RODNEY STEVENS ACOUSTICS
Acoustic Consultants
Member Australian Acoustical Society

Proposed Mixed Development

449 Victoria Street, Wetherill Park NSW 2164

Noise Impact Assessment

REPORT R160498R1

Revision 0

Prepared for:

Mr. Simon Ochudzawa

C/- JS Architects

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28 November 2016

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Noise Impact Assessment

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DOCUMENT CONTROL

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1 INTRODUCTION

Rodney Stevens Acoustics Pty Ltd (RSA) has been engaged by JS Architects to prepare a Noise Assessment for the proposed mixed development at 449 Victoria Street, Wetherill Park NSW.

JS Architects requires a statement addressing the following:

- Road noise intrusion into the development from Victoria Street
- Proposed Service Station noise intrusion into the development
- Construction noise and vibration management plan

Where required in-principle design advice to achieve the requirements of acoustic amenity within the motel will also be presented in this report.

Specific acoustic terminology is used in this report. An explanation of common acoustic terms is provided in Appendix C.

2 PROJECT OVERVIEW

2.1 Proposed Development

The proposed development is located at 449 Victoria Street, Wetherill Park.

The proposal is the construction of a six mixed use developments comprising retail and commercial tenancies on the ground floor, two levels of above ground car park and three levels of motel accommodation above consisting of 155 rooms.

The project area and its surrounding environment are presented in Figure 2-1 below.

Figure 2-1 Project Area and Surrounding Environment

Aerial image courtesy of © 2016 nearmap ltd

The proposed site layouts of the proposed development site are presented in Figure 2-2 to Figure 2-4.

Figure 2-2 Levels 1-5 Floor Plan

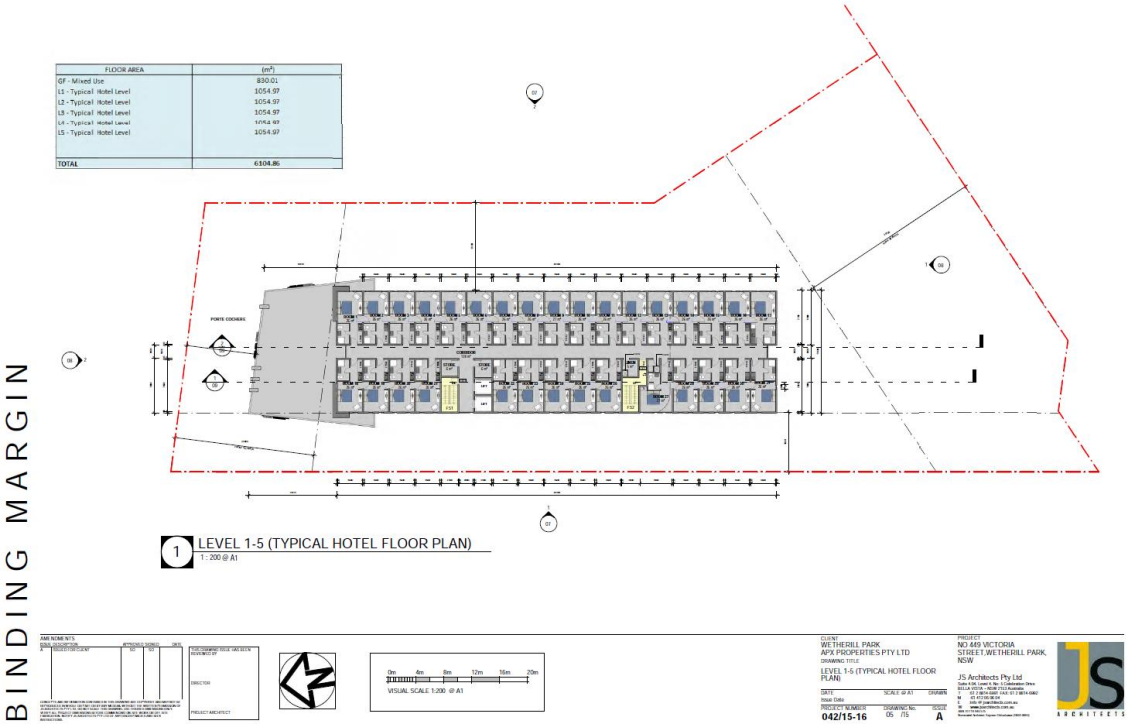


Figure 2-3 East & West Elevation

Figure 2-4 North & South Elevation

3 EXISTING NOISE ENVIRONMENT

Unattended noise monitoring for the proposed development was carried out between 18 November and 22 November 2016 at locations shown in Figure 2-1.

The locations were selected after a detailed inspection of the project area giving consideration to other noise sources that may influence the readings, the proximity of noise-sensitive receivers and security issues for the noise monitoring device and gaining permission for access from the residents or landowners. The results of the ambient noise monitoring are shown in Table 3-1.

Instrumentation for the survey comprised of 2 RION NL-42 Environmental Noise Loggers (serial numbers 410151 and 345934) fitted with microphone windshields. Calibration of the logger was checked prior to and following measurements. Drift in calibration did not exceed ±0.5 dBA. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

From the measured noise levels, the results have been summarised and presented in Table 3-1 and Table 3-2. These results represent the external noise exposure to the proposed development site. The monitored baseline noise levels are detailed in Table 3-1 and Table 3-2.

Table 3-1 Traffic Noise Levels Corresponding to Defined SEPP 2007 Periods

Location	Measurement Descriptor	Measured Noise Level – dBA re 20 µPa	
		Daytime 7.00 am – 10.00 pm	Night-time 10.00 pm – 7.00 am
Location 1	L_{Aeq}[1]	67	61
	RBL (Background)[2]	58	52
Location 2	L_{Aeq}[1]	62	56
	RBL (Background)[2]	54	49

Note 1: The LAeq is essentially the average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.
Note 2: The RBL noise level is representative of the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

Table 3-2 Measured Baseline Noise Levels Corresponding to Defined INP Periods

Location	Measurement Descriptor	Measured Noise Level – dB(A) re 20 µPa		
		Daytime 7 am - 6 pm	Evening 6 pm – 10 pm	Night-time 10 pm – 7 am
Location 1	L_{Aeq}	67	62	61
	RBL (Background)	58	50	52
Location 2	L_{Aeq}	62	60	56
	RBL (Background)	54	53	49

Notes: All values expressed as dB(A) and rounded to nearest 1 dB(A);
L_{Aeq} Equivalent continuous (energy average) A-weighted sound pressure level. It is defined as the steady sound level that contains the same amount of acoustic energy as the corresponding time-varying sound.
L_{A90} Noise level present for 90% of time (background level). The average minimum background sound level (in the absence of the source under consideration)

4 ASSESSMENT CRITERIA

4.1 Road Traffic Noise Assessment Criteria

The road traffic noise intrusion into the motel component of the development will be assessed to the assessment criteria for residential spaces. This is to ensure a stringent noise assessment from the nearby Victoria Road and the operation of nearby industrial area.

Residential Buildings require a statement addressing “AS 3671 Road Traffic Noise Intrusion Guidelines”. Clause 3.23 requires dwellings adjoining arterial roads to be designed “to acceptable internal noise level, based on AS 3671 Road Traffic Noise Intrusion Guidelines”. Australian Standard 3671:1989 “Acoustics – Road traffic noise intrusion Building siting and construction” provides the guidelines for determining the type of building construction necessary to achieve the acceptable indoor noise levels, as recommended by

Australian/New Zealand Standard "2107:2000 Acoustics - Recommended design sound levels and reverberation times for building interiors".

AS/NZS 2107:2000 is primarily concerned with establishing internal noise levels for relatively steady noise sources, such as air conditioning plant and continuous road traffic noise. Table 4-1 provides a summary of recommended noise levels for residential buildings near "major" roads given in AS/NZS 2107:2000. The guideline lower and upper range of the noise levels are described as "satisfactory" and "maximum" respectively.

Table 4-1 AS/NZS 2107:2000 Recommended Design Sound Levels for Residential Spaces

Type of Occupancy/Activity	Recommended Design Sound Level LAeq dBA re 20 µPa	
	Satisfactory	Maximum
Houses and apartments near major roads		
Living areas	35 dBA	45 dBA
Sleeping areas	30 dBA	40 dBA
Work areas	35 dBA	45 dBA

SEPP (Infrastructure) 2007 was introduced to assist the delivery of necessary infrastructure by improving regulatory certainty and efficiency. The Infrastructure SEPP has specific planning provisions and development controls for various types of infrastructure and to development adjacent to infrastructure.

Clause 102 includes provisions to ensure that noise sensitive development proposed adjacent to road corridors which carry considerable traffic volumes are not adversely affected by road noise. The clause applies to development adjacent to roads with an annual average daily traffic volume (AADT) of more than 40, 000 vehicles (based on the traffic volume data published on the website of Roads & Marine Services (RMS)), and that the consent authority considers likely to be adversely affected by road noise. Where residential development is proposed, appropriate measures must be taken to ensure that the following internal noise levels are met:

- The L_{Aeq} noise level between the hours of 10.00 pm and 7.00 am shall not exceed 35 dB(A) with a bedroom, and
- The L_{Aeq} noise level within any other habitable room (excluding a garage, kitchen, bathroom or hallway) shall not exceed 40 dB(A) at any time.

5 NOISE ASSESSMENT

5.1 Road Traffic Noise Intrusion

This assessment predicts road traffic noise intrusion primarily from Victoria Street, Newton Road and the operation of the nearby commercial operations in the internal spaces.

Standard window glazing of a building will typically attenuate these noise levels by 20 dB(A) with windows closed and 10 dB(A) with windows open (allowing for natural ventilation). The predicted internal noise levels of the proposed motel development are presented in Table 5-1 for the windows open and windows closed scenarios. Standard window system (4 mm thick glass with aluminium frame) has been assumed for this prediction.

Table 5-1 Predicted Internal Noise Levels

Type of Occupancy	Descriptor	Internal Noise Level		Noise Criteria
		Windows Open	Windows Closed	
Motel Rooms on Northern Façade (Victoria Street)				
Living Areas (Daytime)	$L_{Aeq,15hour}$	57 dB(A)	47 dB(A)	40 dB(A)
Living Areas (Night time)	$L_{Aeq,9hour}$	51 dB(A)	41 dB(A)	40 dB(A)
Sleeping Areas (Night time)	$L_{Aeq,9hour}$	51 dB(A)	41 dB(A)	35 dB(A)
Motel Rooms on the Western Façade (facing adjacent industrial complex)				
Living Areas (Daytime)	$L_{Aeq,15hour}$	42 dB(A)	32 dB(A)	40 dB(A)
Living Areas (Night time)	$L_{Aeq,9hour}$	46 dB(A)	36 dB(A)	40 dB(A)
Sleeping Areas (Night time)	$L_{Aeq,9hour}$	46 dB(A)	36 dB(A)	35 dB(A)

The predicted internal noise levels indicate that external noise on the proposed motel will potentially exceed the noise criteria with windows opened and closed for the motel rooms facing Victoria Street and nearby industrial complex.

5.2 Service Station Impact Assessment

It is understood that a 24hour service station is proposed adjacent to the proposed development site. As the service station will operate on a 24hour basis, the cumulative noise emissions would potentially have a negative impact on the acoustic amenity of the guests of the motel. At this stage of the service station development, the plans, traffic management and operational plan hasn't been finalised.

In order to assess the impact to the motel from the service station, a generic approach to the noise impact was conducted. Rodney Stevens Acoustics has previously conducted a noise impact study on various 24hour service station developments. A typical 24hour service station has the following dominant noise sources:

- Operation of light vehicles including cars, light trucks and motorcycles including vehicle starting, doors opening/closing, engine idling and vehicle movements. Approximately 15 light vehicle movements per hour.

- Operation of heavy trucks including truck starting, engine idling, truck reversing (including reverse alarms) and truck movement. Approximately 3 heavy truck movements per hour.

- Operation of mechanical plants including cooling towers, compressors and pumps

A cumulative noise level of $L_{Aeq(15min)}$ 86 dBA at 10m from a typical service station has been previously calculated. The proposed service is approximately 100m from the nearest façade of the motel development. A noise level of $L_{Aeq(15min)}$ 66 dBA from 1m from the façade window at most times has been applied. The predicted noise level from the proposed service station is similar to the current noise levels from the road traffic and the operation of the nearby industrial complex.

It is in the opinion of Rodney Stevens Acoustics that the operation of the proposed service station will not have an adverse impact on the acoustic amenity of the guests staying at the motel.

6 RECOMMENDATIONS

6.1 Window Glazing Requirement

Based on the above predicted road traffic noise impact the following noise control measures are recommended for the motel rooms:

- Where glazed windows and doors on facades of the motel development require to be closed to meet internal noise levels, alternative ventilation methods which meet the ventilation requirements of the BCA and Australian Standard AS 1668.2:2002 will be required and design input should be sought from an appropriately qualified mechanical services consultant.

Based on the predicted internal noise levels, glazed windows and doors certain facades of the development should have the following minimum Rw rating as indicated in Table 6-1 below.

Table 6-1 In-principle Glazing Recommendations

Location	Glazing Type	Minimum Glazing Rw Rating	Indicative Glazing System
Northern façade Levels 1-3 (Victoria Street)			
Living Rooms	Sliding Door	Rw 35	7.52mm laminated glass with acoustically sealed frame*
	Sliding Window	Rw 35	7.52mm laminated glass with acoustically sealed frame*
Bedrooms	Sliding Door	Rw 35	7.52mm laminated glass with acoustically sealed frame*
	Sliding Window	Rw 35	7.52mm laminated glass with acoustically sealed frame*
Northern façade Levels 4-5 (Victoria Street)			

Living Rooms	Sliding Door	Rw 37	10.38mm laminated glass with acoustically sealed frame*
	Sliding Window	Rw 37	10.38mm laminated glass with acoustically sealed frame*
Bedrooms	Sliding Door	Rw 37	10.38mm laminated glass with acoustically sealed frame*
	Sliding Window	Rw 37	10.38mm laminated glass with acoustically sealed frame*
Western and Southern façade Levels 1-3			
Living Rooms	Sliding Door	Rw 30	6.38mm laminated glass with acoustically sealed frame*
	Sliding Window	Rw 30	6.38mm laminated glass with acoustically sealed frame*
Bedrooms	Sliding Door	Rw 30	6.38mm laminated glass with acoustically sealed frame*
	Sliding Window	Rw 30	6.38mm laminated glass with acoustically sealed frame*
Western and Southern façade Levels 4-5			
Living Rooms	Sliding Door	Rw 35	7.52mm laminated glass with acoustically sealed frame*
	Sliding Window	Rw 35	7.52mm laminated glass with acoustically sealed frame*
Bedrooms	Sliding Door	Rw 35	7.52mm laminated glass with acoustically sealed frame*
	Sliding Window	Rw 35	7.52mm laminated glass with acoustically sealed frame*
Eastern façade Levels 1-5			

Living Rooms	Sliding Door	Rw 32	6.38mm laminated glass with acoustically sealed frame*
	Sliding Window	Rw 32	6.38mm laminated glass with acoustically sealed frame*
Bedrooms	Sliding Door	Rw 32	6.38mm laminated glass with acoustically sealed frame*
	Sliding Window	Rw 32	6.38mm laminated glass with acoustically sealed frame*

Note *: glazing system are for reference only. Any glazing system to be installed for the development is to achieve the minimum Rw rating indicated above.

Please note Rw ratings provided in Table 6-1 rely on the acoustic performance of the window glazing and frame. Rw ratings should be checked with glazing manufacturers and frames should be selected and installed as to not degrade the performance of the glazing. It is also recommended that glazing specifications are reviewed at the detailed design stage, most notably if changes to the glazing area are made throughout the design.

7 CONSTRUCTION NOISE & VIBRATION MANAGEMENT PLAN

7.1 Construction Noise and Vibration Criteria

7.1.1 Construction Noise

Noise criteria for construction works are established in accordance with the EPA *Interim Construction Noise Guidelines* (ICNG).

All construction works are to be undertaken during daytime core hours of 7 am–6 pm Monday to Friday and 8 am-1 pm Saturdays. No construction works are anticipated to be required outside of the standard daytime standard construction hours unless otherwise approved.

The ICNG provides recommended construction (airborne) noise management levels for residential receivers as detailed in Table 7-1.

Site specific noise management levels (NML) have been established adopting the background noise levels (L_{A90}) measured within the project site.

The noise management levels are design as a trigger for the project to investigate feasible and reasonable noise management and mitigation measures to reduce noise impacts at nearest noise affected receivers.

Table 7-1 Recommended Residential Construction Noise Criteria

Time of construction	Noise Management level $L_{Aeq, 15min}$	Adopted noise NML $L_{Aeq, 15min}$ at neighbouring residences
Standard construction hours Monday to Friday 7 am – 6 pm Saturday 8 am-1 pm No work on Sundays or public holidays	Noise affected receivers RBL + 10 dB(A)	64 dB(A)

Note: RBL rating background level, the measured L_{A90} noise level.

As construction works for the proposed development will only be carried out during the daytime period a standard daytime construction noise management level for the neighbouring residential receivers of 64 dB(A) $L_{Aeq, 15min}$ has been adopted in accordance with the ICNG. NMLs for the evening and night periods are not applicable to this assessment.

There are no noise sensitive receivers such as schools, hospitals or places of worship that have been identified within the study area.

A 70 dB(A) $L_{Aeq,15min}$ highly noise affected construction noise management level will be applied as a trigger for the application of additional construction noise controls such as respite periods or restriction of construction hours of operation. This trigger would apply to noise impacts on residential receivers only.

The recommended noise management levels are planning goals only. Factors such as the social benefits of the activity, economic constraints, and the nature and duration of the proposed construction program need to be considered when assessing potential noise impacts from construction works.

7.1.2 Construction Vibration

Vibration during construction works is considered an intermittent source associated with two main types of impact; disturbance at receivers and potential architectural/structural damage to buildings. Generally, if disturbance issues are controlled, there is limited potential for structural damage to buildings.

Detailed in Table 7-2, the ICNG guidance adopts the *Environmental Noise Management Assessing Vibration: a technical guideline* (2006) for the assessment of human annoyance due to construction vibration. German Standard DIN 4150: Part 3-1999, provides guidelines for evaluating the effects of vibration on structures.

Dependent upon the dominant frequency of vibration, assessed in Hertz (Hz), structural vibration limits are established at the foundation of nearest buildings.

Table 7-2 Adopted Vibration Constriction Criteria

Receiver	Annoyance VDV criteria, $m/s^{1.75}$		Structural PPV criteria, mm/s
	Preferred	Maximum	
Residential	0.2	0.4	5 - 20

Notes: Structural vibration goals established for < 10 – 100 Hz dominant frequency of vibration.
VDV = vibration dose value; PPV = peak particle velocity

7.2 Noise & Vibration Intensive Works

7.2.1 Construction Noise

The basis for the project-specific construction airborne noise goals for approved daytime hours is shown in Table 7-1**.**

Where the noise goals shown in Table 7-1 cannot be achieved, the construction contractor will use all reasonable and feasible noise mitigation and management measures to reduce noise generation and impacts.

7.2.2 Construction Vibration

The construction contractor will, if required, ensure compliance with the criteria.

It is anticipated that there will be minimal Construction Vibration within this development.

7.2.3 Typical Plant & Equipment Sound Pressure Levels

Sound pressure levels for typical items of plant are listed in Table 7-3. These noise levels are representative of modern plant operating with noise control measures in good condition.

Table 7-3 Noise Levels of Typical Construction Plant & Equipment

Item	Typical Plant Type	Typical L_{Aeq} Noise Level at 15 metres – dB(A)
Excavator	5 to 8 tonne	75
Bob Cat		71
Tip trucker		72
Hand Tools: - saws, nail gun, drills, hammers		70
Concrete pump		75
Cement mixer		75
Crane		70
Kango		75

7.3 Noise & Vibration Mitigation Measures

7.3.1 Noise Control

The following noise mitigation measures will, if required, be implemented. The construction contractor will, where reasonable and feasible, apply best practice noise mitigation measures including:

- Maximising the offset distance between noisy plant items and nearby noise sensitive receivers.
- Avoiding the coincidence of noisy plant working simultaneously close together and adjacent to sensitive receivers.
- Minimising consecutive works in the same locality.
- Orienting equipment away from noise sensitive areas.
- Carrying out loading and unloading away from noise sensitive areas.

In order to minimise noise impacts during the works, the construction contractor will take all reasonable and feasible measures to mitigate noise effects.

The contractor will also take reasonable steps to control noise from all plant and equipment. Examples of appropriate noise control include efficient silencers and low noise mufflers.

Silenced air compressors, fitted with noise labels indicating a maximum (L_{Amax}) sound pressure level of not more than 75 dB(A) at 7 m will be used on site. The sound pressure level of noise emitted from a compressor used will comply with noise label requirements.

7.3.2 Vibration Control

The following vibration mitigation measures will be implemented by the construction contractor:

- Relocate any vibration generating plant and equipment to areas within the site in order to lower the vibration impacts.
- Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment.
- Use lower vibration generating items of excavation plant and equipment e.g. smaller capacity rockbreaker hammers.
- Minimise consecutive works in the same locality (if applicable).
- Schedule a minimum respite period of at least 1 hour before activities commence which are to be undertaken for a continuous four hour period. The respite period is to be between 12:00 pm to 1:00 pm prior to the 1:00 pm to 5:00 pm continuous four hour activity.

7.3.3 Summary of Mitigation Measures

The noise and vibration mitigation measures to be implemented by the construction contractor are listed in Table 7-4.

Table 7-4 Summary of Noise & Vibration Mitigation Measures

Item	Description
Construction Hours	Works will be carried out within the standard construction hours.
Deliveries	Deliveries will be carried out within the standard construction hours.
Site Layout	Where possible, plant and equipment will be located and orientated to direct noise away from sensitive receivers.
Quietest Suitable Equipment	Plant and equipment will be selected to minimise noise emission, where possible, whilst maintaining efficiency of function. Residential grade silencers will be fitted and all noise control equipment will be maintained in good order.
Hammer Equipment	Maximise hammer penetration (and reduce blows) by using sharp hammer tips. Keep stocks of sharp profiles at site, and monitor the profiles in use.
Reversing Alarms	Mobile plant and trucks operating on site for a significant portion of the project will have reversing alarm noise emissions minimised, where possible, recognising the need to maintain occupational safety standards.
PA System	No public address system will be used at this site.
Truck Noise (off site)	All trucks regularly used for the project are to have mufflers, and any other noise control equipment, maintained in good working order. Trucking routes will use main roads, where feasible.
Construction Hours	Works will be carried out within the standard construction hours.

7.4 Identifying and Managing Future Noise & Vibration Issues

If additional activities or plant are found to be necessary that will emit noise and/or vibration emissions significantly exceeding those assumed for this assessment, these will, if required, be assessed by the Acoustical Consultant on a case-by-case basis and appropriate mitigation measures will be implemented.

7.5 Complaint Handling

The construction contractor will adopt the following protocol for handling complaints. This protocol is intended to ensure that the issues are addressed and that appropriate corrective action is identified and implemented as necessary:

- The project manager will record all verbal and telephone complaints in writing and will forward all complaints to the contractor, together with details of the circumstance leading to the complaint and all subsequent actions.
- Complaints received by the contractor will, as an initial step, be referred to the project manager who will respond as described above.

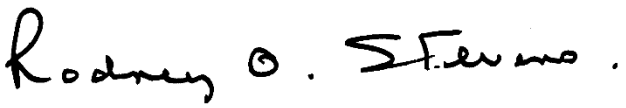
- The contractor will investigate the complaint in order to determine whether a criterion exceedance has occurred or whether noise and/or vibration have occurred unnecessarily.
- If excessive or unnecessary noise and/or vibration have been caused, corrective action will be planned and implemented by the project manager.
- Complainants will be informed by contractor that their complaints are being addressed, and (if appropriate) that corrective action is being taken.
- Complainants will be informed of the implementation of the corrective action that has been taken to mitigate the adverse effects

8 CONCLUSION

Rodney Stevens Acoustics has conducted Noise Assessment including Road Traffic Impact Assessment, and Construction Noise & Vibration Management Plan for the proposed mixed development site at 449 Victoria Street, Wetherill Park NSW.

The assessment has been conducted to satisfy State Environmental Planning Policy (Infrastructure) 2007 Clause 102 and local council regulation.

Approved:-



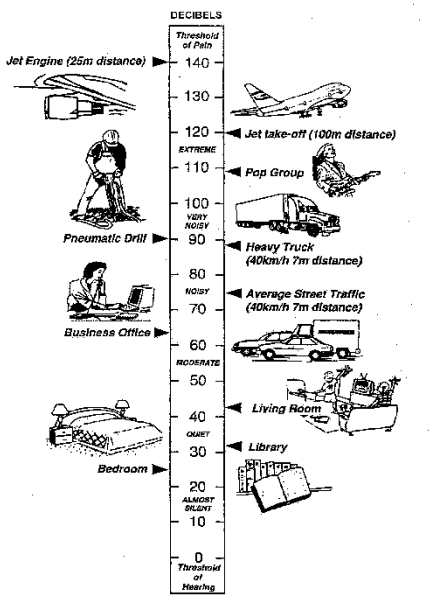
Rodney Stevens - MAAS

Appendix A – Acoustic Terminology

A-weighted sound pressure	The human ear is not equally sensitive to sound at different frequencies. People are more sensitive to sound in the range of 1 to 4 kHz (1000 – 4000 vibrations per second) and less sensitive to lower and higher frequency sound. During noise measurement an electronic '*A-weighting*' frequency filter is applied to the measured sound level *dB(A)* to account for these sensitivities. Other frequency weightings (B, C and D) are less commonly used. Sound measured without a filter is denoted as linear weighted dB(linear).
Ambient noise	The total noise in a given situation, inclusive of all noise source contributions in the near and far field.
Community annoyance	Includes noise annoyance due to: ▪ character of the noise (e.g. sound pressure level, tonality, impulsiveness, low-frequency content) ▪ character of the environment (e.g. very quiet suburban, suburban, urban, near industry) ▪ miscellaneous circumstances (e.g. noise avoidance possibilities, cognitive noise, unpleasant associations) ▪ human activity being interrupted (e.g. sleep, communicating, reading, working, listening to radio/TV, recreation).
Compliance	The process of checking that source noise levels meet with the noise limits in a statutory context.
Cumulative noise level	The total level of noise from all sources.
Extraneous noise	Noise resulting from activities that are not typical to the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.
Feasible and reasonable measures	Feasibility relates to engineering considerations and what is practical to build; reasonableness relates to the application of judgement in arriving at a decision, taking into account the following factors: ▪ Noise mitigation benefits (amount of noise reduction provided, number of people protected). ▪ Cost of mitigation (cost of mitigation versus benefit provided). ▪ Community views (aesthetic impacts and community wishes).

- Noise levels for affected land uses (existing and future levels, and changes in noise levels).

Impulsiveness	Impulsive noise is noise with a high peak of short duration or a sequence of these peaks. Impulsive noise is also considered annoying.
Low frequency	Noise containing major components in the low-frequency range (20 to 250 Hz) of the frequency spectrum.
Noise criteria	The general set of non-mandatory noise levels for protecting against intrusive noise (for example, background noise plus 5 dB) and loss of amenity (e.g. noise levels for various land use).
Noise level (goal)	A noise level that should be adopted for planning purposes as the highest acceptable noise level for the specific area, land use and time of day.
Noise limits	Enforceable noise levels that appear in conditions on consents and licences. The noise limits are based on achievable noise levels, which the proponent has predicted can be met during the environmental assessment. Exceedance of the noise limits can result in the requirement for either the development of noise management plans or legal action.
Performance-based goals	Goals specified in terms of the outcomes/performance to be achieved, but not in terms of the means of achieving them.
Rating Background Level (RBL)	The rating background level is the overall single figure background level representing each day, evening and night time period. The rating background level is the 10^{th} percentile min L_{A90} noise level measured over all day, evening and night time monitoring periods.
Receptor	The noise-sensitive land use at which noise from a development can be heard.
Sleep disturbance	Awakenings and disturbance of sleep stages.
Sound and decibels (dB)	Sound (or noise) is caused by minute changes in atmospheric pressure that are detected by the human ear. The ratio between the quietest noise audible and that which should cause permanent hearing damage is a million times the change in sound pressure. To simplify this range the sound pressures are logarithmically converted to decibels from a reference level of 2 x 10-5 Pa. The picture below indicates typical noise levels from common noise sources.



dB is the abbreviation for decibel – a unit of sound measurement. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure.

Sound Power Level (SWL)

The sound power level of a noise source is the sound energy emitted by the source. Notated as SWL, sound power levels are typically presented in *dB(A)*.

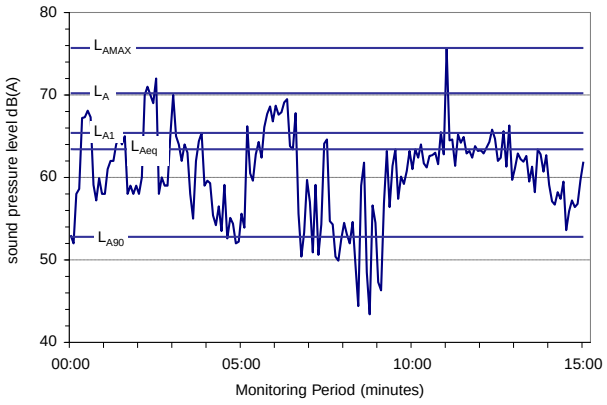
Sound Pressure Level (SPL)

The level of noise, usually expressed as SPL in *dB(A)*, as measured by a standard sound level meter with a pressure microphone. The sound pressure level in *dB(A)* gives a close indication of the subjective loudness of the noise.

Statistical noise levels

Noise levels varying over time (e.g. community noise, traffic noise, construction noise) are described in terms of the statistical exceedance level.

A hypothetical example of A weighted noise levels over a 15 minute measurement period is indicated in the following figure:



Key descriptor

- LAmax Maximum recorded noise level.

- L_{A1} The noise level exceeded for 1% of the 15 minute interval.
- L_{A10} Noise level present for 10% of the 15 minute interval. Commonly referred to the average maximum noise level.
- L_{Aeq} Equivalent continuous (energy average) A-weighted sound pressure level. It is defined as the steady sound level that contains the same amount of acoustic energy as the corresponding time-varying sound.
- L_{A90} Noise level exceeded for 90% of time (background level). The average minimum background sound level (in the absence of the source under consideration).

Threshold	The lowest sound pressure level that produces a detectable response (in an instrument/person).
Tonality	Tonal noise contains one or more prominent tones (and characterised by a distinct frequency components) and is considered more annoying. A 2 to 5 dBA penalty is typically applied to noise sources with tonal characteristics.

Appendix B – Calibration Certificates

Acoustic Research Labs Pty Ltd
Level 7 Building 2 423 Pennant Hills Rd
Pennant Hills NSW AUSTRALIA 2120
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter
IEC 61672-3.2006

Calibration Certificate

Calibration Number C15557

Client Details Rodney Stevens Acoustics Pty Ltd
1 Majura Close
St Ives Chase NSW 2075

Equipment Tested/ Model Number : Rion NL-42
Instrument Serial Number : 00810779
Microphone Serial Number : 148338
Pre-amplifier Serial Number : 22257

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	20.8°C	**Ambient Temperature :**	20.7°C
Relative Humidity :	51.4%	**Relative Humidity :**	51.4%
Barometric Pressure :	99.85kPa	**Barometric Pressure :**	99.81kPa

Calibration Technician : Dennis Kim
Calibration Date : 20/10/2015
Secondary Check: Kate Alchin
Report Issue Date : 20/10/2015

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10: Self-generated noise	*Pass*	14: Level linearity on the reference level range	*Pass*
11: Acoustical tests of a frequency weighting	*Pass*	15: Level linearity incl. the level range control	*Pass*
12: Electrical tests of frequency weightings	*Pass*	16: Toneburst response	*Pass*
13: Frequency and time weightings at 1 kHz	*Pass*	17: Peak C sound level	*Pass*
		18: Overload Indication	*Pass*

The sound level meter submitted for testing has successfully completed the class 2 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed.

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

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.120dB*	*Temperature*	*±0.3°C*
12.5kHz	*±0.165dB*	*Relative Humidity*	*±4.1%*
16kHz	*±0.245dB*	*Barometric Pressure*	*±0.1kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.121dB*		

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

NATA
WORLD RECOGNISED ACCREDITATION

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

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025.

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

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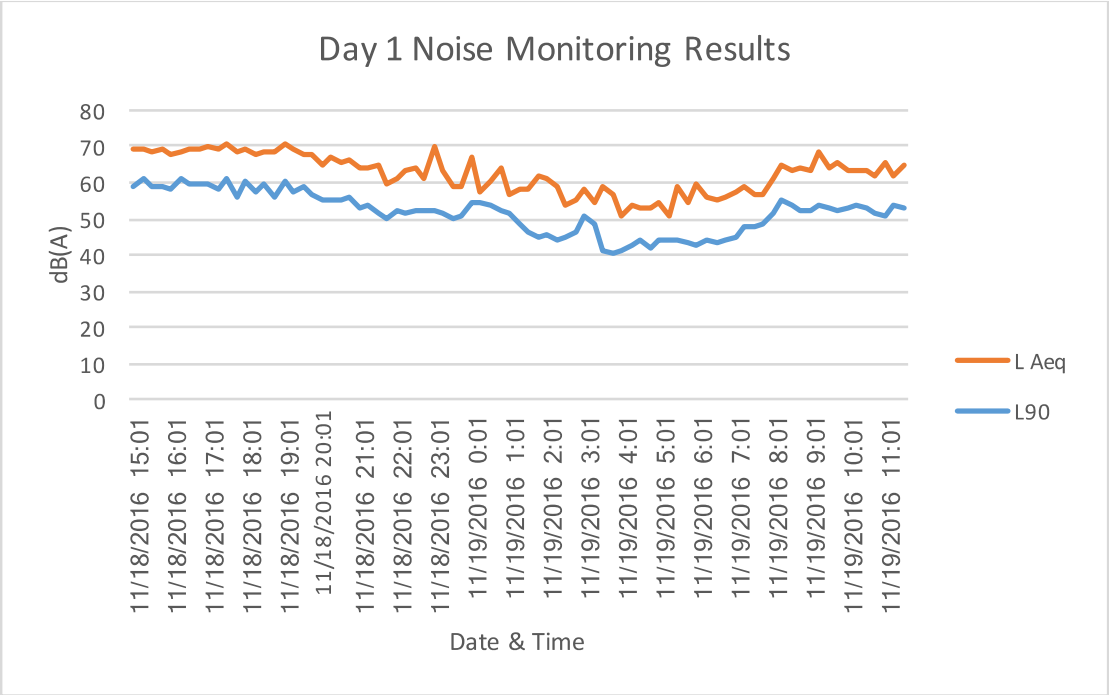
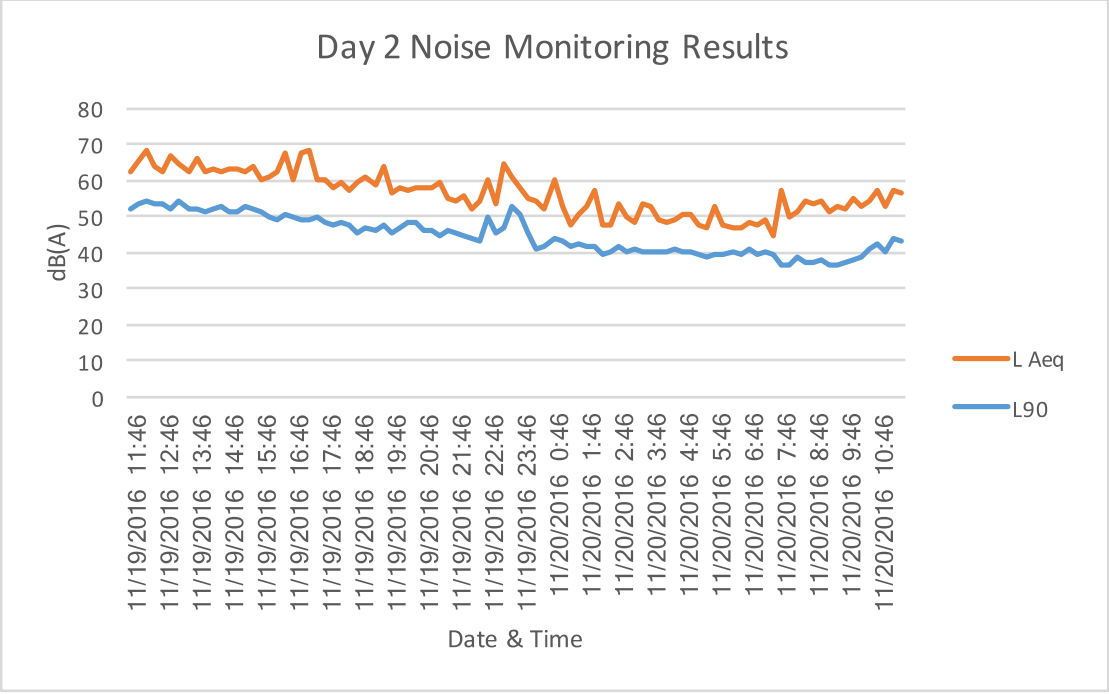
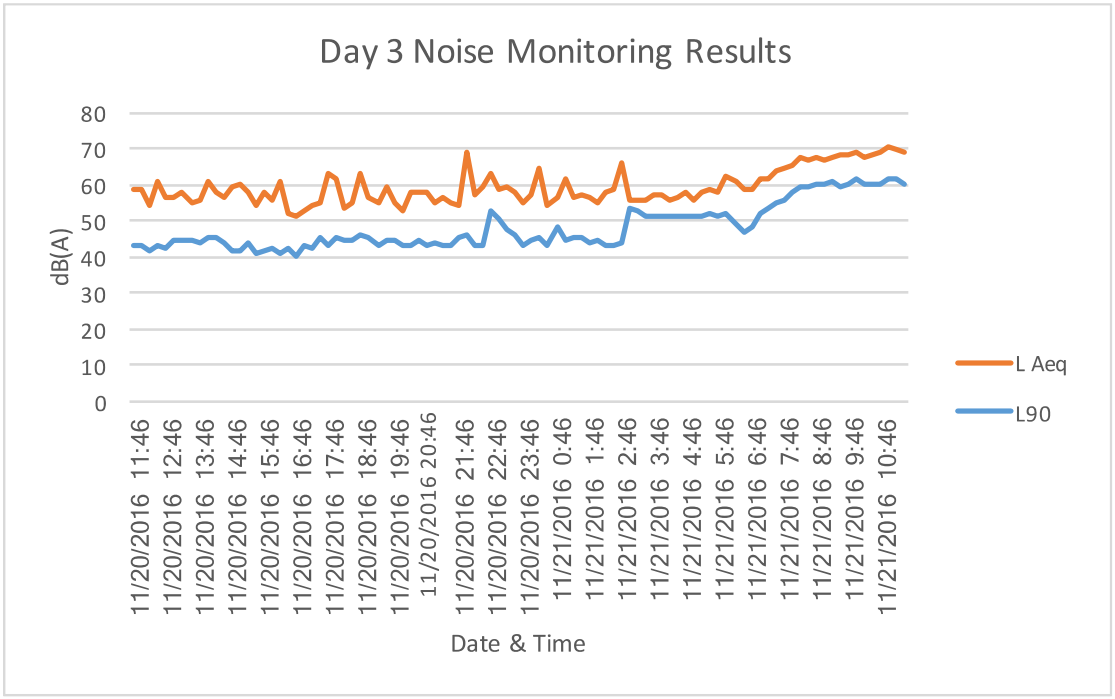
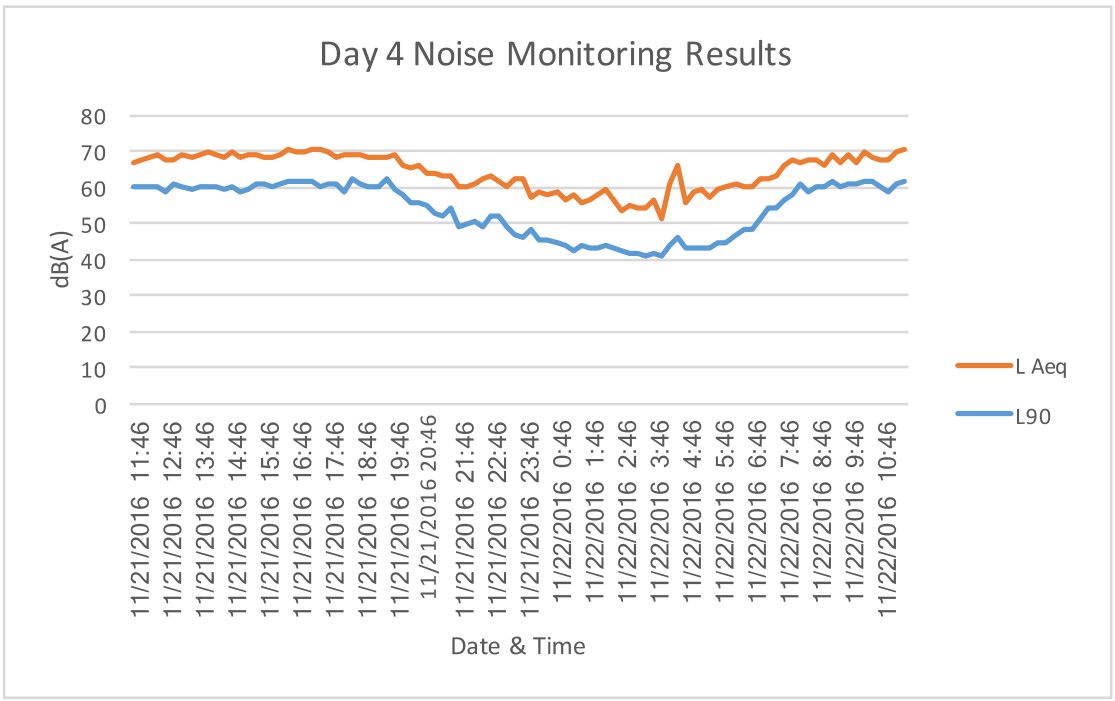
Appendix C – Logging Results

Location 1

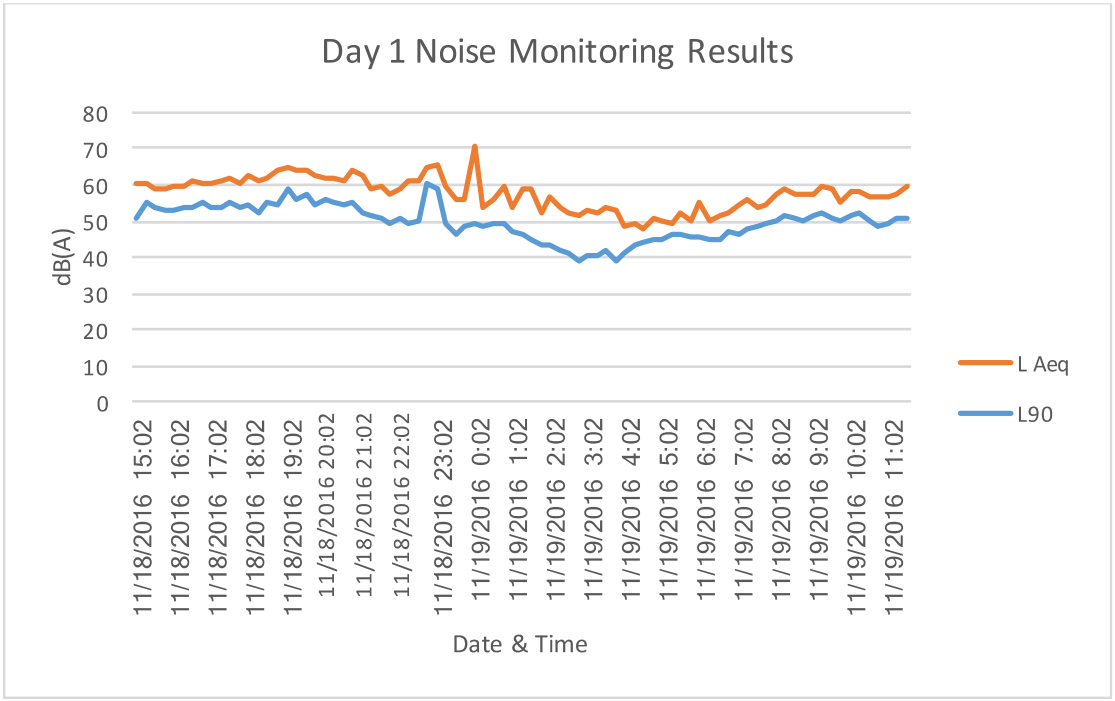


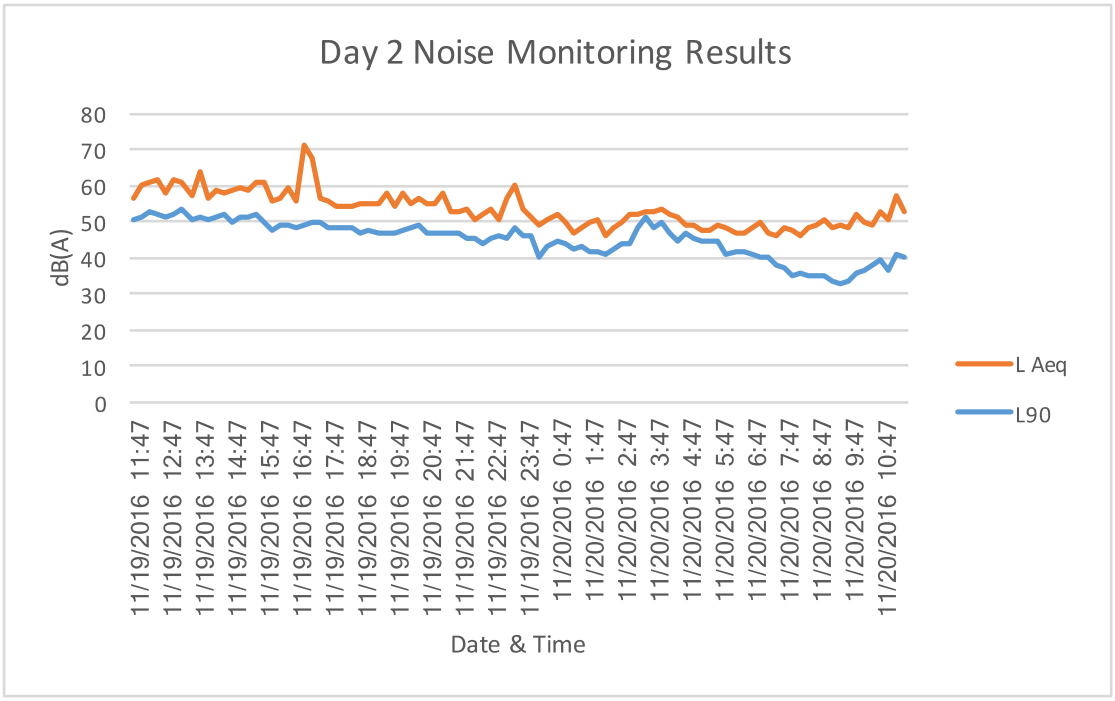


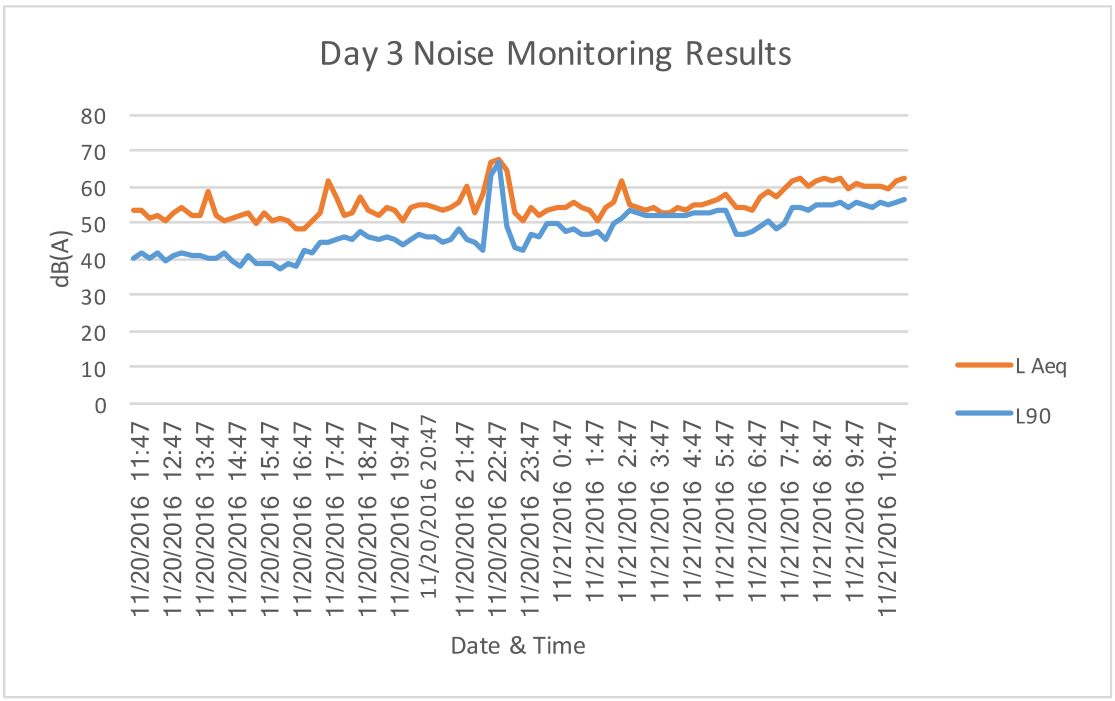

Day 3 Noise Monitoring Results
dB(A)
80
70
60
50
40
30
20
10
0
11/20/2016 11:46
11/20/2016 12:46
11/20/2016 13:46
11/20/2016 14:46
11/20/2016 15:46
11/20/2016 16:46
11/20/2016 17:46
11/20/2016 18:46
11/20/2016 19:46
11/20/2016 20:46
11/20/2016 21:46
11/20/2016 22:46
11/20/2016 23:46
11/21/2016 0:46
11/21/2016 1:46
11/21/2016 2:46
11/21/2016 3:46
11/21/2016 4:46
11/21/2016 5:46
11/21/2016 6:46
11/21/2016 7:46
11/21/2016 8:46
11/21/2016 9:46
11/21/2016 10:46
Date & Time
L Aeq
L90

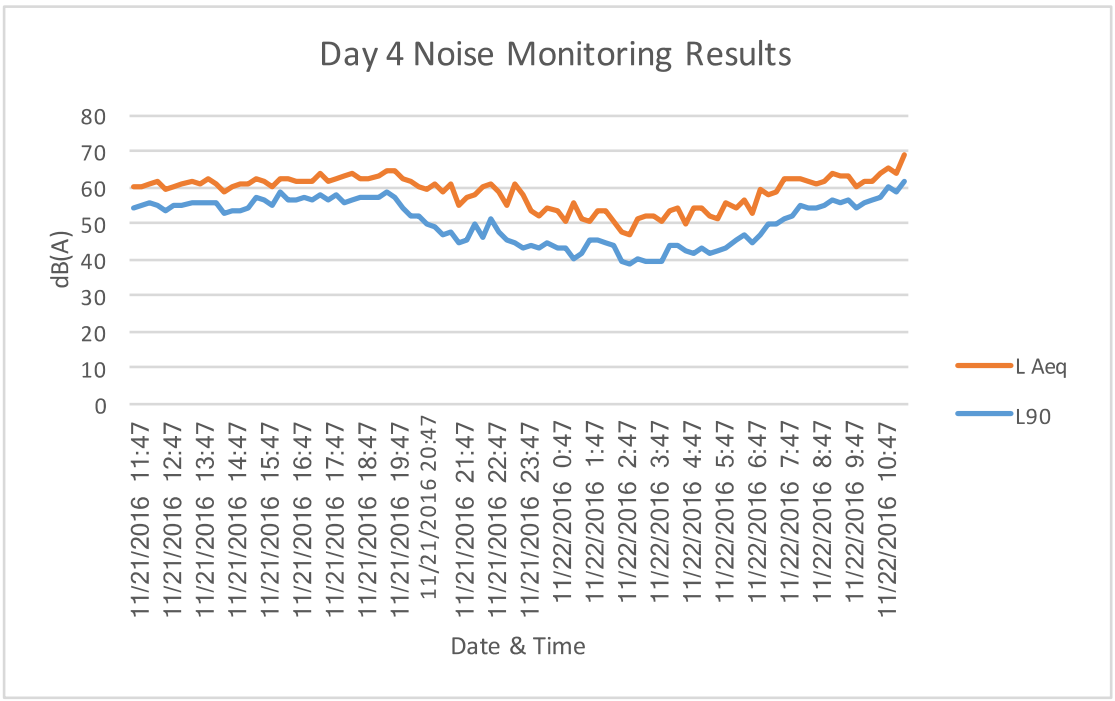

Day 4 Noise Monitoring Results
dB(A)
80
70
60
50
40
30
20
10
0
11/21/2016 11:46
11/21/2016 12:46
11/21/2016 13:46
11/21/2016 14:46
11/21/2016 15:46
11/21/2016 16:46
11/21/2016 17:46
11/21/2016 18:46
11/21/2016 19:46
11/21/2016 20:46
11/21/2016 21:46
11/21/2016 22:46
11/21/2016 23:46
11/22/2016 0:46
11/22/2016 1:46
11/22/2016 2:46
11/22/2016 3:46
11/22/2016 4:46
11/22/2016 5:46
11/22/2016 6:46
11/22/2016 7:46
11/22/2016 8:46
11/22/2016 9:46
11/22/2016 10:46
Date & Time
L Aeq
L90

Location 2


Day 1 Noise Monitoring Results
dB(A)
80
70
60
50
40
30
20
10
0
11/18/2016 15:02
11/18/2016 16:02
11/18/2016 17:02
11/18/2016 18:02
11/18/2016 19:02
11/18/2016 20:02
11/18/2016 21:02
11/18/2016 22:02
11/18/2016 23:02
11/19/2016 0:02
11/19/2016 1:02
11/19/2016 2:02
11/19/2016 3:02
11/19/2016 4:02
11/19/2016 5:02
11/19/2016 6:02
11/19/2016 7:02
11/19/2016 8:02
11/19/2016 9:02
11/19/2016 10:02
11/19/2016 11:02
Date & Time
L Aeq
L90


Day 2 Noise Monitoring Results
dB(A)
80
70
60
50
40
30
20
10
0
11/19/2016 11:47
11/19/2016 12:47
11/19/2016 13:47
11/19/2016 14:47
11/19/2016 15:47
11/19/2016 16:47
11/19/2016 17:47
11/19/2016 18:47
11/19/2016 19:47
11/19/2016 20:47
11/19/2016 21:47
11/19/2016 22:47
11/19/2016 23:47
11/20/2016 0:47
11/20/2016 1:47
11/20/2016 2:47
11/20/2016 3:47
11/20/2016 4:47
11/20/2016 5:47
11/20/2016 6:47
11/20/2016 7:47
11/20/2016 8:47
11/20/2016 9:47
11/20/2016 10:47
Date & Time
L Aeq
L90


Day 3 Noise Monitoring Results
dB(A)
80
70
60
50
40
30
20
10
0
11/20/2016 11:47
11/20/2016 12:47
11/20/2016 13:47
11/20/2016 14:47
11/20/2016 15:47
11/20/2016 16:47
11/20/2016 17:47
11/20/2016 18:47
11/20/2016 19:47
11/20/2016 20:47
11/20/2016 21:47
11/20/2016 22:47
11/20/2016 23:47
11/21/2016 0:47
11/21/2016 1:47
11/21/2016 2:47
11/21/2016 3:47
11/21/2016 4:47
11/21/2016 5:47
11/21/2016 6:47
11/21/2016 7:47
11/21/2016 8:47
11/21/2016 9:47
11/21/2016 10:47
Date & Time
L Aeq
L90


Day 4 Noise Monitoring Results
dB(A)
80
70
60
50
40
30
20
10
0
11/21/2016 11:47
11/21/2016 12:47
11/21/2016 13:47
11/21/2016 14:47
11/21/2016 15:47
11/21/2016 16:47
11/21/2016 17:47
11/21/2016 18:47
11/21/2016 19:47
11/21/2016 20:47
11/21/2016 21:47
11/21/2016 22:47
11/21/2016 23:47
11/22/2016 0:47
11/22/2016 1:47
11/22/2016 2:47
11/22/2016 3:47
11/22/2016 4:47
11/22/2016 5:47
11/22/2016 6:47
11/22/2016 7:47
11/22/2016 8:47
11/22/2016 9:47
11/22/2016 10:47
Date & Time
L Aeq
L90