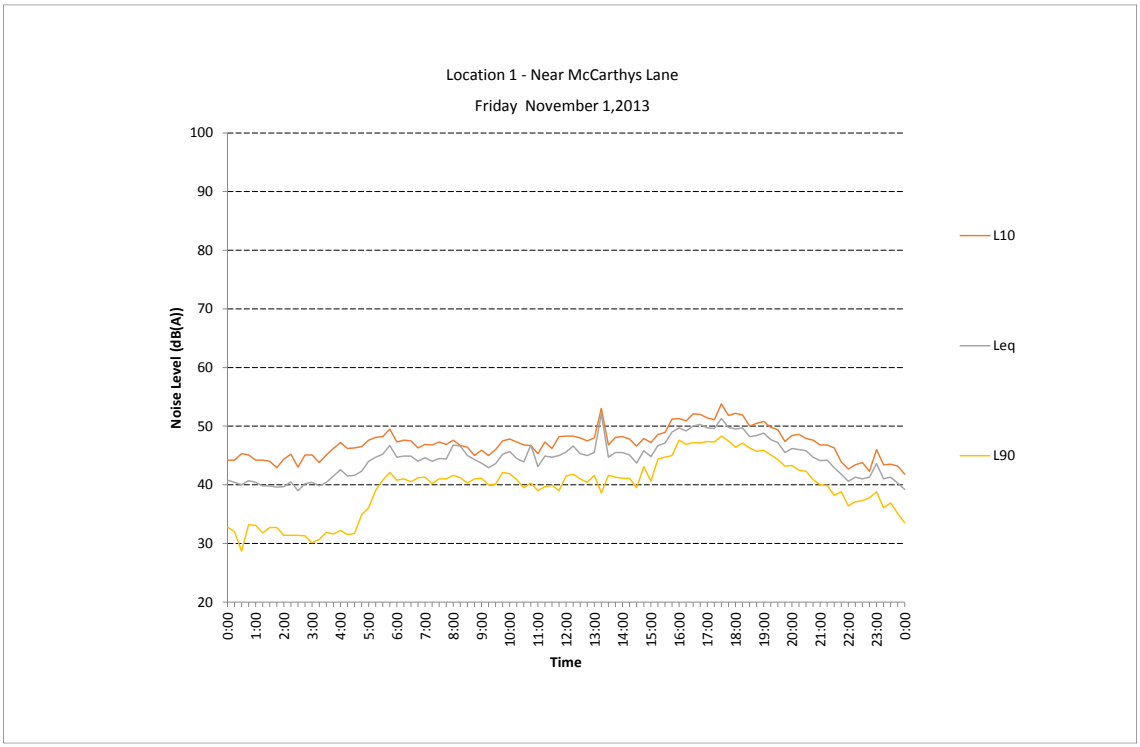
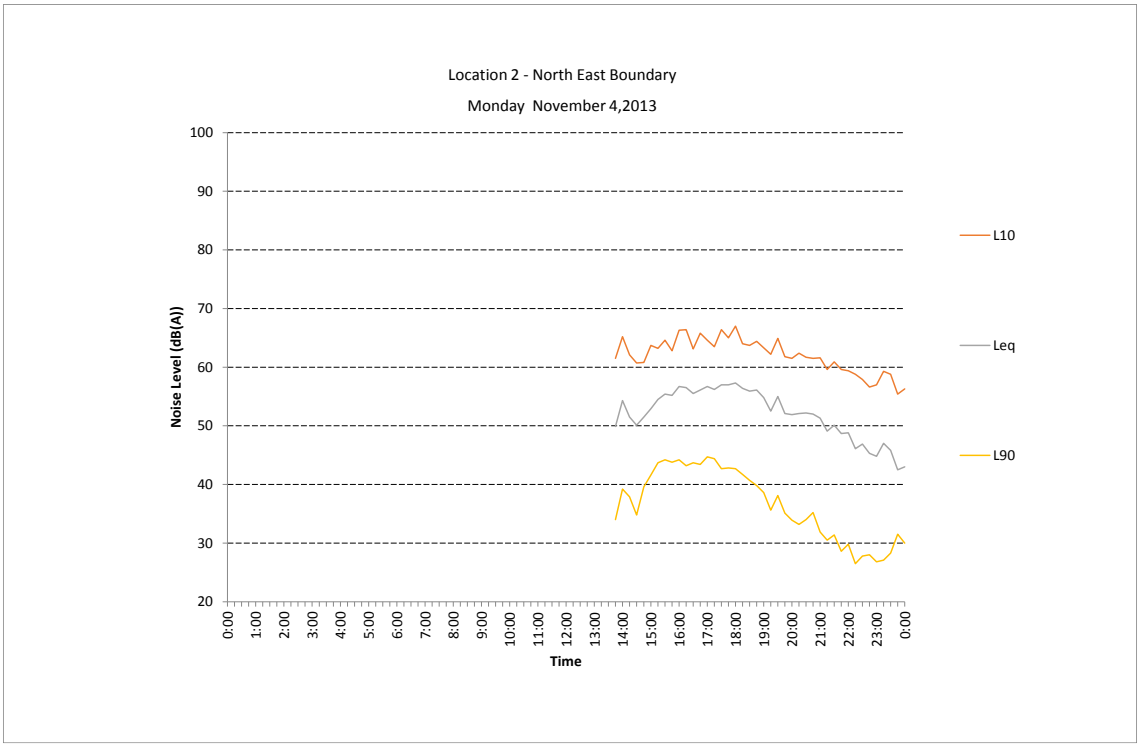
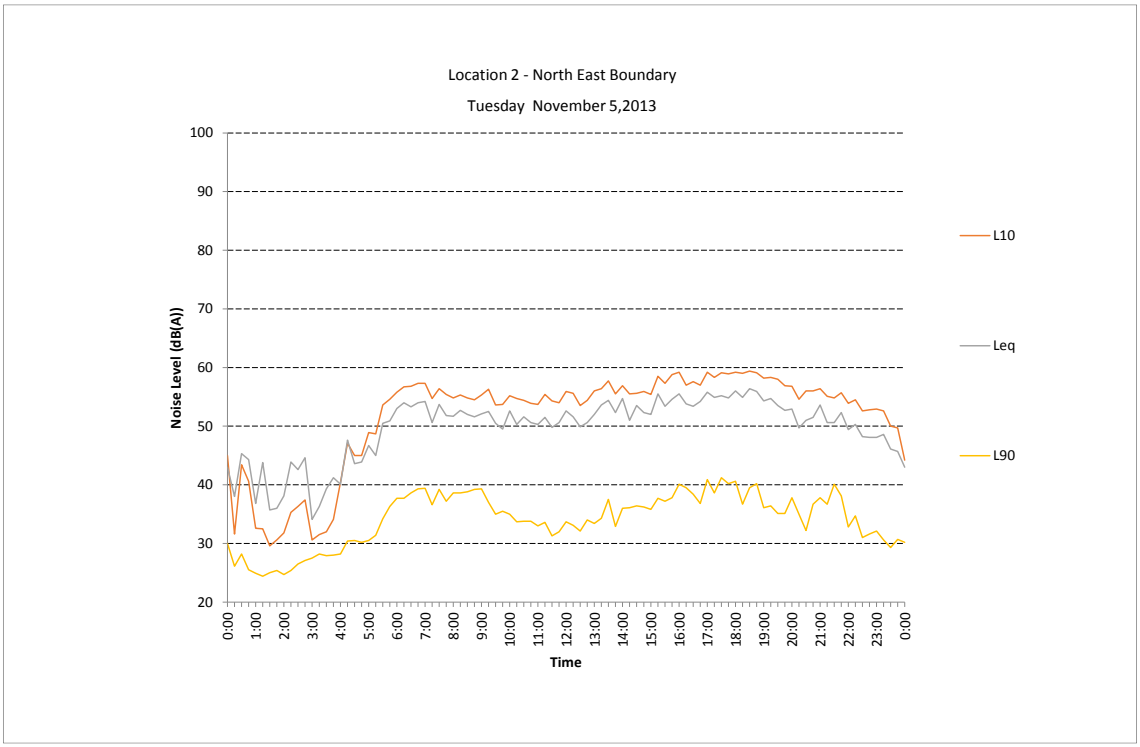


7.2. Location 2 – North East Boundary

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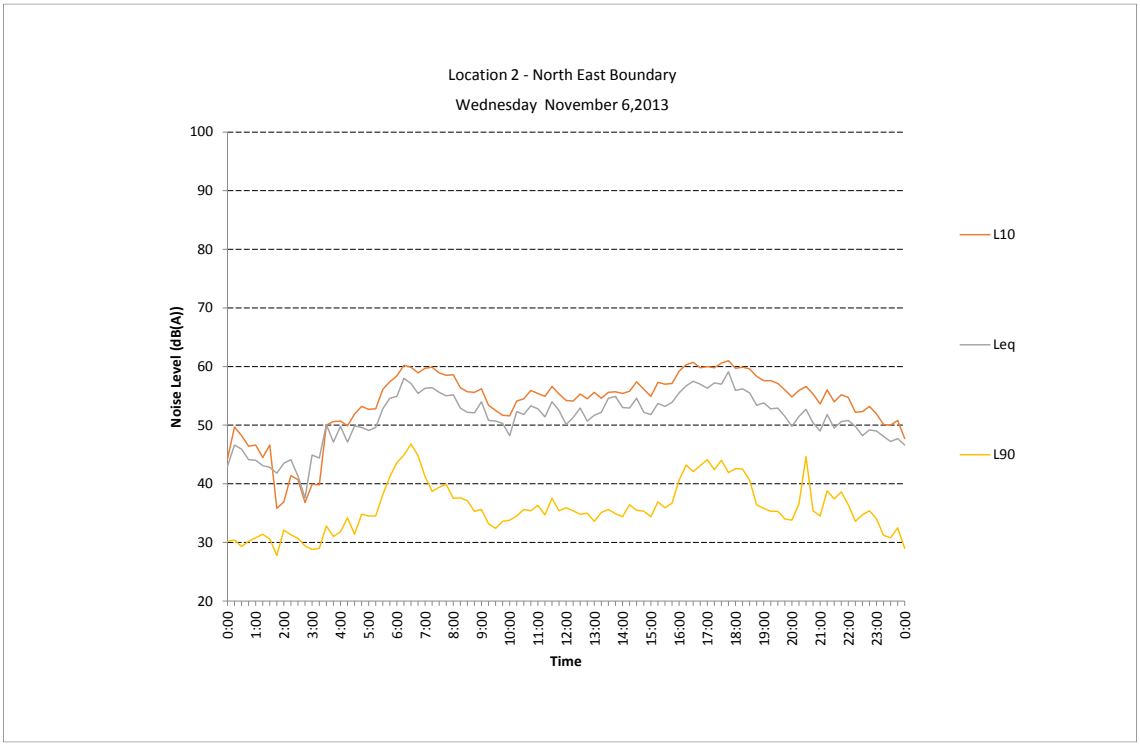
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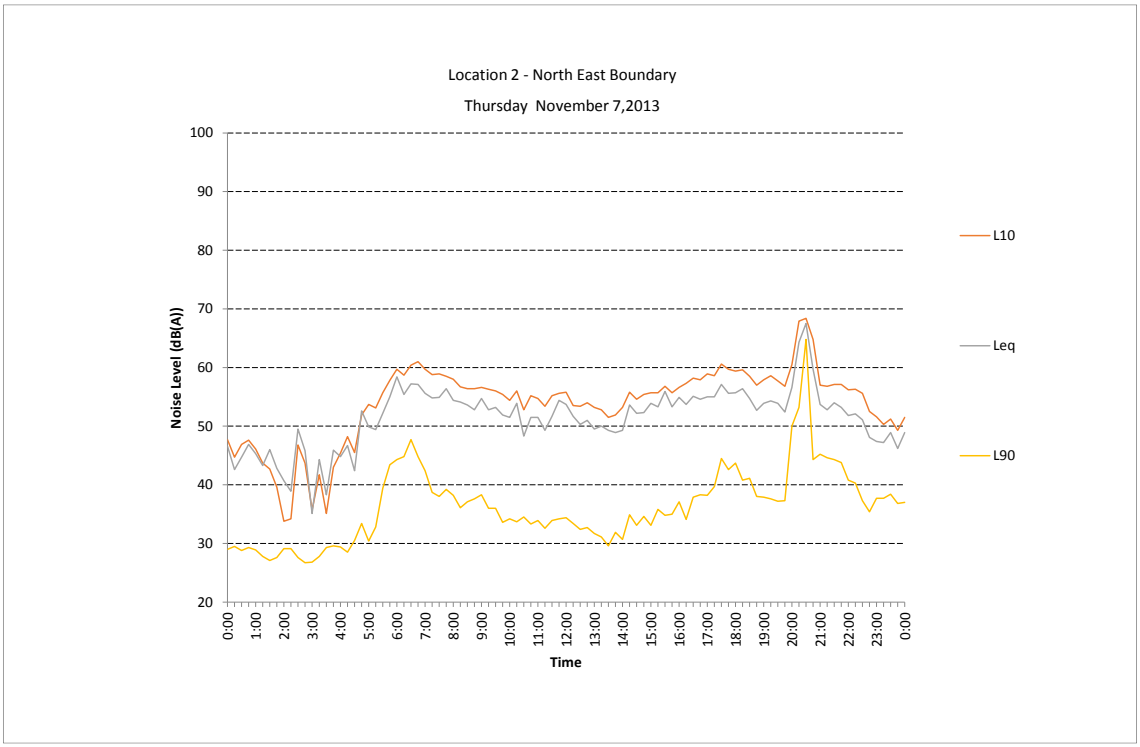
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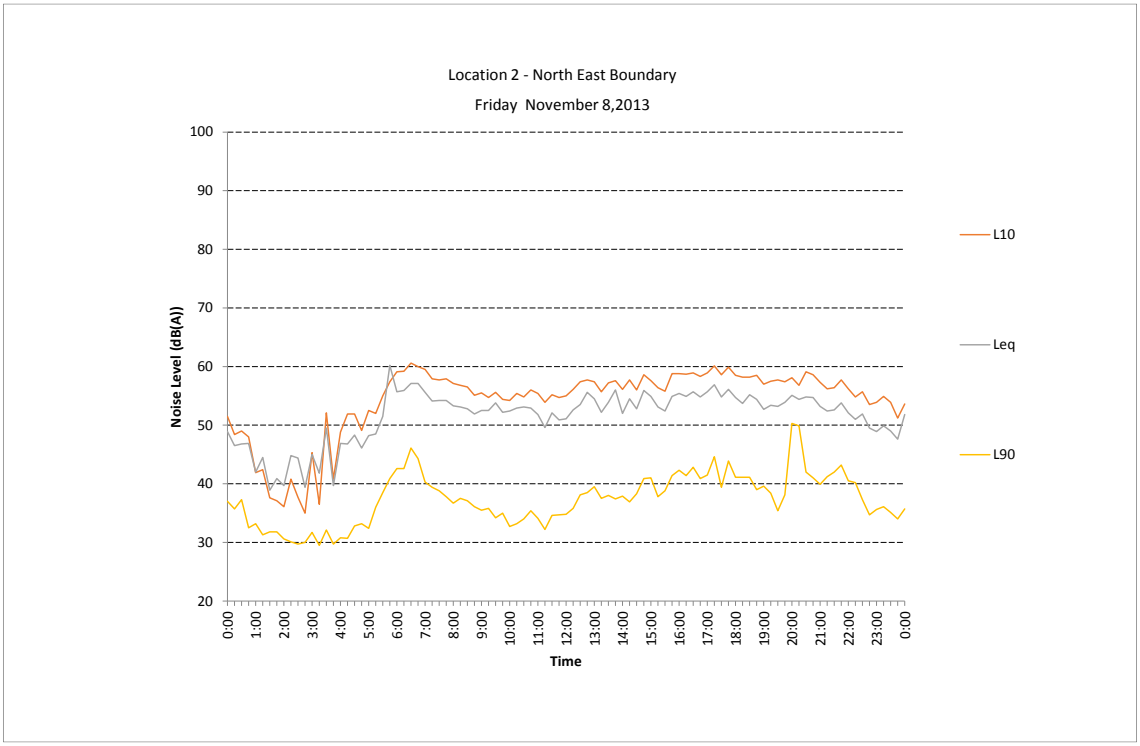
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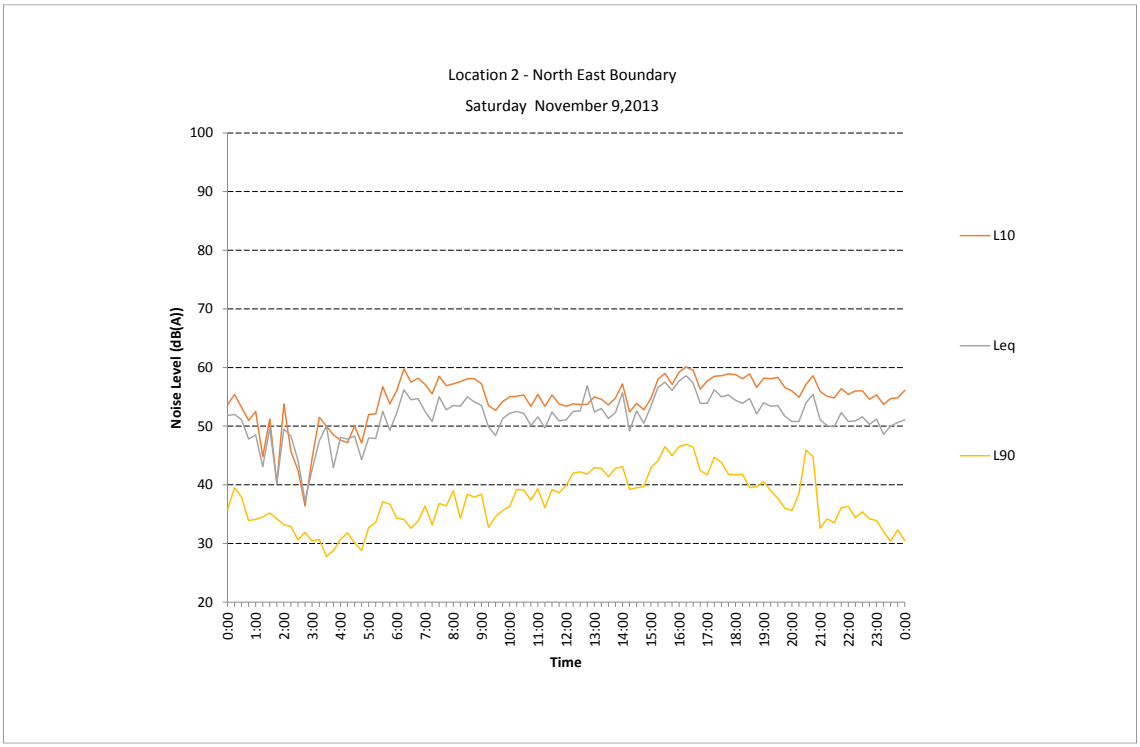
Time
L10
Leq
L90


Location 2 - North East Boundary
Saturday November 9,2013
Noise Level (dB(A))
100
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
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21:00
22:00
23:00
0:00
Time
L10
Leq
L90


Location 2 - North East Boundary
Sunday November 10,2013
Noise Level (dB(A))
100
90
80
70
60
50
40
30
20
0:00
1:00
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4:00
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Time
L10
Leq
L90

8. Appendix 2 – Acoustic Glossary

DECIBEL

The ratio of sound pressures which we can hear is a ratio of 10^6 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (L_p) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

dB(A)

The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dB(A). An A-weighting network can be built into a sound level measuring instrument such that sound levels in dB(A) can be read directly from a meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. It is worth noting that an increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise, and a change of 2 to 3 dB is subjectively barely perceptible.

EQUIVALENT CONTINUOUS SOUND LEVEL (L_{eq})

Another index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

FREQUENCY

The rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted kHz, eg 2 kHz = 2000 Hz. Human hearing ranges approximately from 20 Hz to 20 kHz. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.

MAXIMUM NOISE LEVELS (L_{max})

The maximum noise level identified during a measurement period. Experimented data has shown that the human ear does not generally register the full loudness of transient sound events of less than 125 ms. Fast time weighting has an exponential time constant of 125 ms which reflects the ear's response. The maximum level measured with fast time weighting is denoted as $L_{AMax, f}$. Slow time weighting (S) with an exponential time constant of 1s is used to allow more accurate estimation of the average sound level on a visual display.

Impulse (I) time weighting has a fast rise (35 ms) and a slow decay and is intended to mimic the ear's response to impulsive sounds.

STATISTICAL NOISE LEVELS

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L10, the level exceeded for ten per cent of the time period under consideration, has been adopted in this country for the assessment of road traffic noise. The L90, the level exceeded for ninety per cent of the time, has been adopted to represent the background noise level. The L1, the level exceeded for one per cent of the time, is representative of the maximum levels recorded during the sample period. A weighted statistical noise levels are denoted LA10, dBLA90 etc. The reference time period (T) is normally included, eg dBLA10, 5min or dBLA90, 8hr.

TYPICAL LEVELS

Some typical noise levels are given below:

Noise Level dB(A)	Example
130	Threshold of pain
120	Jet aircraft take-off at 100 m
110	Chain saw at 1 m
100	Inside disco
90	Heavy lorries at 5 m
80	Kerbside of busy street
70	Loud radio (in typical domestic room)
60	Office or restaurant
50	Domestic fan heater at 1m
40	Living room
30	Theatre
20	Remote countryside on still night
10	Sound insulated test chamber
0	Threshold of hearing