Appendix K

Noise and vibration impact assessment

NSW Roads and Maritime

Duplication of Tourle Street and Cormorant Road, Kooragang

Noise and Vibration Impact Assessment

13 June 2014

PARSONS BRINCKERHOFF
A BALFOUR BEATTY COMPANY

NSW Roads and Maritime

Duplication of Tourle Street and Cormorant Road, Kooragang

Noise and Vibration Impact Assessment

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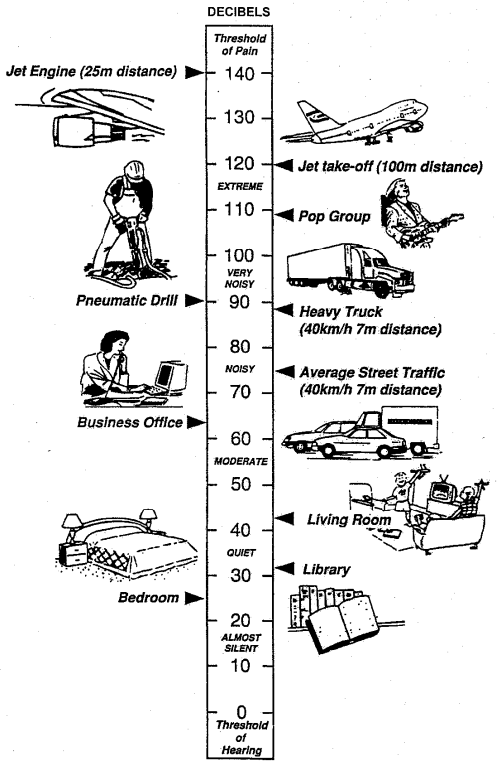
Glossary

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.
EPA Licence	Environment Protection Authority Licence.
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.

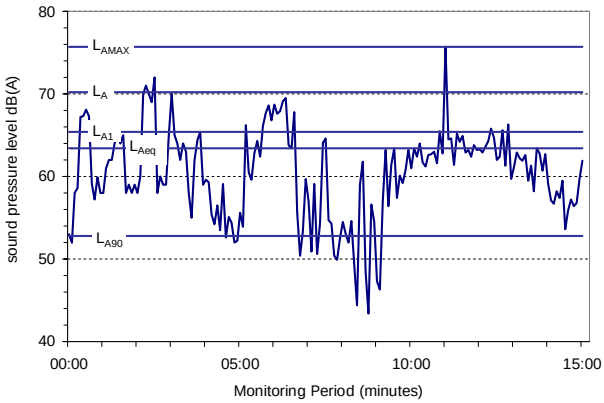
Noise Limits	Enforceable noise levels that appear in conditions on consents and licences. The noise limits are based on achievable noise levels, which the proponent has predicted can be met during the environmental assessment. Exceedance of the noise limits can result in the requirement for either the development of noise management plans or legal action.
Non-compliance	A development is deemed to be in non-compliance with its noise consent / licence conditions if the monitored noise levels exceed its statutory noise limit by more than 2 dB.
NSW DECCW	New South Wales Department of Environment, Climate Change and Water.
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 median L_{A90} noise level measured over all day, evening and night time monitoring periods.
Receiver	The noise-sensitive land use at which noise from a development can be heard.
Sleep disturbance	Awakenings and disturbance of sleep stages.
Sound & 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 would 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 2×10^{-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 descriptors:

L_{AMax}	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 present for 90% of time (background level). The average minimum background sound level (in the absence of the source under consideration).

Steady state noise level	The steady state noise level is the operator observed baseline noise level where sources influencing the statistical results are determined.
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 5 dB(A) penalty is typically applied to noise sources with tonal characteristics.

Executive summary

Roads and Maritime engaged Parsons Brinckerhoff Australia Pty Ltd (Parsons Brinckerhoff) to undertake a noise and vibration impact assessment (NVIA) for the construction and operation of the proposed Duplication of Tourle Street and Cormorant Road, Kooragang (the proposal).

This NVIA has been prepared for inclusion in the proposal's Review of Environmental Factors (REF), with consideration to the Roads and Traffic Authority (RTA) *Environmental Noise Management Manual* (ENMM 2001), the Department of Environmental, Climate Change and Water (DECCW) NSW *Road Noise Policy* (2011) and the NSW Department of Environment, Climate Change (DECC) *Interim Construction Noise Guideline* (ICNG 2009).

A baseline noise survey was undertaken in October 2013 at existing nearest residential receivers to the proposal in Mayfield West and a representative traffic noise validation location adjacent to Tourle Street. Adopting measured background noise levels, construction noise goals for residential and noise sensitive receivers were established with consideration to the ICNG.

With consideration to the Environment Criteria for Road Traffic Noise (ECRTN), for the management of potential arterial road traffic noise at residential receivers and land uses, project noise goals of 60 dB(A) $L_{Aeq,\ 15hr}$ day time (7 am – 10 pm) and 55 dB(A) $L_{Aeq,\ 9hr}$ night time have been adopted. Guidance on external noise levels for industrial receivers was also adopted.

Construction received noise and vibration levels

A noise assessment was undertaken for the proposed construction works for the road duplication, bridge construction and associated infrastructure. A worst case scenario of all plant in cumulative operation was assumed for proposed day time (core hours) works.

Worst case construction noise impacts at nearest residential receivers in Mayfield West were predicted to comply with the adopted noise goals. These predictions are dependent upon minimum separation distances between work locations and receivers and the appropriate operation of construction plant being maintained. Where out of hours pavement or earthwork construction is required on Tourle Street, noise impacts up to 10 dB(A) above the adopted goal were predicted, depending on proximity of sources to receivers.

Predicted constriction road traffic noise and construction vibration impacts were also found to be compliant with adopted road traffic noise goals and perceptible and structural vibration criteria.

To reduce noise impacts and minimise receiver noise levels, it was recommended that a construction noise and vibration management plan be developed that includes working practises and a consultation process to inform the local community of any anticipated impacts and the proposed works.

Operational road traffic noise assessment

As the proposal area does not include sensitive noise receivers, there are no operational noise criteria for the proposal and an operational noise assessment was not required.

1. Introduction

Roads and Maritime engaged Parsons Brinckerhoff Australia Pty Ltd (Parsons Brinckerhoff) to undertake a noise and vibration impact assessment (NVIA) for the construction and operation of the proposed Duplication of Tourle Street and Cormorant Road, Kooragang (the proposal).

This NVIA has been prepared for inclusion in the proposal's Review of Environmental Factors (REF), with consideration to the RTA *Environmental Noise Management Manual* (RTA ENMM 2001), the Environmental Protection Agency (EPA) *Road Noise Policy* (RNP, 2011) and the NSW Department of Environment, Climate Change (DECC) *Interim Construction Noise Guideline* (ICNG 2009).

1.1 Objectives

The objectives of this NVIA were to:

- provide assessment of potential noise and vibration levels from the proposed construction and operation of the proposal
- compare potential construction and operational noise and vibration levels with adopted guidelines at nearest receivers
- recommend management and mitigation measures to minimise noise and vibration impacts with consideration to the adopted acoustic guidelines.

1.2 Scope of works

To deliver the objectives of the NVIA the assessment included:

- identification of potentially affected receivers and existing influences to the ambient noise environment
- a baseline noise study incorporating noise monitoring at the nearest potentially affected existing receivers and at a representative traffic noise modelling location
- establishing project specific noise and vibration design objectives for construction and operation phases of the proposal
- predictive assessment of construction noise and vibration levels at nearest potentially affected receivers
- based on the results of the assessment, recommend noise and vibration control and mitigation practises where adopted noise and vibration design objectives would possibly be exceeded.

Reference should be made to the limitations accompanying this report (Section 8) and the supporting information in the appendices.

2. Proposal details and site description

2.1 Proposal details

The proposal would involve the duplication of a 3.8 kilometre (km) section of Tourle Street and Cormorant Road on Kooragang Island, NSW. This will include the following components:

- construction of a new reinforced two lane concrete bridge located immediately to the west of the existing bridge over the Hunter River
- construction of new southern and northern approaches
- widening of Tourle Street and Cormorant Road from 350 metres (m) to the north of the intersection with Industrial Drive to 200 m west of the intersection with Egret Street to four lanes (two lanes in each direction).

For further details of the proposal, refer to the Duplication of Tourle Street and Cormorant Road Kooragang, REF (Parsons Brinckerhoff 2014).

2.2 Site description

The proposal is located in Mayfield West and Kooragang, NSW. Land uses surrounding the proposal area include industrial land uses west of Tourle Street in Mayfield West and industrial land use in Mayfield North to the east. North of the Hunter River on Kooragang Island, Cormorant Road is bounded by industrial land uses and some estuarine habitat areas.

Noise sources in the study area include traffic along Industrial Drive, Tourle Street, Cormorant Road and industry noise resultant from the neighbouring industrial sites. The proposal area described further in Section 3.1.

2.3 Existing road features

Tourle Street and Cormorant Road are classified as part of MR108 and are arterial roads. Tourle Street is a 60 km per hour (km/h) undivided road between its intersection with Industrial Drive and the existing Tourle Street Bridge. This section of the road ranges between two lanes south of the bridge and expanding to four lanes, with merge and turning lanes at the intersection of Tourle Street and Industrial Drive. Tourle Street and Cormorant Road are currently designated for use by 25/26 m B-Double vehicles operating at High Mass Limits (HML).

The existing Tourle Street Bridge was constructed in 2009 and comprises nine spans of up to 35 m. The bridge contains one traffic lane in each direction, 2.0 m shoulders on each lane and a 1.8 m protected footway on its western side. The speed limit on the existing Tourle Street Bridge is 80 km/h.

Cormorant Road consists of a two lane, undivided road with an 80 km/h speed limit. An extension to the existing westbound lane was recently constructed to provide additional traffic capacity on Cormorant Road between its intersection with Egret Street and a point 200 m to the west of the intersection of Cormorant Road and Pacific National Access Road.

There are no separated facilities for cyclists or pedestrians over the length of the proposal on either Tourle Street or Cormorant Road. The existing Tourle Street Bridge has a pedestrian footpath constructed on its eastern side, although this does not connect to a paved footpath on either end.

3. Existing ambient noise environment

3.1 Existing noise environment

Land use surrounding the proposal includes industrial land uses west of Tourle Street in Mayfield West and industrial land use in Mayfield North to the east. North of the Hunter River on Kooragang Island Cormorant Road is bounded by industrial land uses and some estuarine habitat areas.

The proposal does not include any upgrade works to the existing Industrial Road and Tourle Street intersection. The nearest residential receivers are located on the southern side of the intersection of Industrial Drive and Tourle Street. These receivers include residential properties in Groongal Street and Simpson Court, West Mayfield which back onto Industrial Drive. The dominant noise exposure for these receivers is from Industrial Road traffic and the adjacent intersection with Tourle Street.

Noise sources in the area include traffic along Industrial Drive, Tourle Street and industry noise resultant from the neighbouring industrial sites. Baseline noise surveys have been carried out in the study area to develop background noise profiles and identify existing ambient noise profiles.

3.2 Noise monitoring locations

Continuous unattended noise monitoring has been undertaken at locations indicative of nearest existing residential receivers to the proposal to establish construction noise goals. Monitoring was undertaken at the following locations:

- Location A: 5 Groongal Street, Mayfield West, noise logger 16-207-008 was established within the rear yard of the property to determine background noise profiles.
- Location B: 3 Simpson Court, Mayfield West, noise logger 16-207-023 was established within the rear yard of the property to determine background noise profiles.

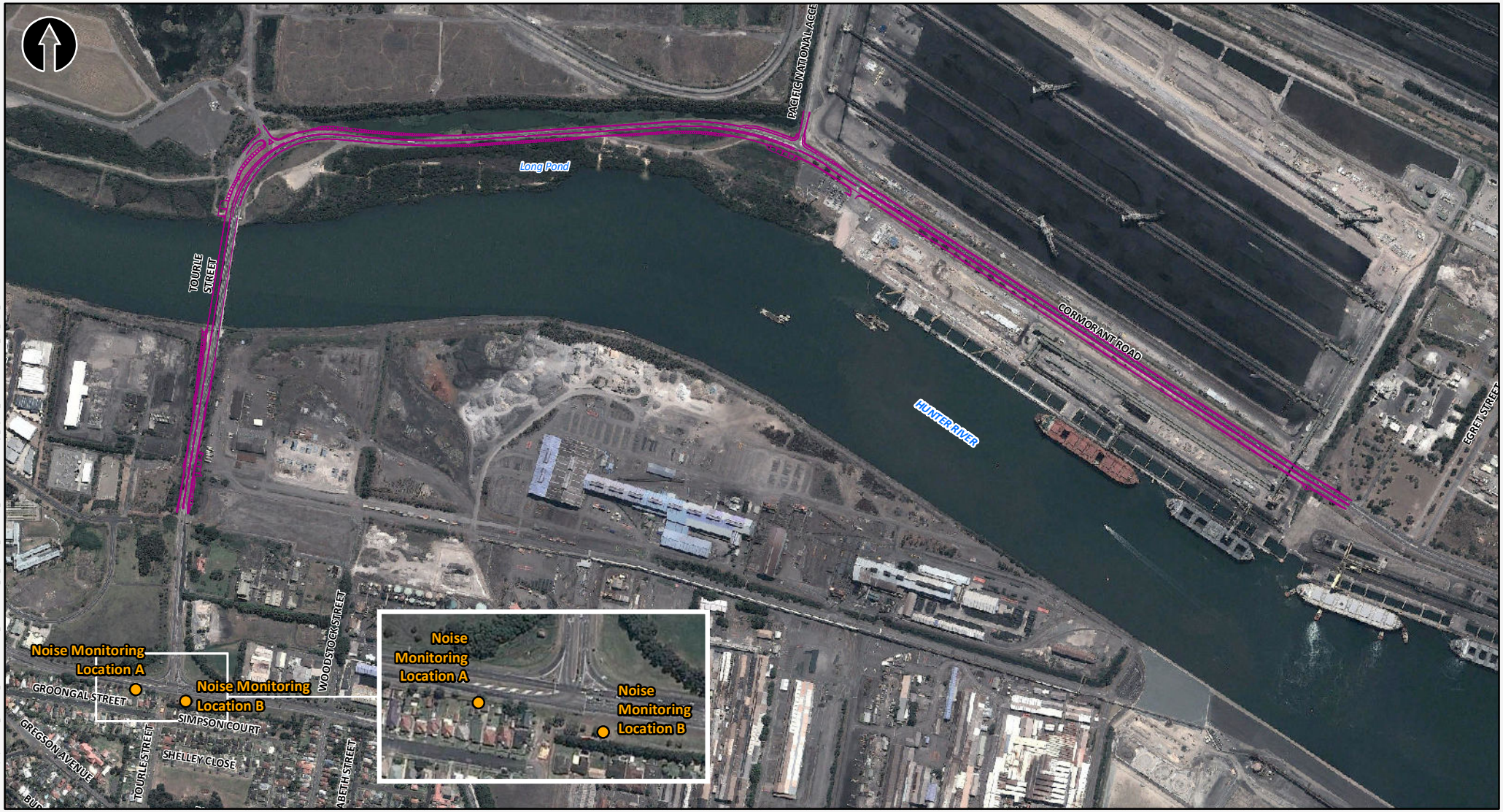
These monitoring locations and the proposal area are also indicated in Figure 3.1.

3.3 Instrumentation

Long-term unattended noise monitoring was carried out using Acoustic Research Laboratories statistical environmental noise loggers, type EL-316.

Instrument sets were calibrated by a NATA accredited laboratory within two years of the measurement period and comply with Australian Standard AS-1259: *Sound Level Meters.* Copies of the instrument set calibration certificates have been included in Appendix C.

Microphones were positioned 1.5 m above ground level and fitted with windsocks. Each instrument was calibrated before and after the measurement period to ensure the reliability and accuracy of results. No significant variances were observed.



0 200 400 600 m

Noise Assessment Survey Monitoring Locations

Proposed Area

Figure 3.1
Proposed area and noise monitoring locations

3.4 Meteorological data

Hourly meteorological data was obtained from the nearest Bureau of Meteorology (Nobbys Head, 61055) all-weather station to the noise monitoring location.

Review of meteorological data for the monitoring period indicated unsatisfactory conditions as a result of precipitation, and wind speed exceeding five m/second (m/s) were present approximately 3.5 per cent of the monitoring period.

Inclement meteorological conditions have been shown as shaded on the compiled daily noise logger graphs (Appendix A) and filtered from derived baseline period noise levels.

3.5 Measured noise levels

Observations during logger establishment noted ambient noise environments at the nearest residential receivers to the proposal are primarily influenced by traffic flows along Industrial Drive.

The median day time (7 am – 6 pm), evening (6 pm – 10 pm) and night time (10 pm – 7 am) period background noise levels determined from the unattended noise survey are presented in Table 3.1.

Table 3.1 Unattended noise monitoring results (median period noise levels)

Location	Day (7 am – 6 pm)		Evening (6 pm – 10 pm)		Night (10 pm – 7 am)	
	$L_{Aeq, 11hr}$	$L_{A90, 11hr}$	$L_{Aeq, 4hr}$	$L_{A90, 4hr}$	$L_{Aeq, 9hr}$	$L_{A90, 9hr}$
A	69	52	64	51	71	46
B	60	52	56	50	55	45

(1) Notes: Values expressed as dB(A); dB(A) = decibels, A-weighted; all values rounded to nearest 1 dB(A)
(2) LAeq = equivalent continuous (energy average) A-weighted sound pressure level
(3) LA90 = A-weighted sound pressure level exceeded for 90 percent of the time (background)

Monitoring was undertaken over a 10 day period between Friday 11 October and Monday 21 October 2013. The Location A: 5 Groongal Street noise logger only collected 4 days of data before stopping due to a suspected battery problem. Daily noise logger graphs are included as Appendix A.

Review of the noise levels recorded at the residential receivers (A and B) showed noise characteristics typical of an urban area adjacent to a major road source. Noise profiles followed diurnal patterns with the lowest levels typically occurring in the early hours of the morning. Location A results were slightly higher than location B due to differences in separation distance and some vegetation attenuation. Location A night time L_{Aeq} results were potentially influenced by extraneous sources, elevated noise levels were apparent on the night of the 13 October and morning of the 14 of October.

The Location B results which included a full 10 days of monitoring data are considered suitable for establishing construction noise goals for the nearest residential receivers to the proposal.

4. Adopted criteria and guidelines

4.1 Overview

The *Protection of the Environment Operations Act 1997* (PoEO Act) regulates noise generation and prohibits the generation of "offensive noise" as defined under the Act. In addition to regulatory requirements under the PoEO Act, the NSW Environment protection authority (EPA) and Roads and Maritime provide guidelines regarding acoustic criteria and noise controls.

4.2 Construction noise criteria

Noise management levels for construction works were established with consideration to the ICNG which provides guidance for the assessment and management of construction noise. Detailed in Table 4.1, noise management levels have been established adopting measured day time, evening and night time background noise level (L_{A90}) from Location B, 3 Simpson Court, Mayfield West.

Table 4.1 Recommended residential construction noise criteria

Construction period	RBL L_{A90} dB(A)	Management level $L_{Aeq, 15min}$	Application
Standard day time construction hours: • Monday to Friday 7 am to 6 pm • Saturday 8 am to 1 pm	52	62	Where measured or predicted noise level > management level: • Proponent is to apply all feasible and reasonable work practises to meet the management level. • Potentially affected residents are to be informed of the works and expected noise levels duration.
Outside of standard day time construction hours	45	50	Strong justification for works is required. Proponent to apply all feasible and reasonable work practices to meet the management level. Where all feasible and reasonable practices have been applied and noise is >5 dB (A) above the management level the Proponent is to negotiate with the community.
Highly noise affected	–	75	Where noise is above this level respite periods for dominant noise generating activity may be required, to consider: • Times identified by the community where they are less sensitive. • If the community is prepared to accept longer periods of construction exchange for restriction on construction hours.

(1) L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level.
(2) L_{A90} - A-weighted sound pressure level exceeded for 90% of the time (background).

Based on the noise environments at the proposed construction work locations, residential noise management levels for standard day time construction hours of **62 dB(A) $L_{Aeq,15min}$** and outside of standard day time of **50 dB(A)** have been adopted.

Nearest Industrial/commercial receivers are on both the eastern and western sides of Tourle Street located adjacent to the proposed duplication works. The ICNG recommend noise management levels of **75 dB(A) $L_{Aeq,15min}$** for external industrial areas and **70 dB(A) $L_{Aeq,15min}$** for noise levels external of commercial and office receivers.

4.3 Construction vibration criteria

4.3.1 Human exposure to ground vibration

The DEC's *Assessing Vibration: A Technical Guideline* (2006) provides guidance for assessing human exposure to ground vibration. In consideration to British Standard BS6472:1992, the DEC guideline recommends Vibration Dose Value (VDV) levels to achieve a low probability of annoyance or disturbance at affected residential and sensitive land uses during construction.

Table 4.2 details adopted VDV vibration goals for residential receivers. No vibration sensitive receivers such as hospitals, education institutions or places of worship were identified adjacent to the road corridor.

Table 4.2 Adopted residential ground vibration goals

Location	Vibration Dose Value goals, $m/s^{-1.75}$			
	Day time		Night time	
	Preferred	Maximum	Preferred	Maximum
Residences	0.20	0.40	0.13	0.26
Offices, schools, places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

(1) Day time 7 am - 10 pm, Night time 10 pm- 7 am.

4.3.2 Structural ground vibration

To evaluate the effects of vibration on structures and buildings, the DEC guidance references German Standard DIN 4150: Part 3-1999. Dependent upon the dominant frequency of vibration, assessed in Hertz (Hz), structural vibration limits are established at the foundation of nearest buildings.

Adopted DIN 4150 structural vibration goals in Table 4.3 have been applied to assess potential structural damage during construction activities at residential receivers, industrial premises or sensitive structures.

Table 4.3 Adopted structural ground vibration goals

Structure	Structural vibration goal, PPV mm/s		
	1 – 10 Hz	10 – 50 Hz	50 Hz – 100 Hz
Dwellings and residences or similar occupancy	5	5 to 15	15 to 20
Commercial and industrial premises and buildings of similar design	20	20 to 40	40 to 50
Sensitive structures not classified by either definition above and of great intrinsic value	3	3 to 8	8 to 10

(1) Referenced from German Standard DIN 4150.

4.4 Road traffic noise criteria

In accordance with the RNP, Section 3.4.1 *Process for applying the criteria*, there are no sensitive land uses located within a distance of 600 m of the centre line of the outermost traffic lane on each side of the proposal. The proposal does not include any upgrade works to the existing Industrial Drive and Tourle Street intersection. The nearest residential receivers are located on the southern side of the intersection of Industrial Drive and Tourle Street approximately 400 m south of the southern extent of the proposal where it ties in with existing four lanes on the northern approach to the intersection. These receivers include residential properties in Groongal Street and Simpson Court, West Mayfield which back onto Industrial Drive. The dominant noise exposure for these receivers is from traffic on Industrial Drive and the adjacent intersection with Tourle Street. The proposal will not in itself increase the traffic volume or change the traffic mix on Industrial Drive and the related Tourle Street intersection. These properties are not affected by the proposal and are considered out of scope of this assessment. There are therefore no operational noise criteria for the proposal.

For industrial and commercial receivers the RNP recommends the guidance given in Australian Standard AS2107:2000 *Acoustics – Recommended design sound levels and reverberation times for building interiors.* Based on this, guidance internal noise levels of 45 dB(A) would apply for general office areas and for industrial process areas noise levels of 70 dB(A) and less are desirable.

5. Construction noise and vibration impact assessment

An assessment of noise and vibration impact potential has been undertaken for the proposed construction activities. Where required, experience and knowledge of construction practises and standard construction techniques have been applied to the modelled scenarios.

5.1 Construction activities

Outlined below is a brief overview of the construction methods and activities proposed for the proposal.

5.1.1 General site establishment

Site establishment will include the stripping of existing vegetation and installation of erosion and sediment controls. Excess topsoil will be removed and stockpiled for re-use during site rehabilitation. Construction compounds and associated traffic controls will then be installed and implemented. Realignment of infrastructure services shall occur as required including electricity, water and sewer mains and telecommunications.

5.1.2 Bridge

Bridge construction is to commence through the installation of temporary construction platforms within the Hunter River at both the northern and southern approaches. These platforms are to be constructed through the installation of H-piles and subsequent infilling and capping. Temporary construction platforms shall facilitate access for barge mounted cranes and piling rigs.

Piling will include driving composite, steel or concrete piles up to depths of 40 m for the southern and northern bridge approaches and bridge piers.

Concrete piers, beams and abutments will be poured in-situ. Precast Super T girders will be delivered to site and installed either by crane or a girder launching gantry working from one side of the river to the other followed by deck construction.

5.1.3 Roadway and abutments

Road way and abutment construction shall include the installation of drainage works including culverts and drainage pipes in certain locations to be confirmed. Earthworks including the importation of suitable fill materials are anticipated to reach the required level for road alignment followed by lying of the road base and pavement. The new road construction will require the import of fill, aggregates, concrete and bitumen. Installation of street furniture and line marking will complete the road construction.

5.2 Construction equipment source noise levels

The individual sound power levels (SWL) for the anticipated type of construction plant have been referenced from Parsons Brinckerhoff's database of noise sources (refer to Table 5.1). The SWL will be adopted in the construction noise impact assessment. Based on the information provided, the works are proposed to be undertaken during a 24 month period.

Table 5.1 Construction plant and equipment sound power levels

Construction stage	Activities	Anticipated Type of plant and equipment	SWL L_{Aeq} dB(A)
Roadway and abutments	General site establishment	Semi – Trailers	106
		Trucks (8–9 tonnes)	100
		Mobile Crane (30 tonnes)	102
		Excavators	107
	Earthworks	Excavators	107
		Dump Trucks	108
		Front end loaders	113
		Bulldozer	115
		Grader	114
		Compactor	109
		Backhoe	104
	Utilities and Diversion	Excavator	107
		Dump Trucks	108
		Road Trucks	108
		Crane	113
	Road pavement	Asphalt paver	114
		Compactor	109
		Road trucks	106
		Water trucks	107
		Grader	114
		Concrete Truck	108
		Concrete Saw	115
		Road Miller	115
	Rehabilitation, landscaping, signs and line marking	Excavators	107
		Road Trucks	100
		Water truck	107
		Bob cat	104

Construction stage	Activities	Anticipated Type of plant and equipment	SWL L_{Aeq} dB(A)
Bridge	Establishment of Construction Platforms	Impact Piling Rig	120
		Bored Piling Rig	114
		Concrete Truck	108
		Concrete Pump	107
		Excavators	107
		Cranes (45 Tonnes)	105
		Tug boats	87
		Service boats	72
		Road Trucks	100
	Abutments and piers	Impact Piling Rig	120
		Bored Piling Rig	114
		Concrete Truck	108
		Concrete Pump	107
		Excavators	107
		Cranes (45 Tonnes)	105
		Tug boats	87
		Service boats	72
		Generators	95
		Dump trucks	108
	Superstructure and deck	Cranes(45 tonnes)	105
		Concrete Truck	108
		Concrete Pump	107
		Generators	95
		Air Compressor	105
		Road Trucks	100
		Excavators	107
		Pneumatic tools	101

5.3 Construction noise prediction methodology

Due to the mobile nature of the construction works, the potential noise impacts at receivers would be variable with potential received noise levels dependent on the separation distance between noise generating construction plant and machinery in relation to receivers and the power rating at which the plant and equipment is operating.

The assessment of the potential noise impacts from construction activities has been based on the prediction of noise propagation over increasing separation distance from the construction site. Equation 5.1 has been

applied with the construction SWLs to predict noise impacts at nearest receivers. The equation does not account for noise attenuation from receiver buildings and the local terrain. All construction plant and equipment have been treated as point noise source.

$$SPL\ received = SWL\ source - 20\log(r) - 8$$

Where: SPL received = construction noise level at the receiver
SWL source = sound power level for construction plant

Equation 5.1 Calculation of noise propagation

The equation includes a -8 dB(A) correction for the loss of acoustic energy from hemi-spherical radiation from noise sources.

5.4 Construction noise impact assessment

The predicted construction noise levels at increasing separation distance during the various construction work stages of the proposal are detailed in Figure 5.1, Figure 5.2 and Figure 5.3 below. The predicted noise levels in the figures below represent the worst case scenario of all plant and equipment operating simultaneously during the construction activities. Where the proposed plant and equipment are not in concurrent operation or undertaken at greater separation distances to the assessed locations, further reductions in noise impacts would be expected. It is also noted that the works are unlikely to be continuous for extended periods of time; therefore noise levels are expected to be lower than the predicted construction noise levels.

5.4.1 Assessment of noise impacts from site establishment

The predicted construction noise levels at increasing separation distance during site establishment are detailed in Figure 5.1 below.

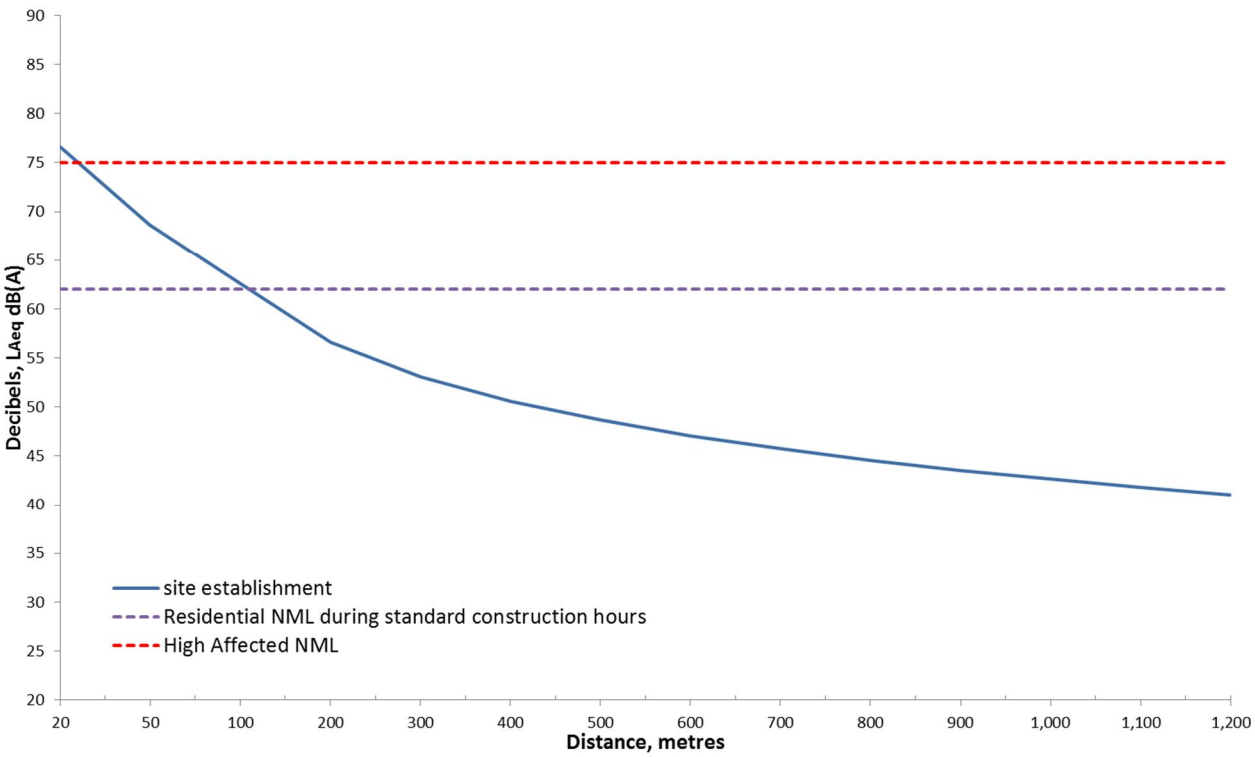


Figure 5.1 Estimated noise levels at increasing separation distance site establishment

Based on Figure 5.1, in a worst case scenario, compliance with the adopted residential NML for standard construction hours for site establishment activities, was predicted to be achieved at approximately 110 m.

5.4.2 Assessment of noise impacts for roadway construction

The predicted construction noise levels at increasing separation distance during roadway construction activities are detailed in Figure 5.2 below.

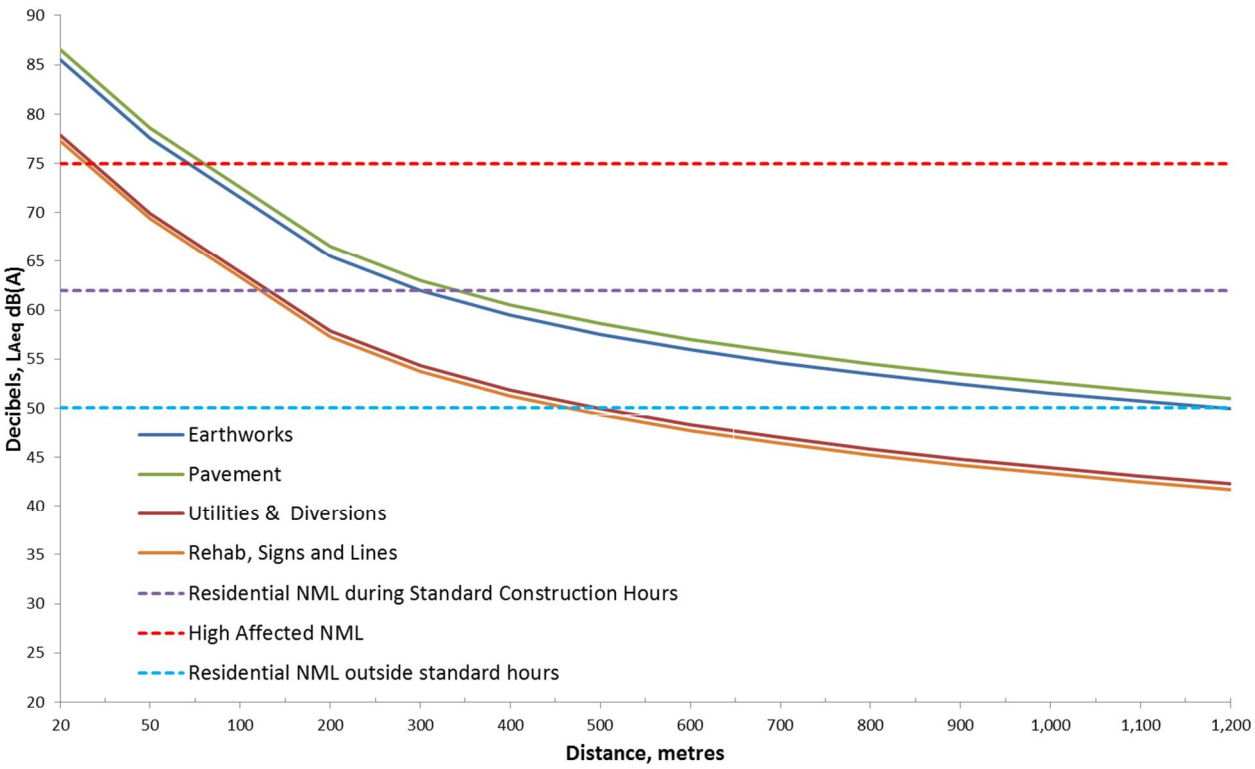


Figure 5.2 Estimated noise levels at increasing separation distance roadway construction

Based on Figure 5.2, in a worst case scenario, compliance with the adopted residential daytime NML for pavement construction was predicted to be achieved at approximately 350 m from the proposed construction works. Earthworks construction was predicted to achieve the residential daytime NML at approximately 300 m from the proposed construction works. Rehabilitation, sign installation, line marking and utility diversion activities were predicted to achieve the daytime residential noise at approximately 120 m from the proposed construction activities. As the nearest residential receivers are located approximately 400 m from the nearest point of the proposed road construction activity, compliance with the NML is predicted to be achieved for worst-case daytime construction activities.

Where out of hours works are required, the NML would be achieved at a separation distance of approximately 1300 m for pavement construction and earth works. Utilities diversion, rehabilitation works, sign installation and line marking were predicted to achieve the night time residential NML at approximately 500 m from the proposed construction activities.

Where night time or out of hours pavement and earth works are required, construction noise levels are therefore predicted to exceed the night-time NML at the nearest residential receivers to the proposal by up to 10 dB(A). These activities would require the implementation of mitigation measures which have been further described in section 6.

5.4.3 Bridge construction

The predicted construction noise levels during bridge construction are detailed in Figure 5.3 below.

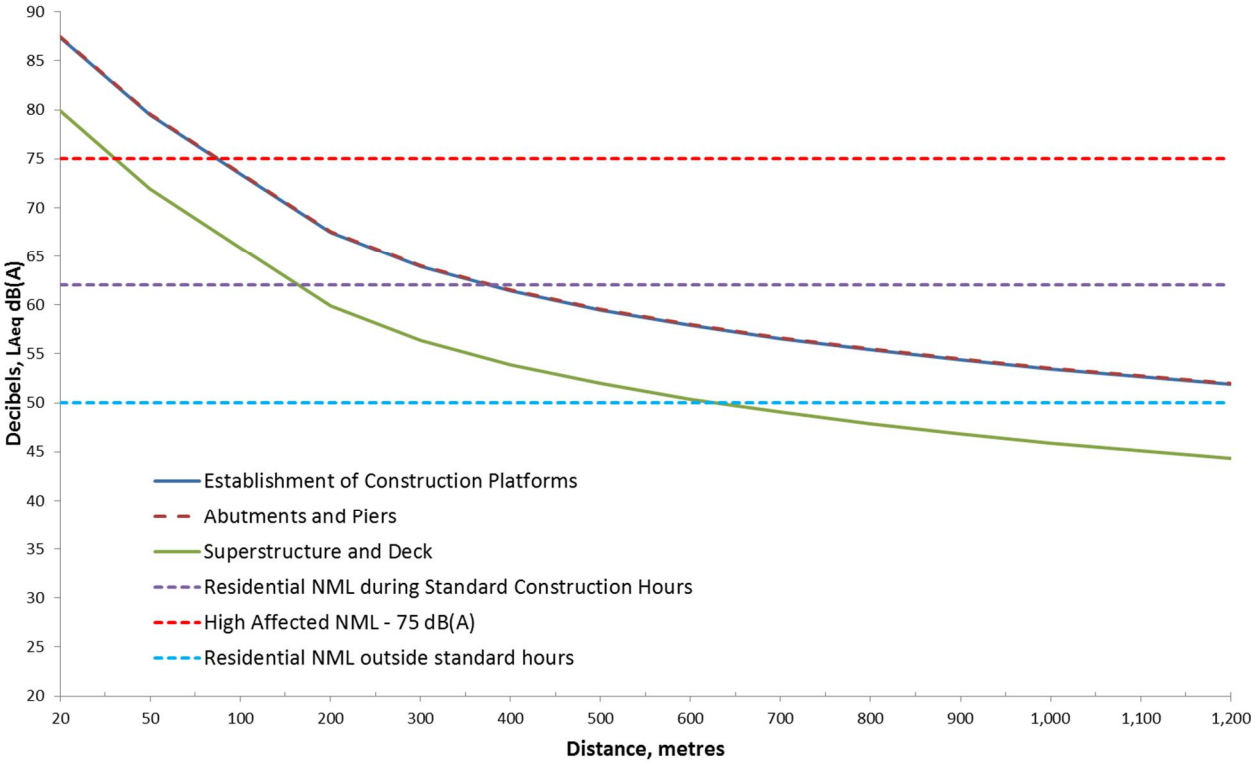


Figure 5.3 Estimated noise levels during bridge construction

Based on Figure 5.3 in a worst case scenario, compliance with the adopted residential NML for standard construction hours for bridge construction, are predicted to be achieved at approximately 350 m from the proposed construction works. Given the separation distance between the nearest residential receivers and the construction works of over 800 m adverse impacts are not anticipated during the day time period. Where out of hours works are required, piling is predicated to exceed the NML. Other bridge construction activities are not expected to exceed the NML.

5.5 Construction road traffic noise impacts

During construction, road vehicles will access the construction site via Industrial Drive. Up to 50 light vehicles and 400–500 heavy vehicles movements are anticipated to be required during the proposal's construction. An assessment of construction road traffic influence on existing road traffic noise has been undertaken to determine potential increases in existing traffic noise levels from construction traffic.

The prediction of road traffic noise has adopted guidance from the Calculation of Road Traffic Noise (UK Department of Transport, CoRTN 1988).

Construction traffic is not expected to adversely influence existing day time ambient environment at receivers adjacent to arterial roads. Given the existing traffic volumes any increase in traffic noise associated with construction traffic is expected to be less than 1 dB(A).

5.6 Construction vibration assessment

This section provides an assessment of potential ground vibration impacts from the proposed construction works.

5.6.1 Construction vibration prediction methodology

The assessment of potential ground vibration impacts has referenced measured peak particle velocity (PPV) levels for key vibration generating plant and machinery from Parsons Brinckerhoff's database of vibration levels.

In the assessment scenarios the referenced PPV levels have been applied in Equation 5.2 to estimate received ground vibration levels. The dominant frequency of vibration has been assumed to be between 1 Hertz (Hz) and 10Hz; the most conservative range for assessing potential impacts.

$$PPV\ at\ receptor\ =\ PPV\ source\ x\ \left({25m}/{dist.\ to\ receiver, m}\right)^{1.5}$$

Equation 5.2 Calculation for the estimation of ground vibration propagation

Equation 5.3 has been referenced to estimate vibration dose value (VDV) from the PPV levels for the assessment of potential disturbance impacts at nearest receivers.

$$eVDV\ =\ 1.4\ x\ \frac{2\pi 8}{1000}\ V_{rms} x\ t^{0.25}$$

Where *t* is time in seconds and Vrms is the vibration velocity (root mean squared).

Equation 5.3 Calculation for the estimation of VDV

5.6.2 Construction vibration assessment

Measured ground vibration levels from the operations of construction plant have been applied to recommend safe work distances between key vibration generating construction plant and nearest sensitive receivers.

Table 5.2 Recommended vibration safe working distances for construction plant

Construction Plant	Measured PPV at 25m (mm/s)	Recommended safe working distance, metre (m)	
		Human annoyance	Structural damage
Excavator	0.6	>15	>7
Truck pass-by at 50 km/h	0.3	>10	>5
Rock breaker	1.1	>40	>13
Compactor	1.3 – 1.8	>40	>18

PPV = Peak Particle Velocity at the recommended safe working distances in Table 5.2, compliance with the most conservative structural damage vibration management levels is predicted to be achieved at greater than one m from the individual assessed sources of vibration. Compliance with the most conservative human annoyance management levels is predicted to be achieved at greater than 15 m from the individual assessed sources of vibration. All nearest sensitive receivers are located more than 15 m from the proposal.

All ground vibration levels are expected to be contained within the proposal area, and any receiver ground vibration would comply with the maximum allowable eVDV of 0.4 $m/s^{1.75}$ (human annoyance) and 5 mm/s (structural damage) vibration goals.

The majority of construction road traffic would be at least 15 m from the nearest receivers on the local roads; referencing a road truck vibration level of 0.1 mm/s at 25 m, potential vibration levels would be within the human annoyance and structural damage vibration goals. No vibration impacts are expected from construction road traffic for the proposal.

6. Recommended noise management and mitigation measures

Potential construction, road traffic noise and construction vibration impacts at nearest receivers are anticipated to be within adopted ICNG criteria during standard construction hours.

A series of construction measures and management practices designed to mitigate and ensure satisfactory noise levels are detailed in Section 6.1. The recommended management approaches have been made considering the predicted noise impacts and the proposed construction schedules.

Operational noise from the proposal is not anticipated to impact on adjacent land uses.

6.1 Construction noise management and mitigation measures

During the planning and scheduling of construction works the predicted noise levels should be considered in establishing work site locations, construction techniques and on site practices.

The following principles and proactive noise management measures should be considered for implementation:

- A Construction Noise and Vibration Management Plan (CNVMP) should be formulated to provide a framework for addressing noise levels associated with construction works. Specifically any out of hours works undertaken near sensitive receivers.
- Standard construction working hours should be restricted between 7 am and 6 pm (Monday to Friday), and between 8 am and 1 pm Saturdays, with no works on Sundays or public holidays, unless site specific conditions expressly require works outside these times and subject to approvals.
- Construction works should adopt Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA) practices as addressed in the ICNG. BMP includes factors discussed within this report and encouragement of a project objective to reduce noise emissions.
- Impact piling where required for bridge construction should be limited to standard construction hours.
- Construction plant source noise levels should be confirmed prior to the commencement of works to verify construction noise impacts and confirm the requirement for noise management and mitigation measures.

The construction program would be scheduled where feasible to:

- Maximise the offset distance between construction plant and adjacent receivers.
- Orientate construction and auxiliary equipment away from sensitive receivers.
- Minimise reversing alarm noise emissions from mobile plant and vehicles and where practicable, site entry and exit points will be managed to limit the need for reversing.

- Minimise concurrent operation of dominant noise generating equipment such as: bulldozer, rock breaker, mobile crane and asphalt paver construction plant. Where dominant noise generating plant are not in concurrent operation reductions to received noise impacts of up to 6 dB(A) are anticipated.
- Adjacent residents should be notified of potential night time construction works at least two weeks prior to the commencement of construction works.
- A one page summary of required construction noise and vibration management practices would be provided to construction staff and contractors and be discussed during site inductions. The summary should include, as a minimum, the permitted hours of construction work, work site locations, locations of sensitive receivers and site ingress/egress.
- A complaints management procedure would be established and implemented in the environmental management plan for the proposal. This would include the implementation of a phone hotline and a procedure for recording and responding to any issues relating to noise that may arise during fieldwork associated with the proposal.
- Noise impacts would be minimised in accordance with Practice Note 7 in the RTA's Environmental Noise Management Manual and RTA's Environmental fact sheet No. 2- Noise management and Night Works.
- Noise monitoring will be considered if complaints are received regarding excessive noise and this would be assessed against relevant guidelines.
- Machinery and equipment would be well maintained to assist with minimising noise levels.
- Idling equipment would be turned off where appropriate.

6.2 Road traffic noise management and mitigation measures

Given the existing land uses surrounding the proposal, no additional operational road noise mitigation measures are anticipated to be required.

6.3 Future development within the road corridor

The predictive assessment of road traffic noise impacts has not included potential future development within the adjacent land to the road corridor, however, potential development consistent with existing industrial land use are unlikely to result in road traffic noise impacts.

7. Conclusion

A construction noise assessment was undertaken for the proposed construction works for the road duplication, bridge construction and installation of associated infrastructure associated with the proposal. A worst case scenario of all plant in cumulative operation was assumed for proposed day time (core hours) works.

Predictions of worst case construction noise impacts at nearest residential receivers in Mayfield West were found to comply with the adopted noise goals for daytime construction activities. The predicted construction noise impacts and statement of compliance are dependent upon the separation distances between work locations and receivers and the required operation of construction plant. It was predicted that night-time construction activities would exceed the adopted Project noise goals at locations within 1300 m of pavement construction and earthwork operations by up to 10 dB(A). Measures to mitigate these impacts were recommended in Section 6.

Constriction road traffic is not expected to result in a significant increase in existing road traffic noise. No perceptible or structural construction vibration impacts are expected.

Recommended noise management and mitigation measures include the implementation of a construction noise and vibration management plan, responsible working practises and a consultation process to inform the local community of the proposed works and any anticipated impacts.

As the proposal area does not include sensitive noise receivers, there are no operational noise criteria for the proposal and an operational noise assessment was not required.

8. References

AUSTROADS 1994, *AUSTROADS Vehicle Classification System*, AUSTROADS Sydney.

Department of Transport, Welsh Office (1988) *Calculation of Road Traffic Noise (CoRTN),* HMSO, London.

Department of Environment Climate Change and Water (2011), *NSW Road Noise Policy* (RNP)*,* Sydney NSW.

Kean S, 2008, *Is CorTN an Leq or L10 Procedure,* Australian Acoustical Society, Acoustics 2008 Geelong Victoria.

Parsons Brinckerhoff 2013, *Duplication of Tourle Street and Cormorant Road Kooragang, Project review of environmental factors*. Newcastle, NSW.

Roads and Traffic Authority 2001, *RTA Environmental Noise Management Manual.*

Saunders RE, Samuels SE, Leach R and Hall A, 1983, *An evaluation of the UK DoE traffic noise prediction method. Australian Road Research Board Research Report 122*, Vermont South Victoria.

9. Limitations

Scope of services and reliance of data

This NVIA ('the study') has been prepared in accordance with the scope of work/services set out in the contract, or as otherwise agreed, between Parsons Brinckerhoff and the Client. In preparing this study, Parsons Brinckerhoff has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in this study ('the data'). Except as otherwise stated in the NVIA, Parsons Brinckerhoff has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the study ('conclusions') are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Parsons Brinckerhoff will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Parsons Brinckerhoff.

Study for benefit of client

The study has been prepared for the exclusive benefit of the Client and no other party. Parsons Brinckerhoff assumes no responsibility and will not be liable to any other person or organisation for, or in relation to, any matter dealt with in this study, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in this study (including without limitation matters arising from any negligent act or omission of Parsons Brinckerhoff or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in this study). Other parties should not rely upon the study or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

Other limitations

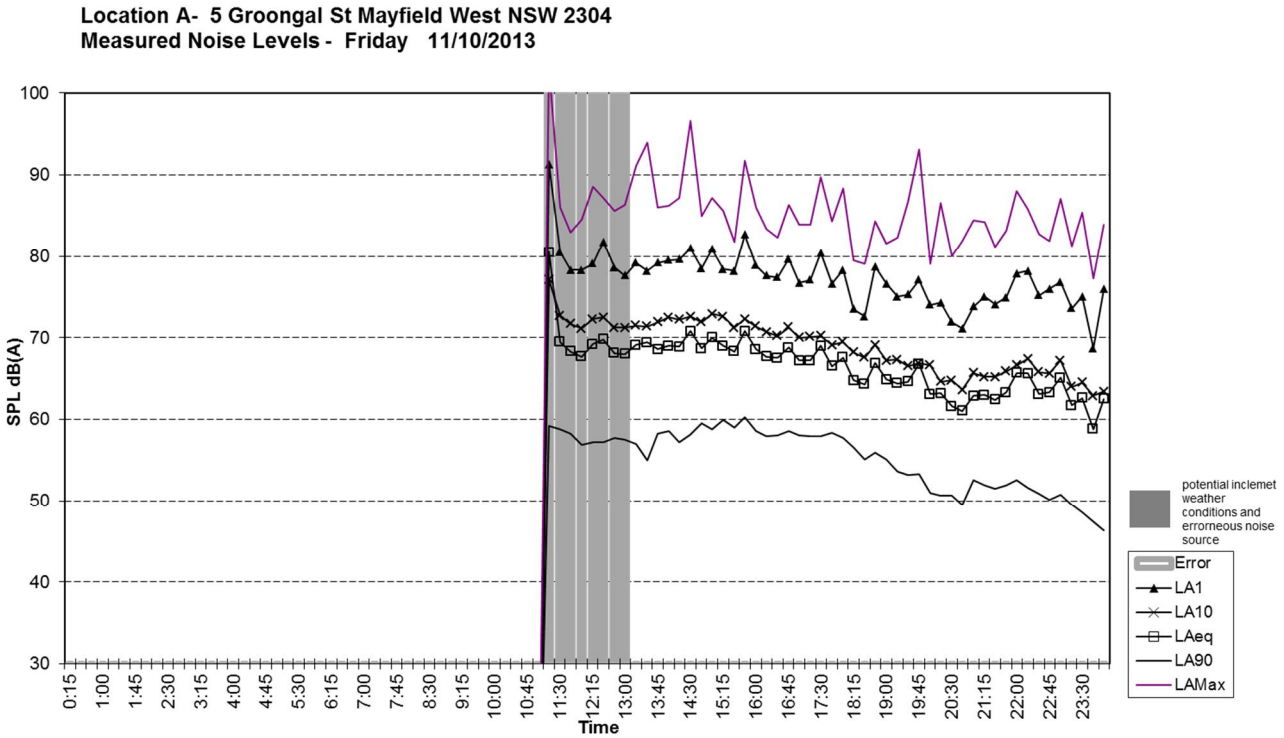
To the best of Parsons Brinckerhoff's knowledge, the project presented and the facts and matters described in this noise impact study reasonably represent the Client's intentions at the time of printing of the noise impact study. However, the passage of time, the manifestation of latent conditions or the impact of future events (including a change in applicable law) may have resulted in a variation of the project and of its possible noise and vibration impacts.

Parsons Brinckerhoff will not be liable to update or revise the study to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the study.

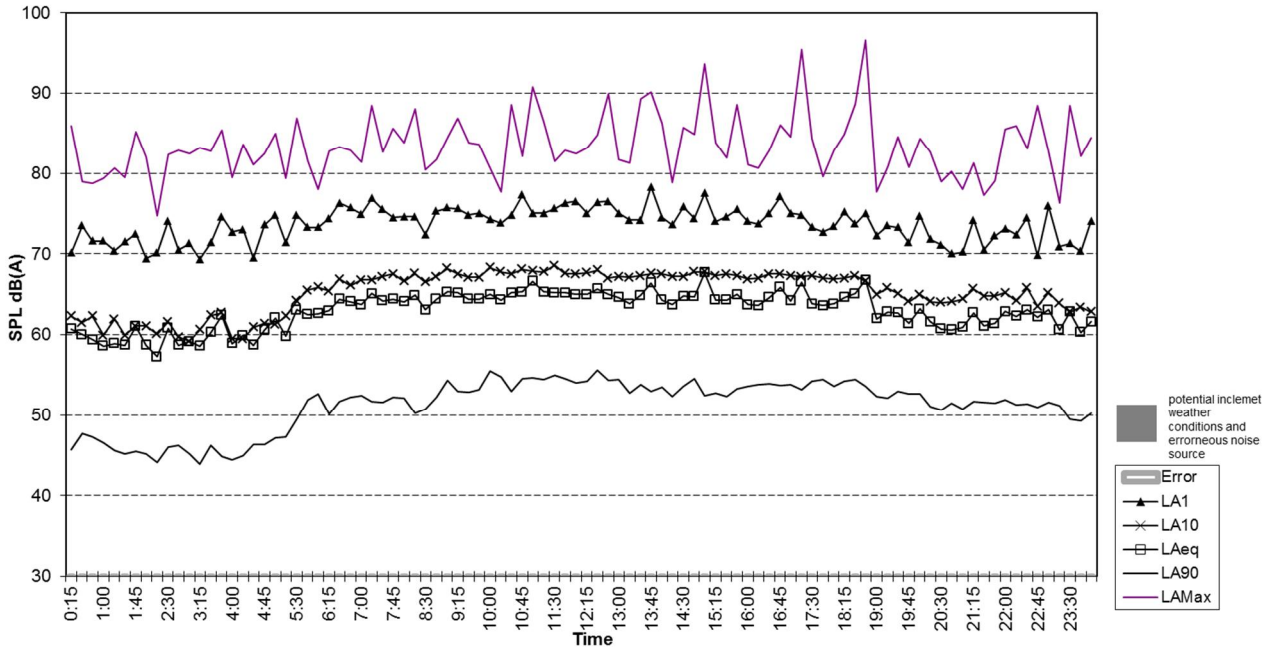
Appendix A

Measured ambient noise levels

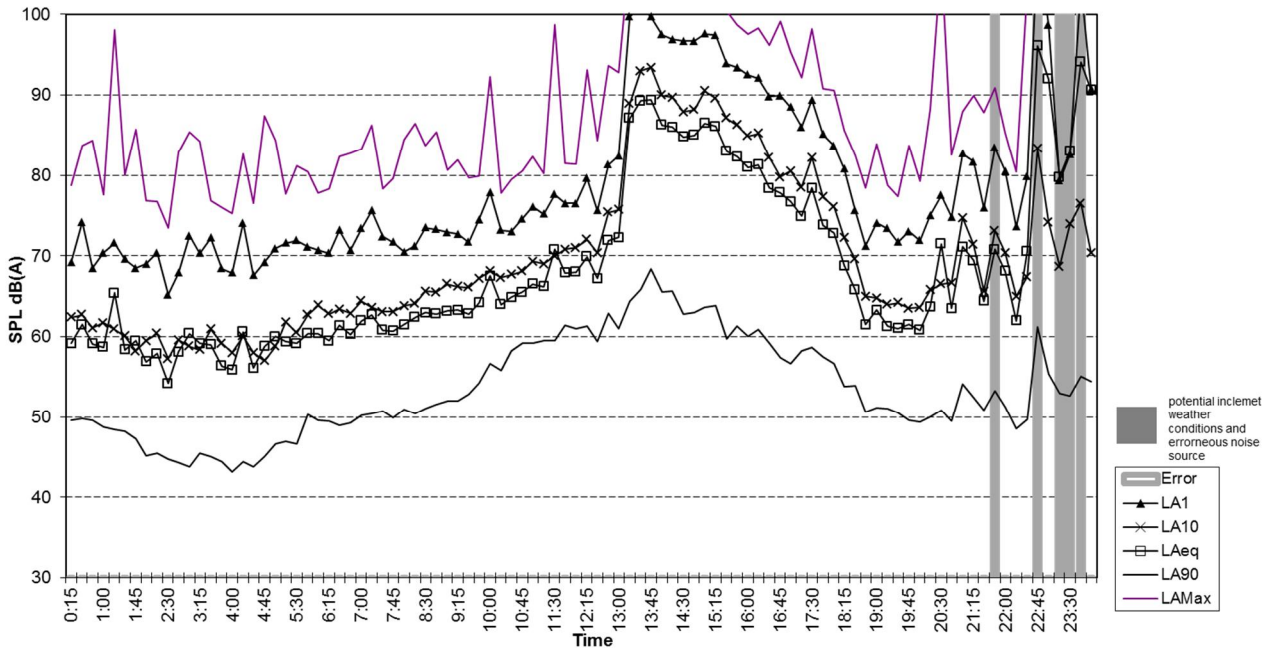
Monitoring location A – 5 Groongal St Mayfield West NSW
32.887194 South, 151.731305 East



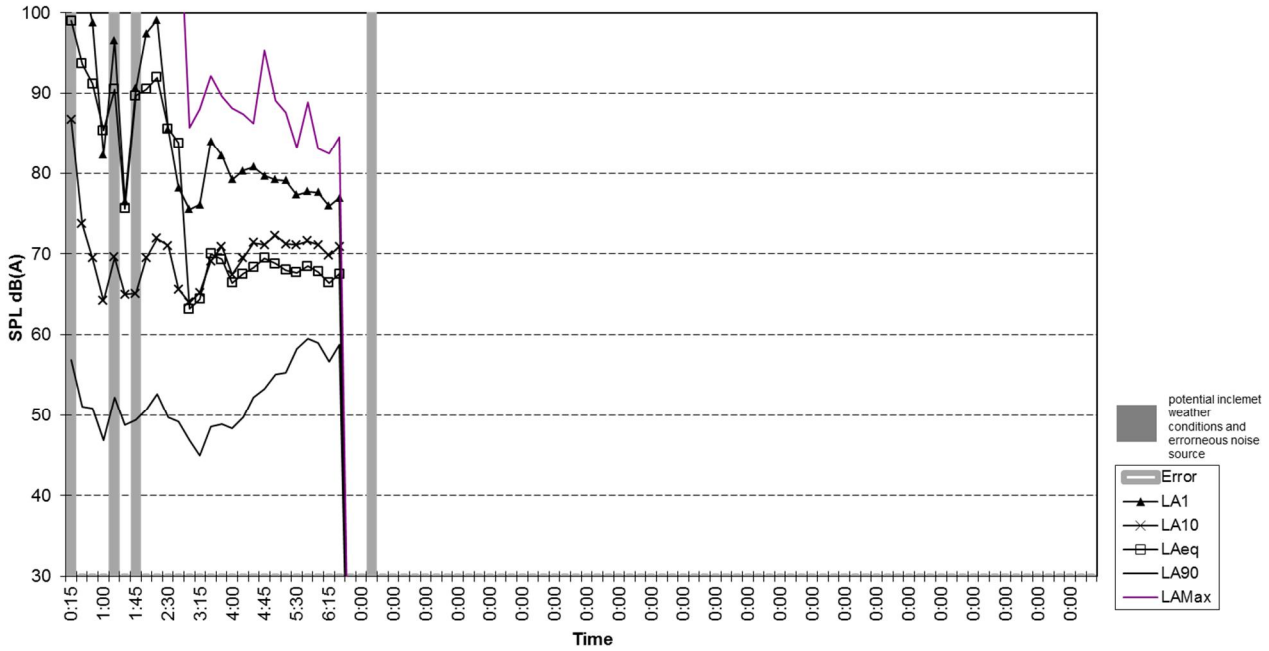
Location A- 5 Groongal St Mayfield West NSW 2304
Measured Noise Levels - Saturday 12/10/2013

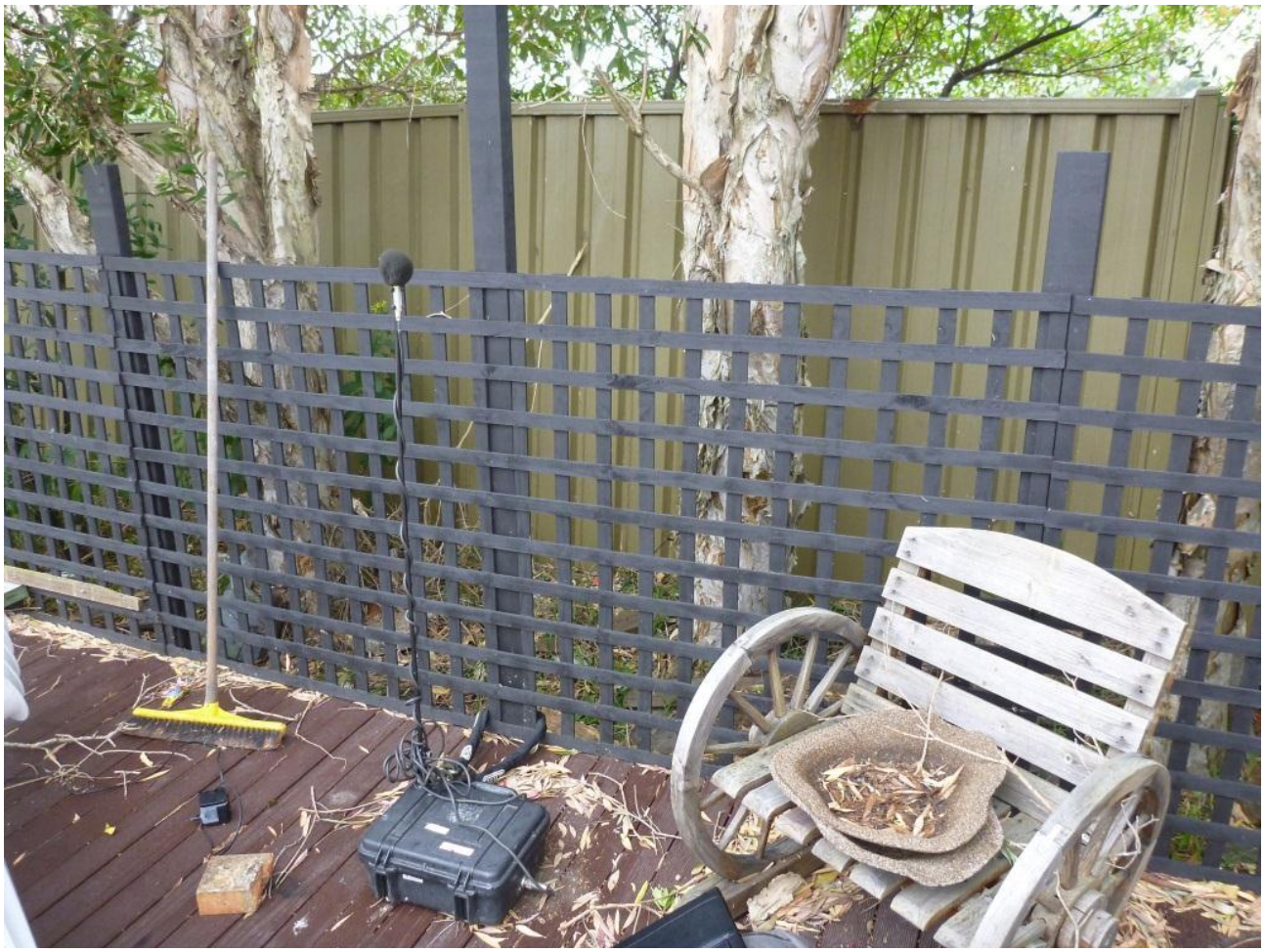


Location A- 5 Groongal St Mayfield West NSW 2304
Measured Noise Levels - Sunday 13/10/2013

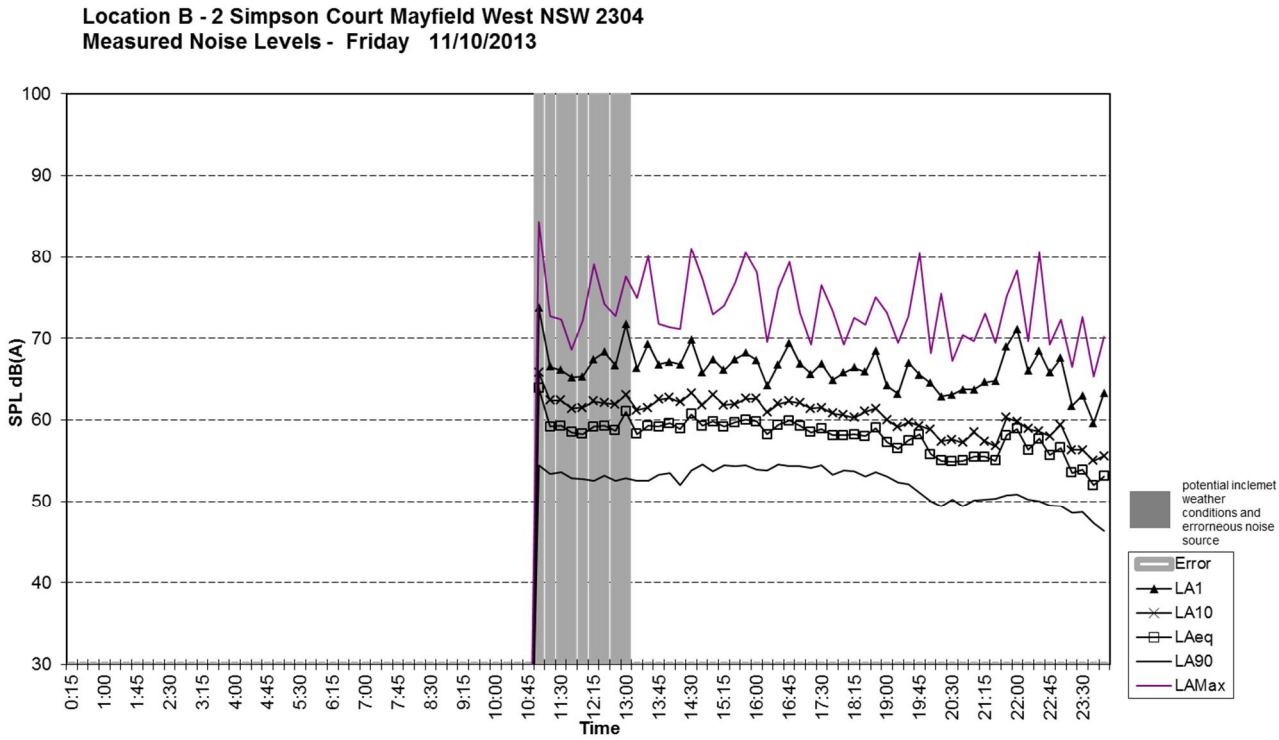


Location A- 5 Groongal St Mayfield West NSW 2304
Measured Noise Levels - Monday 14/10/2013

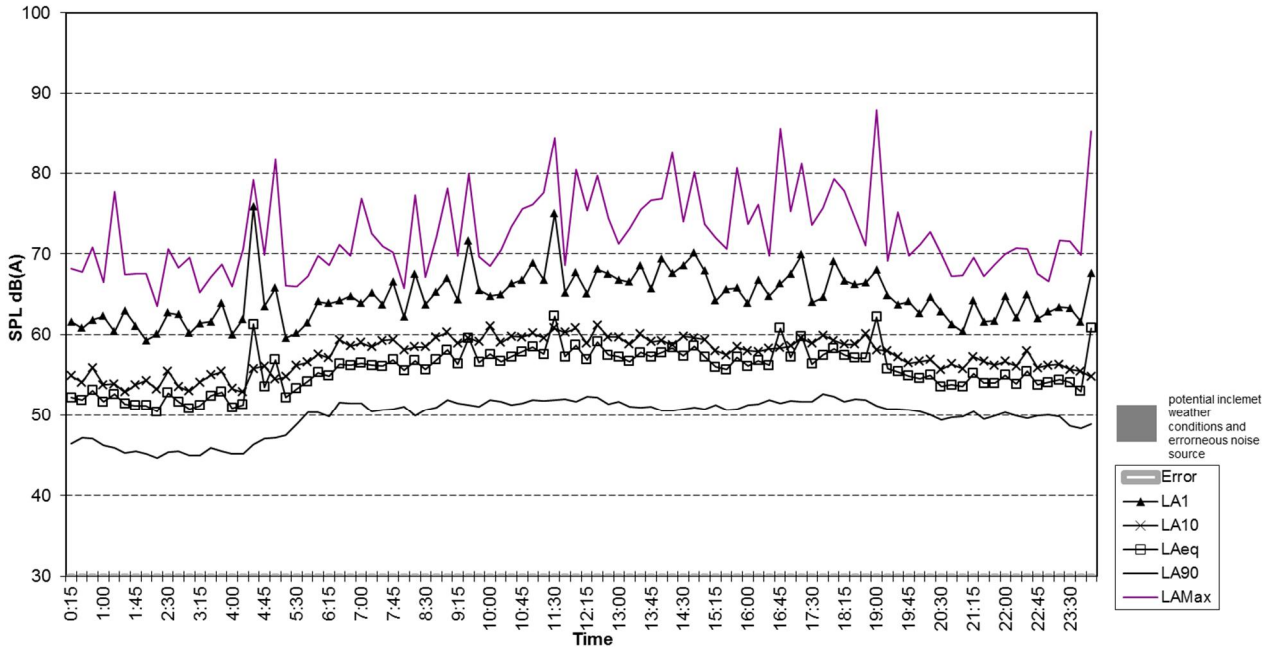




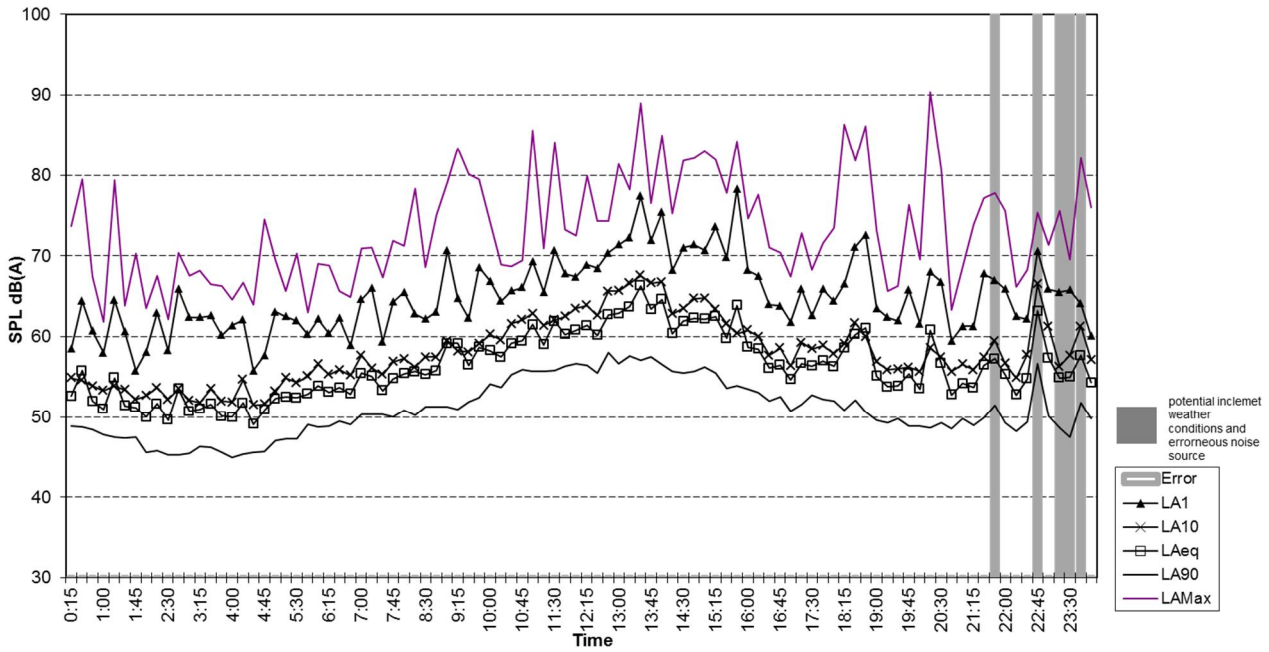
Monitoring Location B 2 Simpson Court Mayfield West NSW
32.887529 South, 151.73217 East



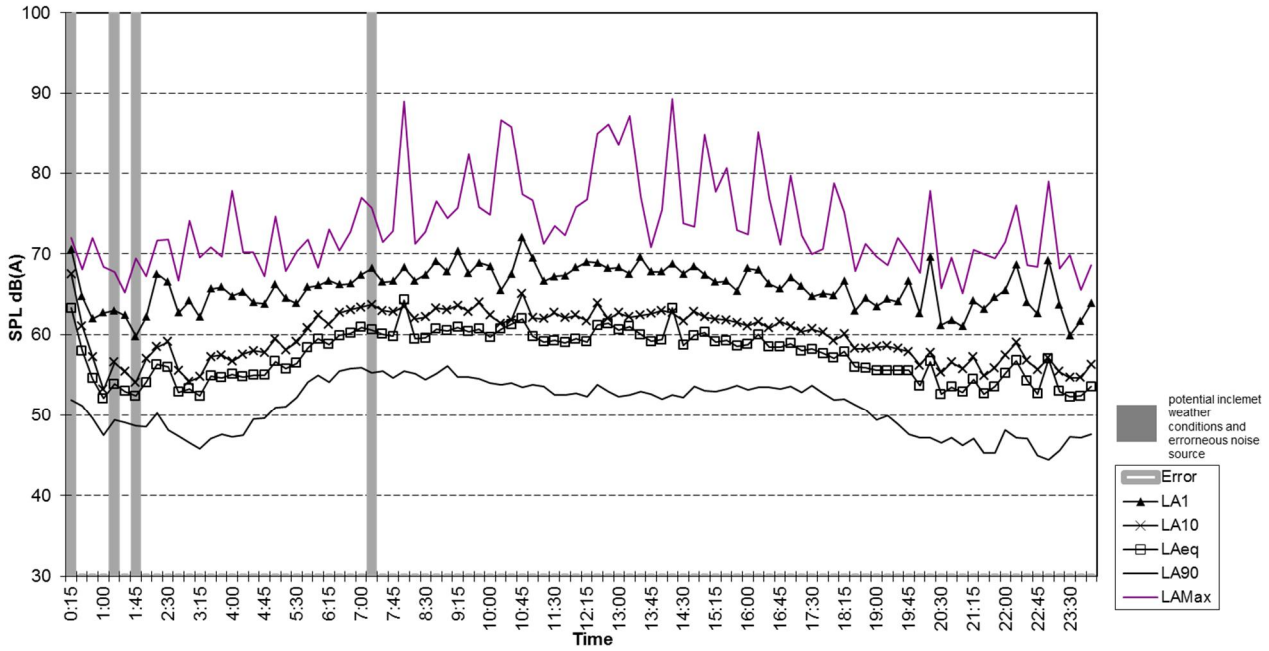
Location B - 2 Simpson Court Mayfield West NSW 2304
Measured Noise Levels - Saturday 12/10/2013



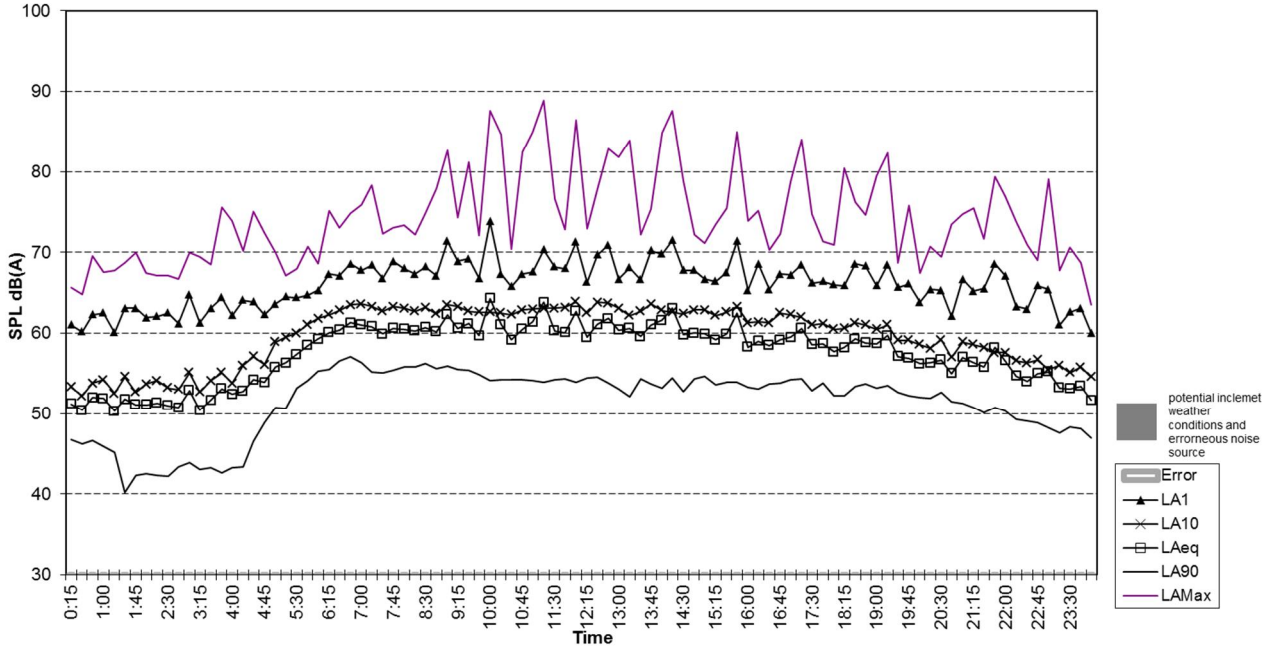
Location B - 2 Simpson Court Mayfield West NSW 2304
Measured Noise Levels - Sunday 13/10/2013



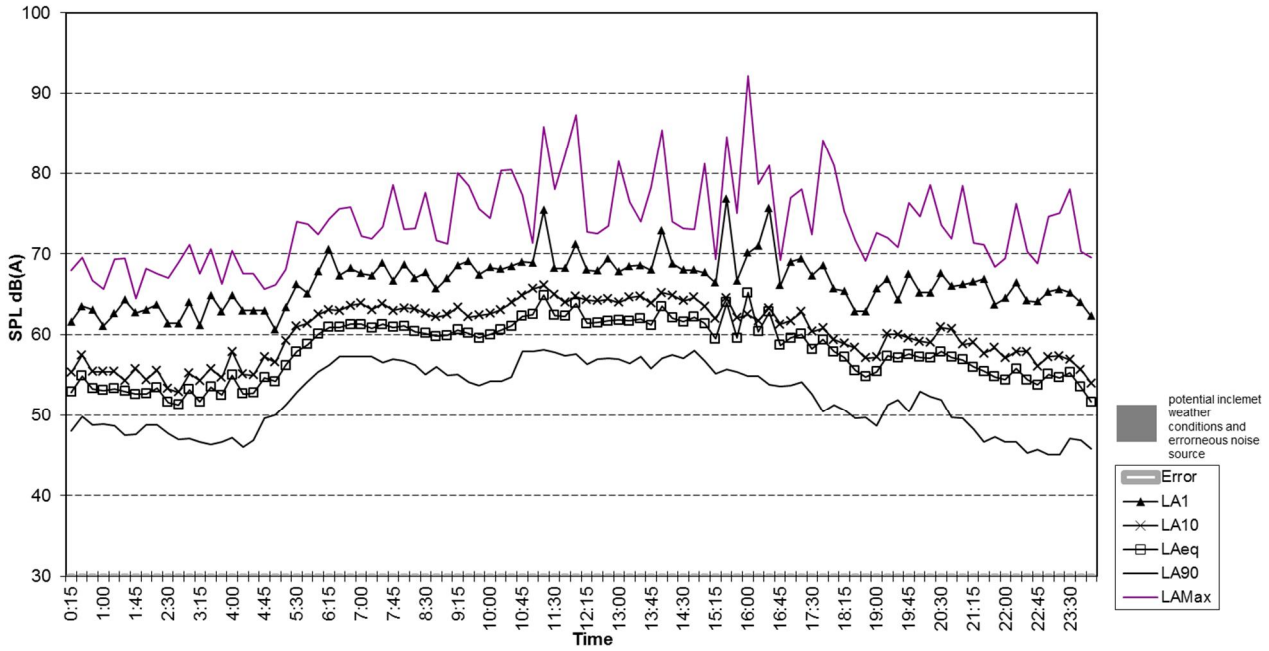
Location B - 2 Simpson Court Mayfield West NSW 2304
Measured Noise Levels - Monday 14/10/2013



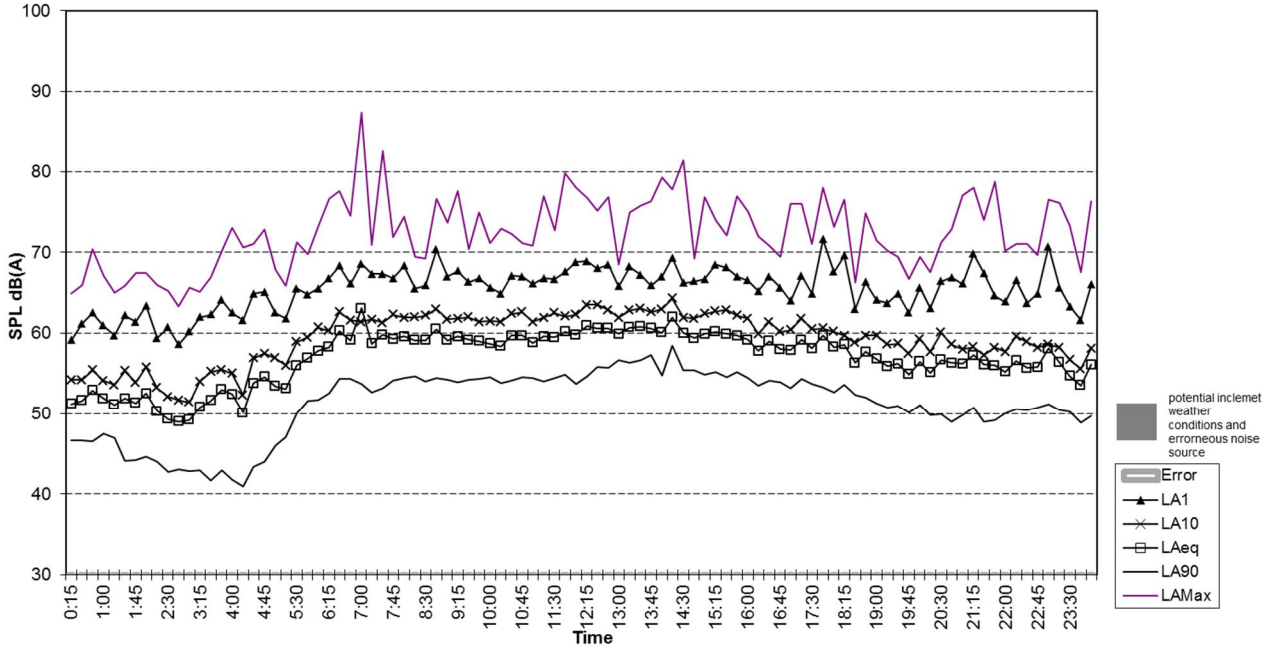
Location B - 2 Simpson Court Mayfield West NSW 2304
Measured Noise Levels - Tuesday 15/10/2013



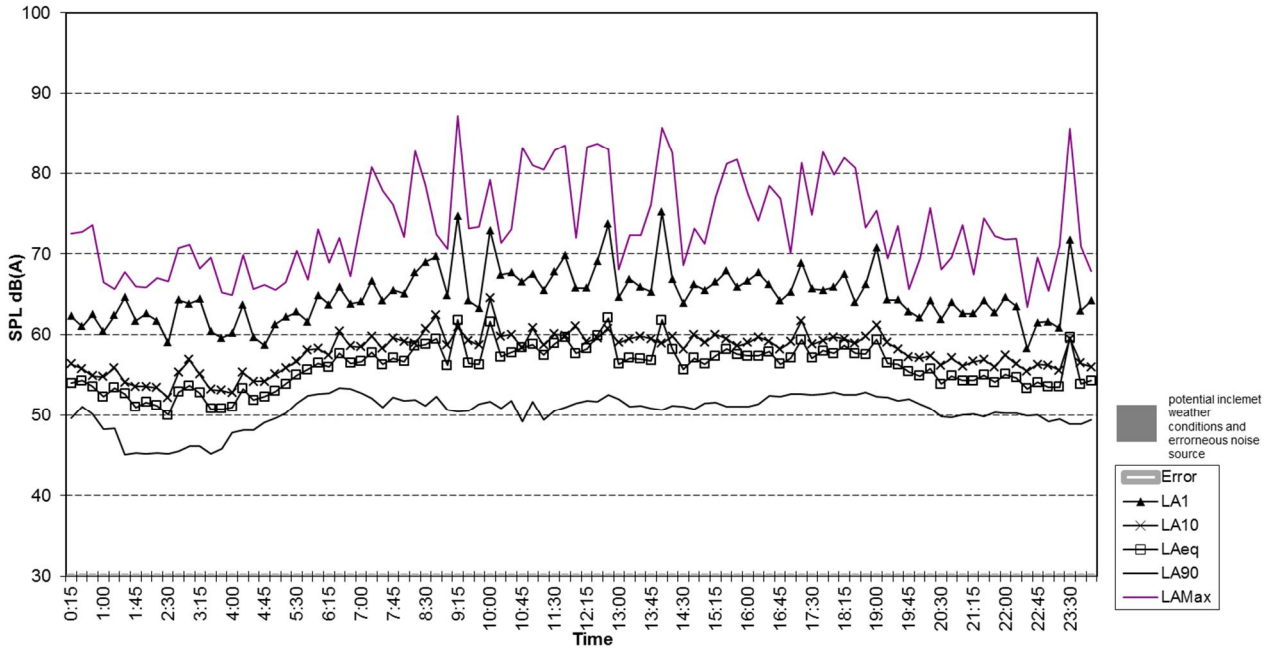
Location B - 2 Simpson Court Mayfield West NSW 2304
Measured Noise Levels - Thursday 17/10/2013



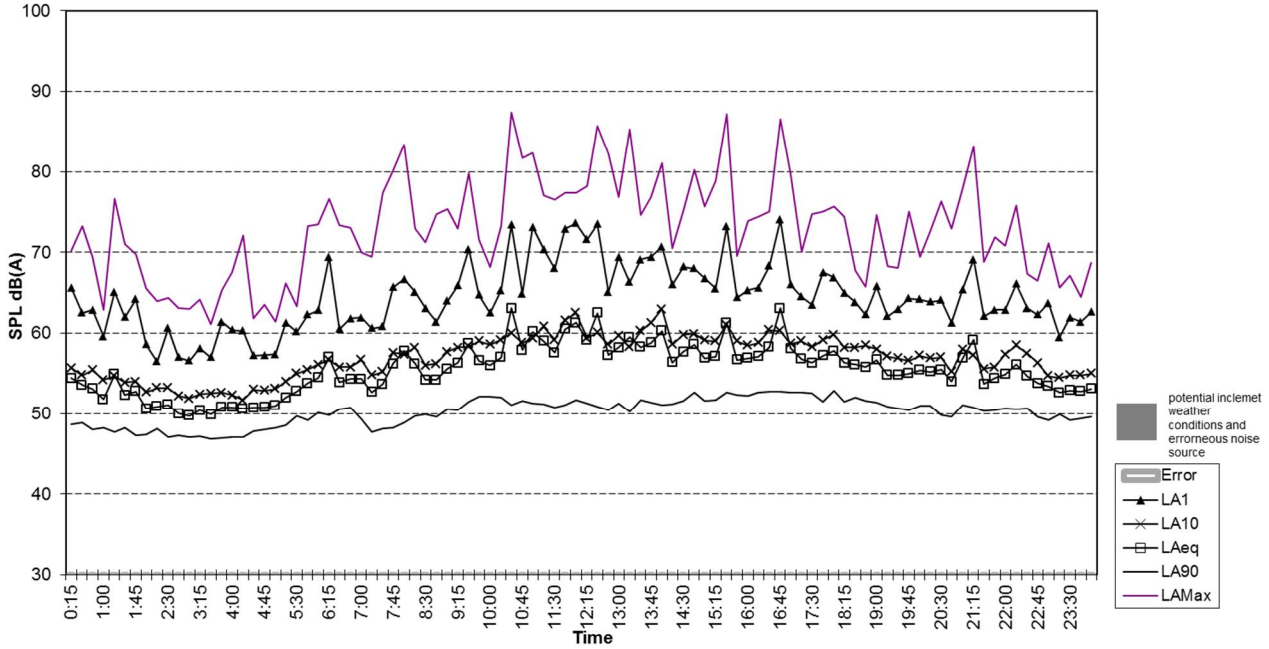
Location B - 2 Simpson Court Mayfield West NSW 2304
Measured Noise Levels - Friday 18/10/2013

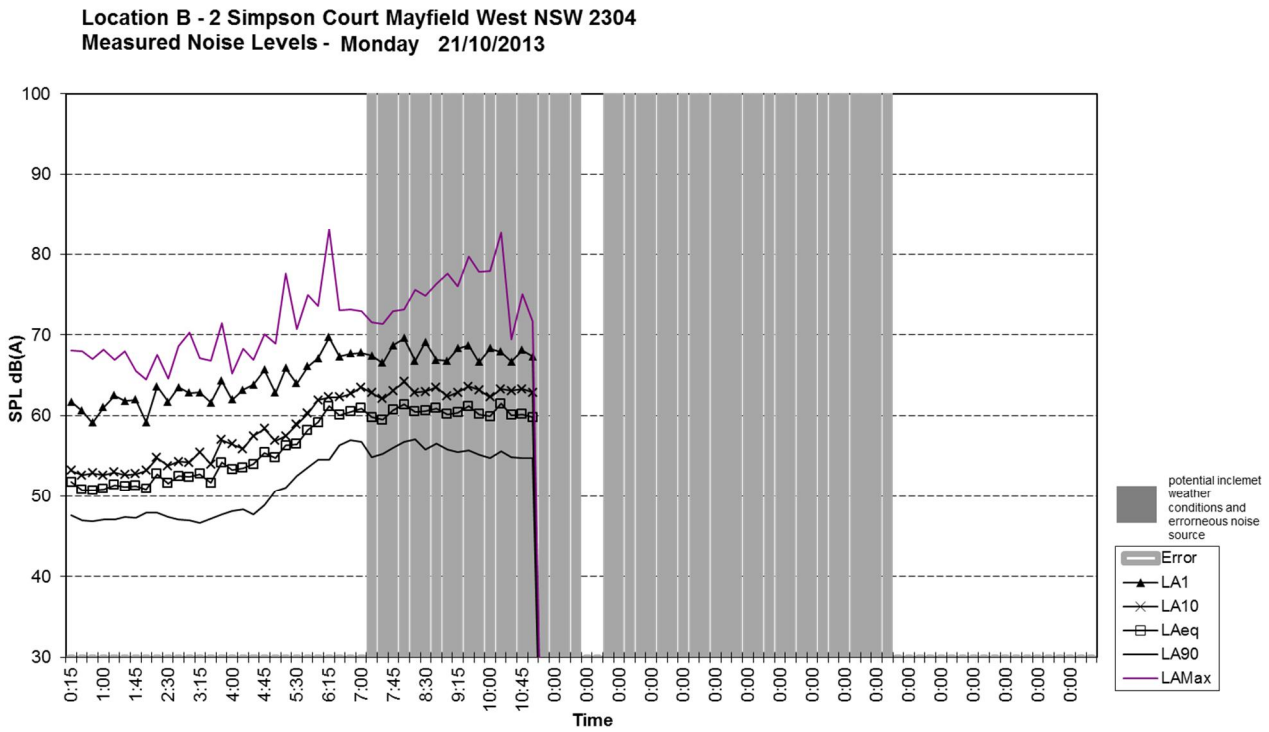


Location B - 2 Simpson Court Mayfield West NSW 2304
Measured Noise Levels - Saturday 19/10/2013



Location B - 2 Simpson Court Mayfield West NSW 2304
Measured Noise Levels - Sunday 20/10/2013




Location B - 2 Simpson Court Mayfield West NSW 2304
Measured Noise Levels - Monday 21/10/2013
SPL dB(A)
Time
potential inclemet weather conditions and errorneous noise source
Error
LA1
LA10
LAeq
LA90
LAMax

Appendix B

Calibration certification

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

Calibration Certificate

Number : C13133

Client Details : Parsons Brinckerhoff (Sydney)
Level 27, Ernst & Young Centre, 680 George
Sydney NSW 2000

Equipment Tested/ Model Number : **ARL EL-316**
Instrument Serial Number : 16-207-008
Microphone Serial Number : 312579
Preamplifier Serial Number : 27471

Ambient Temperature : 24°C
Relative Humidity : 52%
Barometric Pressure : 101.4 kPa

Calibration Technician : Adrian Walker
Calibration Date : 22-March-2013
Secondary Check by : Kirsten Gillies
Report Issue Date : 27-March-2013
Approved Signatory :

Tested To : AS1259.1:1990
AS1259.2:1990

Comments : All tests passed for type 1

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	Pass	10.4.5: R.M.S performance	Pass
10.2.3: Frequency weighting	Pass	9.3.2: Time averaging	Pass
10.3.2: Overload indications	Pass	9.3.5: Overload indication	Pass
8.9: Detector-indicator linearity	Pass		
8.10: Differential level linearity	Pass		
10.3.4: Inherent weighted system noise level	Pass		
10.4.2: Time weighting characteristics F and S	Pass		

NATA

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Pennant Hills NSW AUSTRALIA 2120
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Calibration Certificate

Number : C13003

Client Details : Parsons Brinckerhoff
Level 27; Ernst & Young Centre, 680 George St
Sydney NSW 2000

Equipment Tested/ Model Number : ARL EL-316

Instrument Serial Number : 16-207-023

Microphone Serial Number : 317328

Preamplifier Serial Number : 27521

Ambient Temperature : 22°C

Relative Humidity : 53%

Barometric Pressure : 100.57 kPa

Calibration Technician : Alan Rutherford

Calibration Date : 08-January-2013

Secondary Check by : Sandra Minto

Report Issue Date : 10-January-2013

Approved Signatory :

Tested To : AS1259.1:1990
AS1259.2:1990

Comments : All tests passed for type 1

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	Pass	10.4.5: R.M.S performance	Pass
10.2.3: Frequency weighting	Pass	9.3.2: Time averaging	Pass
10.3.2: Overload indications	Pass	9.3.5: Overload indication	Pass
8.9: Detector-indicator linearity	Pass		
8.10: Differential level linearity	Pass		
10.3.4: Inherent weighted system noise level	Pass		
10.4.2: Time weighting characteristics F and S	Pass		

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