

182-198 VICTORIA ROAD AND 28-30 FAVERSHAM STREET, MARRICKVILLE

Acoustic Assessment for Development Application - Mixed use Development

11 November 2019

TOGA Wicks Park Developments Pty Ltd

TK484-04F02 Acoustic Assessment for DA (r4)

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We have derived data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination and re-evaluation of the data, findings, observations and conclusions expressed in this report.

We have prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

The information contained herein is for the purpose of acoustics only. No claims are made and no liability is accepted in respect of design and construction issues falling outside of the specialist field of acoustics engineering including and not limited to structural integrity, fire rating, architectural buildability and fit-for-purpose, waterproofing and the like. Supplementary professional advice should be sought in respect of these issues.

Executive summary

Renzo Tonin & Associates were engaged to conduct an acoustic assessment of the proposed mixed use development at 182-198 Victoria Road and 28-30 Faversham Street, Marrickville to accompany an application for Development Application.

As a result of our assessment the following potential acoustic issues were identified;

- Traffic noise associated with Victoria Road intruding into the development
- Aircraft noise from Sydney's Kingsford Smith Airport intruding into the development
- Noise emission from the operation of the development such as air-conditioning and mechanical ventilation equipment impacting upon existing premises surrounding the site

This report presents an assessment of the above acoustic components in terms of Council's Development Control Plans, State Environmental Planning Policy (Infrastructure), Australian Standards and NSW Environmental Protection Authority noise policies.

External Noise Intrusion into the Development

External noise intrusions into the development (major sources being aircraft noise and road traffic noise) were assessed in accordance with Inner West Council Marrickville DCP 2011, ISEPP 2007, and AS2021. Consideration has also been given to existing live music venues in the vicinity, as requested by Council.

Based on the external noise impacting upon the development site, appropriate design of the building envelope is required to achieve a suitable indoor amenity for occupants. Our assessment has established that a combination of heavy laminated glass and double glazing were required to some areas for acoustics.

Noise Emission Generated by the Development

Noise from mechanical plant such as building exhaust systems and air-conditioning associated with the development has the potential to impact on nearby noise-sensitive premises. As details of mechanical plant are not available at this stage of the development in-principle noise control advice are present in this report.

Construction Noise

The major construction activities proposed on this site are excavation works, concrete pours and general building works. Construction and building work will be adequately managed so as to minimise disruption to the local community and the environment. As details of construction equipment and operating time are not available at this stage of the project, in-principle noise and vibration measures are provided in this report.

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1 Introduction

Renzo Tonin & Associates were engaged to assess noise impacts onto and the proposed mixed-use development at 182-198 Victoria Road, Marrickville and 28-30 Faversham Street. This report is intended to accompany the Development Application submission.

This study examines the effects of external noise intrusion onto the proposed development from aircraft, road traffic noise and existing live music venues. Noise surveys were carried out on site by Renzo Tonin & Associates from 17th -21st December 2018 and the 18th - 30th September 2019 to establish the existing levels of external noise affecting the development and the background noise levels in the absence of the development.

The site measured traffic noise levels were used to predict noise levels inside the future apartments and then assessed against the recommended internal noise criteria for the project. In addition, an assessment of aircraft noise intrusion was conducted in accordance to Australian Standard AS2021:2015, utilising the site measured aircraft noise spectrum.

Attended measurements were undertaken of noise emissions from the Red Rattler and Marrickville Bowling Club. Their impact on the proposed development has been assessed on the assumption that their noise emissions to existing residential receivers are compliant with their development consents.

Project noise emission goals for the operation of mechanical plant and equipment have been set in accordance with the NSW Environment Protection Authority *Noise Policy for Industry*. A full assessment of mechanical noise emissions cannot be conducted at this time as final plant selections are not yet available. A follow-up assessment shall be prepared for Construction Certificate detailing the proposed selections, the plant noise levels and the treatments proposed for compliance with the project noise emission goals defined herein.

The management of noise emissions from the use of commercial/retail space on the Ground Floor will be subject of a separate Development Application, to be prepared by the future tenant.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

2 Site and Surrounds

The proposed development is located on to the north of Wicks Park Marrickville at 182-198 Victoria Road and 28-30 Faversham Street. The development is to consist of a 6 storey building fronting Victoria Road with 12 storeys at the rear of the site, arranged around a central courtyard of common outdoor space. The Ground Floor is to accommodate predominantly Retail uses, with residential apartments commencing from Level 1.

The site is bounded by Victoria Road to the west, existing commercial/ light industrial to the north and east, Wicks Park to the south and residential and commercial to the west.

Long-term noise monitoring has been undertaken opposite the proposed development site on Victoria Road at Location 1 and at 26 Faversham Street as indicated in Figure 1 below to determine existing acoustic environment.

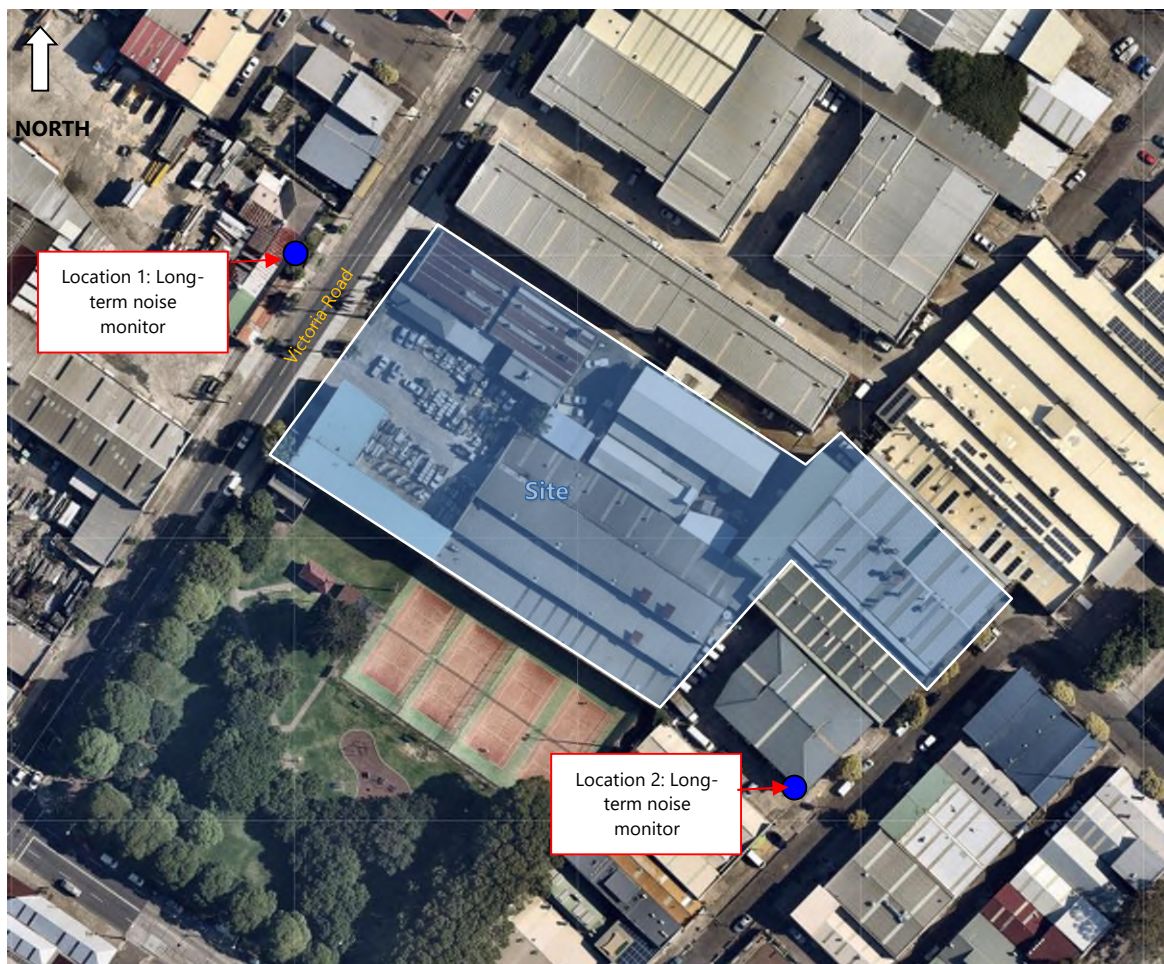


Figure 1 - Noise Monitoring Location & Site Surrounds

3 Acoustic Design Criteria

Long-term noise surveys were conducted on site from 17th December and 21st December 2018 and 18th September to 30th September 2019 to determine existing levels of traffic, aircraft, music and ambient noise surrounding the site. These levels were used to predict noise levels within the residential spaces and assessed against the internal noise criteria recommended for this development.

3.1 Road Traffic Noise Criteria

The internal noise criteria for this development are based on the following relevant Standards, Government Policies, Guidelines and Council Development Control Plans.

1. Inner West Council - Marrickville Development Control Plan 2011
2. State Environment Planning Policy (Infrastructure 2007) - ISEPP2007
3. Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008
4. Australian Standard AS/NZS 2107:2000 "Acoustics – Recommended design sound pressure levels and reverberation times for building interior"

The Department of Planning provides a guideline on assessing noise and vibration impacts from rail corridor or busy road to the requirements of the State Environmental Planning Policy (Infrastructure 2007) or ISEPP. The assessment is mandatory for busy roads with an Annual Average Daily Traffic (AADT) volume exceeding 40,000 and is recommended for roads with an AADT greater than 20,000. Table 3.1 of the guideline is presented in APPENDIX A outlines the interior noise criteria for road traffic.

The Roads and Maritime Services (RMS) publishes traffic volume maps for ISEPP identifying which major roads within the Sydney Metropolitan area have AADT greater than 40,000 and roads with AADT between 20,000 and 40,000. Victoria Road is identified as road having an AADT of less than 20,000, however, Sydenham Road is located 90m to the south of the development site with no intervening structures, and is identified as a road recommended for assessment (>20,000 and <40,000 AADT), therefore consideration for of ISEPP acoustic criteria applies to this development (although compliance is not mandatory).

The recommended internal noise criteria for the development is summarised in Table 1 below.

Table 1: Recommended Maximum Internal Road Traffic Noise Levels

Occupancy	Period	Maximum Noise Level
Living areas (includes open-plan kitchens, dining, family room, media and study rooms)	7am – 10pm	40 dB(A) $L_{Aeq, 15hr}$
Sleeping areas	10pm – 7am	35 dB(A) $L_{Aeq, 9hr}$

Relevant sections of State Environment Planning Policy, Council's DCP, and Government Policies are presents in APPENDIX A of this report. Results of the background and ambient noise monitoring conducted on site are presented in APPENDIX D.

3.2 Aircraft Noise Criteria

The site is located 2.5km to the north of the Sydney's Kingsford Smith Airport, within close proximity. From our site inspections it was observed that the development is potentially affected by aircraft movement on the main north-south runway, namely take offs to the north from the 34L runway and landings to the south on runway 16R. The Australian Standard AS2021-2015 – "Acoustics – Aircraft Noise Intrusion – Building Siting and Construction" provides internal design noise levels, zoning information and guideline for evaluating aircraft noise impacts on residential and commercial buildings.

Table 2 below is an extract of Table 2.1 in AS2021-2015 with the building types relevant to this assessment.

Table 2: Building Site Acceptability Based on ANEF Zones (Table 2.1 – AS2021-2000)

Building Type	ANEF Zone of Site		
	Acceptable	Conditionally Acceptable	Unacceptable
House, home unit, flat, caravan park	Less than ANEF 20	20 to 25 ANEF	Greater than 25 ANEF
Commercial Building	Less than ANEF 25	25 to 35 ANEF	Greater than 35 ANEF

The Standard also recommends the following internal design noise levels for the proposed residential development:

Table 3: Recommended Maximum Internal Aircraft Noise Levels (Table 3.3 – AS2021-2000)

Building Type and Activity	Indoor design aircraft sound level, $L_{A,max}$ dB(A)
Houses, home units, flats, caravan parks	
Sleeping areas, dedicated lounges	50
Other habitable spaces	55
Bathrooms, toilets, laundries	60
Commercial	
Shop	75

The above sound levels are the maximum levels from an aircraft flyover which, when heard inside the specified area by the average listener will be judged as not intrusive or annoying by that listener. Owing to the variability of subjective responses to aircraft noise, these figures may not provide sufficiently low interior noise levels for occupants who have a particular sensitivity to aircraft noise. Relevant sections of the AS2021 are presented in APPENDIX A of this report.

3.3 ANEF Zoning

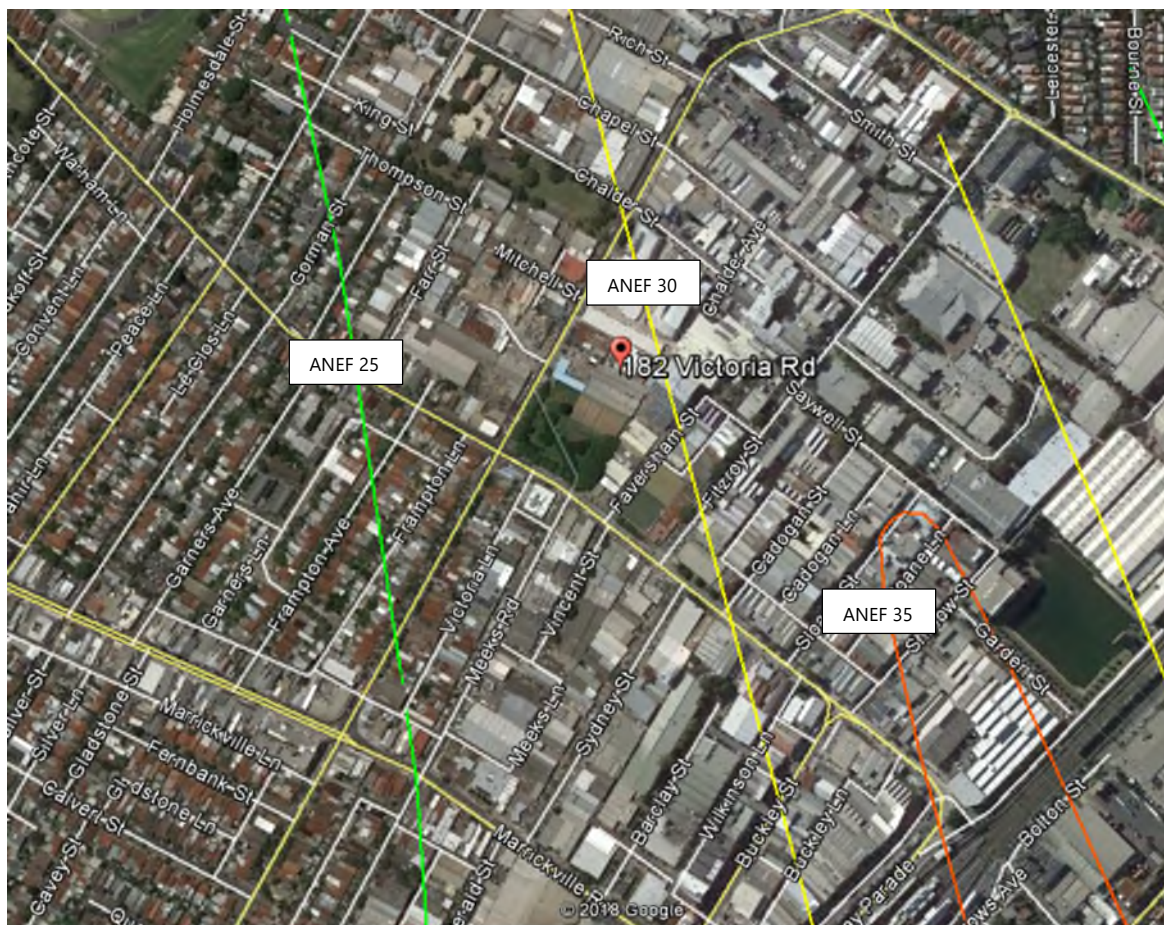
The current ANEF map for Kingsford Smith Airport is the ANEF 2033, approved by the Federal Minister for Infrastructure, Transport and Regional Development and Local Government. The ANEF curves in the 2033 map are generally reduced in comparison to the ANEF 2023/24. This is because of the impact of aircraft which are now quieter, a trend that will accelerate over the next 20 years with the introduction of new generation aircraft including the Airbus A380, Boeing 777 and Boeing B787 Dreamliner.

The applicable noise exposure zones obtained from the ANEF contours are summarised in Table 4

Table 4: Location of Site Relevant to Aircraft Noise Exposure Charts

Assessment Chart	ANEF Zone
ANEF 2033	25-30

According to the ANEF map, the residential component of the property lies within the **Unacceptable** zone nominated in Australian Standards AS2021-2015 – “Acoustics – Aircraft Noise Intrusion – Building Siting and Construction”.



3.4 Aircraft Noise Levels

Aircraft noise exposure levels were calculated for the development site based on Australian Standard AS2021-2015.

To determine resultant aircraft noise levels the following factors were considered as specified in the Standard;

- The site's position relative to each runway, including take-off and landing distances and runway centre line offsets;
- Elevation of the site compared with the elevation of the runways; and,
- Type of aircraft and associated maximum noise level during take-off and landing.

Using these factors, the resultant maximum noise levels were determined for each aircraft type. This calculation is not based on ANEF contours but on the location of the site relative to the runways.

It has been determined that the aircraft operation on the main north-south runway (runway 34L for departure) impacts most onto the proposed development site.

Clause 3.1.4 of the Standard, *"where there is evidence that the particular aircraft type and movement which produced that noise level do not constitute a typical operation, then the noise level can be ignored and the next lowest noise level selected"*.

In accordance to the above Clause, aircraft operations not constituting a typical operation have been excluded from this study. In this case, the upper 5% of movements are assumed to *"not constitute a typical operation"* and were excluded.

Based on published aircraft noise levels in the Standard AS2021-2015, the maximum external noise levels resulting from aircraft flyovers has been determined.

The table below shows the maximum design noise level at the development site.

Table 5: Maximum Noise Levels at Assessment Location as per AS2021

Aircraft Type	Maximum Noise Level dB(A)	
	Arrivals (Runway 16R)	Departure (Runway 34L - long-range curved flightpath)
Airbus A320	75	77
Airbus A380	79	85
Boeing 737-800	79	84
Boeing 787	76	80

The maximum external aircraft noise levels resulting from aircraft flyovers have been calculated in accordance with AS2021-2015. Accordingly, the design noise level at the subject site is 85dB(A) (Note: this level is also supported by the results of the on site noise monitoring).

It should be noted that variations in flight paths and aircraft operational characteristics may generate external noise levels greater than calculated here. The accuracy of noise calculations made in accordance with the AS2021-2015 has been the subject of discussion by the Association of Australian Acoustical Consultants (AAAC) and communicated to various Council's affected by aircraft noise.

The required aircraft noise reductions (ANR) for areas in the proposed development are as follows:

Table 6: Required Aircraft Noise Reduction for the Proposed Development

Area	Required ANR
Residential	
Sleeping areas, dedicated lounges	35
Other Habitable spaces	30
Bathrooms, toilets, laundries	25
Commercial	
Shop	10

The external noise levels are used to calculate the expected internal noise level by taking into account the sound attenuation provided by the building facade. Where internal noise levels exceed the criteria nominated in AS2021-2015, noise mitigation can be implemented using well-established noise control methods such laminated glass and treatment to the facades, roof and ceiling.

4 Measured Noise Levels

4.1 Long-term Noise Survey

An environmental noise monitor was installed in the front yard of 173 Victoria Road (directly opposite the proposed development site) to determine existing traffic, aircraft and ambient noise levels as shown in Figure 1 above. The ambient and background noise surveys were conducted between 17th December and 21st December 2018.

An additional environmental noise monitor was installed on the South Western façade of 26 Faversham Street (adjacent to the proposed development site) to record music noise from nearby licensed premises and ambient noise levels as shown in Figure 1 above. The noise surveys were conducted between 18th and 30th December 2018.

The noise loggers records noise levels on a continuous basis and store data every fifteen minutes. The noise loggers were calibrated before and after measurements and no significant deviation in calibration was noted. The noise monitoring equipment used here complies with Australian Standard 1259.2-1990 "Acoustics - Sound Level Meters" and is designated as Type 2 instruments suitable for field use.

The results of the background and ambient noise monitoring conducted on site are presented in APPENDIX D.

4.2 Measured Traffic Noise Level

The representative L_{Aeq} sound pressure levels for the week during day (7am to 10pm) and night time (10pm to 7am) from the long-term noise survey are taken as the design external traffic noise level. The design external traffic noise levels are presented Table 7 below. These external noise levels will be used in determining the building facade treatment to achieve compliance with interior noise levels defined in Table 1.

Table 7: Representative Day and Night Traffic Noise Levels

Monitoring Location	Survey Period	Measured Maximum Traffic Noise Level $L_{Aeq, T}$ ^{1,2}
Location 1: 173 Victoria Road, Marrickville	Day time (7am to 10pm)	71 dB(A)
	Night time (10pm to 7am)	68 dB(A)

Notes:

- Noise levels presented are façade corrected.
- Representative road traffic noise level in measured L_{Aeq} over 15 hour and 9 hour day and night period respectively.

4.3 Existing Noise Environment at Development Site

The results of the long-term noise monitoring have been summarised in accordance with Noise Policy for Industry requirements published by NSW Environmental Protection Authority (EPA) and are presented in Table 8 below.

Table 8: Measured Site Background Noise Levels

Noise Monitoring		Representative L _{A90} Background Noise Levels in dB(A)		
Location	Duration	Day ¹	Evening ²	Night ³
Location 1: 173 Victoria Road, Marrickville	17.12.2018 – 21.12.2018	57	52	43
Location 2: 26 Faversham Street, Marrickville	18.09.2019 – 30.09.2019	47	47	40

Notes:

Day, Evening & Night assessment periods are defined in accordance NSW EPA's Noise Policy for Industry as follows.

1. Day is defined as 7:00am to 6:00pm, Monday to Saturday; 8:00am to 6:00pm Sundays & Public Holidays. As results were affected by construction noise weekend day and Saturday morning, Sunday results have been presented for the Day time period
2. Evening is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays
3. Night is defined as 10:00pm to 7:00am, Monday to Saturday; 10:00pm to 8:00am Sundays & Public Holidays

The representative background noise levels (L_{A90}) are used in defining external noise emission from the development such as mechanical ventilation and air-conditioning systems in accordance to EPA Noise Policy for Industry.

4.4 Calculated Internal Noise Levels

Results from the noise surveys were used to calculate internal noise levels within the proposed development. Noise calculations were conducted using the OutsideIn Glazing Spreadsheet developed in this office which take into account external noise levels, facade transmission loss and room sound absorption characteristics. Noise levels were calculated for each building facade to account for any variation in the external noise levels affecting different parts of the building.

Glazing constructions required to comply with the nominated noise criteria are presented in the body of this report.

5 Recommendations

5.1 Glazing Design Requirements

Table 9 below presents recommended glazing treatment for the building facades to achieve compliance with the maximum noise levels nominated in Table 1 and Table 3 above.

Table 9: Recommended Glazing Treatment

Level	Facade	Occupancy Type	Recommended Minimum Sound Insulation Rating of Glazing Assembly	Typical Compliance Configuration	Laboratory Test Reference
Residential					
All Levels	Western Facade facing Victoria Road	Bedrooms – total glazed area up to 3.8m ² (or 41% of the floor area)	Rw 37	Heavy laminated glass (nominally 12.5mm vlam hush or acoustically approved equivalent) to achieve require Rw rating and spectral characteristics	ESTIMATE
		Bedrooms – total glazed area up to 12.2m ² (or 120% of the room floor area)	Rw 43-44	Double Glazing: Reynaers CP 155 double glazing system: 6mm and 6mm with double interlayer / 16mm airgap / 8mm and 8mm with double interlayer; Schuco ASS70: 14.28mm laminated / 24mm airgap / 14.28mm laminated Schuco ASS70 14mm float / 24mm airgap / 10mm float	ESTIMATE
		Living/Dining/Kitchen–glazed area facing Victoria Rd (includes corner rooms) up to 30% of the room floor area	Rw 35	Nominal selection 10.38mm laminated	ESTIMATE
		Corner Living/Dining/ Kitchen – glazed area up to 47% of the room floor area	Rw 37	Heavy laminated glass (nominally 12.5mm vlam hush or acoustically approved equivalent) to achieve require Rw rating and spectral characteristics	ESTIMATE
	East facade	Living/Dining/Kitchen – glazed area up to a total 52% of the room floor area overall (i.e. additional glazing is permitted on the façade protected from traffic noise to a total of 52% of the room floor area)	Rw 35	Nominal selection 10.38mm laminated	ESTIMATE

Level	Facade	Occupancy Type	Recommended Minimum Sound Insulation Rating of Glazing Assembly	Typical Compliance Configuration	Laboratory Test Reference
	Remaining facades	Bedrooms – total glazed area up to 3.8m ² (or 41% of the floor area)	Rw 37	Heavy laminated glass (nominally 12.5mm vlam hush or acoustically approved equivalent) to achieve require Rw rating and spectral characteristics	ESTIMATE
		Bedrooms – total glazed area >3.8m ² up to 12.2m ² (or 120% of the room floor area)	Rw 43-44	Double Glazing: Reynaers CP 155 double glazing system: 6mm and 6mm with double interlayer / 16mm airgap / 8mm and 8mm with double interlayer; Schuco ASS70: 14.28mm laminated / 24mm airgap / 14.28mm laminated Schuco ASS70 14mm float / 24mm airgap / 10mm float	ESTIMATE
		Living/Dining/Kitchen – glazed area up to a total 52% of the room floor area overall	Rw 35	Nominal selection 10.38mm laminated	ESTIMATE
Commercial					
G	All	Shops	Rw 28	6mm Float	ESTIMATE

By way of explanation, the Sound Insulation Rating Rw is a measure of the noise reduction property of the partition, a higher rating implying a higher sound reduction performance.

Note that the Rw rating of systems measured as built on site (R'w Field Test) may be up to 5 points lower than the laboratory result.

LEGEND where no appropriate test certificate exists:

1. ESTIMATE: The client is advised not to commence detailing or otherwise commit to partition construction systems which have not been tested in an approved laboratory or for which an opinion only is available. Testing of partition construction systems is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested partition construction systems, estimates or opinions. The advice provided here is in respect of acoustics only.
2. ESTIMATE – APPROVED FOR CONSTRUCTION: Use of the form of construction is approved prior to laboratory certification. To complete the quality control of the design process and confirm the acoustical performance of the construction, we recommend testing in a laboratory to confirm the Rw rating as soon as practicable. In the case of impact rating for floor systems, no particular impact rating is guaranteed to comply with either the Building Code of Australia or Strata Scheme Management Act and hence carpet runners may still be required.
3. ESTIMATE – TEST NOT REQUIRED: Use of the form of construction is approved without laboratory certification. The STC/Rw of the form of construction exceeds the project requirements.
4. The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

Level	Facade	Occupancy Type	Recommended Minimum Sound Insulation Rating of Glazing Assembly	Typical Compliance Configuration	Laboratory Test Reference
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NOTES FOR GLAZING CONSTRUCTIONS:

5. The information in this table is provided for the purpose of Council approvals process and cost planning and shall not be used for construction unless otherwise approved in writing by the acoustic consultant.
6. The design in this table is preliminary and a comprehensive assessment shall be conducted prior to Construction Certification.
7. Before committing to any form of construction or committing to any builder, advice should be sought from an acoustic consultant to ensure that adequate provisions are made for any variations which may occur as a result of changes to the form of construction where only an "estimate" is available for the sound insulation properties of recommended materials.
8. The glazing supplier shall ensure that installation techniques will not diminish the R_w performance of the glazing when installed on site.
9. All openable glass windows and doors shall incorporate full perimeter acoustic seals equivalent to Q-Lon, which enable the R_w rating performance of the glazing to not be reduced.
10. The above glazing thicknesses should be considered the minimum thicknesses to achieve acoustical ratings. Greater glazing thicknesses may be required for structural loading, wind loading etc.

GENERAL

11. The sealing of all gaps in partitions is critical in a sound rated construction. Use only sealer approved by the acoustic consultant.
12. Check design of all junction details with acoustic consultant prior to construction.
13. Check the necessity for HOLD POINTS with the acoustic consultant to ensure that all building details have been correctly interpreted and constructed.
14. The information provided in this table is subject to modification and review without notice.
15. The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

External walls are proposed to be upgraded double stud metal clad, concrete, brick veneer or alternative acoustically approved system, subject to detailed design. The acoustic rating of the wall system is to be 15 points better than the corresponding acoustic rating of the glazed system. This can be achieved using the upgraded light weight metal clad wall or masonry constructions proposed in conjunction with acoustic insulation materials.

Most apartments are not exposed to aircraft noise through the roof/ ceiling. For top floor apartments, the proposed roof construction is in-situ concrete with thermal insulation and a suspended ceiling below. Additional acoustic treatment is not required.

Before committing to any form of construction or committing to any contractor, advice should be sought from an acoustic consultant to certify that the forms of construction selected comply with the criteria nominated in this report and adequate provisions are made for any variations which may occur as a result of changes to the recommended forms of construction.

5.2 Ventilation

In accordance with the Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008:

If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia

In addition, Australian Standard AS2021:2015 Clause 3.3 states:

If it is necessary to close windows and doors to comply with this Standard, building ventilation should be in accordance with the National Construction Code on the assumption that windows and doors are not openable. Mechanical ventilation or air conditioning systems complying with AS1668.2 should be installed.

Where outside air intake is provided to the air conditioning system, the intake duct is to be acoustically treated for compliance with AS2021 and ISEPP internally subject to detailed design.

Based on measured and predicted external noise levels, the internal noise goals with windows opened cannot be achieved during aircraft flyovers. Therefore, an acoustically treated ventilation system is required to achieve the requirements of the National Construction Code and Australian Standard AS1668.2.

6 Assessment of Existing Entertainment Noise

In response to Inner West Council's request, a review of noise emissions from the Red Rattler and the Marrickville Bowling Club was undertaken to assess noise impacts from those uses on the future residents of the TOGA Wicks Park development. As part of this study, Renzo Tonin & undertook long term unattended noise monitoring at 26 Faversham Street, from the 18th to the 30th of September, inclusive. In addition, attended measurements were undertaken on Friday the 27th of September from 11:30pm to 2am.

6.1 Entertainment premises noise emission goals

6.1.1 Red Rattler

The original development consent was DA No. 200800322, determined 6th November 2008, which permitted operation of the licensed premises (including some after midnight trade) with the following acoustic controls.

6. The use of the premises not giving rise to:

- *transmission of unacceptable vibration to any place of different occupancy;*
- *a sound pressure level at any affected premises that exceeds the background (LA90) noise level in the absence of the noise under consideration by more than 3dB(A). The source noise level shall be assessed as an LAeq,15min and adjusted in accordance with Environment Protection Authority guidelines for tonality, frequency weighting, impulsive characteristics, fluctuations and temporal content as described in the NSW Environment Protection Authority's Environmental Noise Control Manual and Industrial Noise Policy 2000 and The Protection of the Environment Operations Act 1997 (NSW). 3 NOTE: Marrickville Council has adopted a 3dB(A) goal in order to prevent background noise creep and the 5dB(A) criteria as outlined in the above mentioned references are not to be used.*

8. Noise from patrons and amplified music emitted from the licensed premises shall comply with the following criteria:

(a) The L10 noise level emitted from the licensed premises shall not exceed 3dB(A) above the background(L90) noise level in any Octave Band Centre Frequency (31.5Hz to 8 KHz) between the hours of 7.00am to 12.00 midnight when assessed at the nearest affected residential boundary. The background noise level shall be measured in the absence of noise emitted from the licensed premises.

(b) The LA10 noise level emitted from the licensed premises shall not exceed the background (LA90) noise level in any Octave Band Centre Frequency (31.5Hz to 8 KHz) between the hours of 12.00 midnight to 7.00am when assessed at the nearest affected residential boundary. The background noise level shall be measured in the absence of noise emitted from the licensed premises.

(c) Notwithstanding compliance with the above clauses, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours of 12.00 midnight to 7.00am. Reason: To prevent loss of amenity to the area.

A number of modifications to the consent were approved over the intervening years (including special event approvals for Fringe Festival and similar), the most recent of which was determined on the 23rd of February 2016. The relevant acoustic controls remained as presented above.

6.1.2 Marrickville Bowling Club

Use of the Marrickville Bowling Club is subject of consent 201500261, dated the 7th of December 2015. This modification allowed for an extension to the hours of operation of the Club to allow dance parties to be held between the hours of 9.00pm and 6.00am the following day on either Friday, Saturday or Sunday (where a Public Holiday falls on a Monday) with no more than 2 dance parties being held in any given month

11. The use of the premises not giving rise to transmission of unacceptable vibration to any place of different occupancy in accordance with the NSW Environment Protection Authority's Environmental Noise Control Manual.

Reason: To prevent loss of amenity to the area.

12. The LA10 noise level emitted from the licensed premises shall not exceed 5dB above the background (LA90) noise level in any Octave Band Centre Frequency (31.5Hz to 8KHz inclusive) between the hours of 7.00am to 12.00 midnight when assessed at the nearest affected residential boundary. The background noise level shall be measured in the absence of noise emitted from the licensed premises.

The LA10 noise level emitted from the licensed premises shall not exceed the background (LA90) noise level in any Octave Band Centre Frequency (31.5Hz to 8KHz inclusive) between the hours of 12.00 midnight to 7.00am when assessed at the nearest affected residential boundary. The background noise level shall be measured in the absence of noise emitted from the licensed premises.

Notwithstanding compliance with the above clauses, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours 12.00 midnight to 7.00am.

Reason: To protect the amenity of the surrounding neighbourhood.

6.2 Noise Monitoring

6.2.1 Long term unattended noise monitoring

Long term unattended noise monitoring was undertaken at 26 Faversham Street, Marrickville from the 18th of September 2019 to the 30th September 2019, inclusive Refer to Location 2 on Figure 1.

The monitor microphone was located on the second floor of the building, with the microphone extending approximately 1m from the façade.

The equipment used for noise measurements was an NTi Audio Type XL2 precision sound level analyser which is a class 1 instrument having accuracy suitable for field and laboratory use. The instrument was calibrated prior and subsequent to measurements using a Bruel & Kjaer Type 4231 calibrator. No significant drift in calibration was observed. All instrumentation complies with IEC 61672 (parts 1-3) 'Electroacoustics - Sound Level Meters' and IEC 60942 'Electroacoustics - Sound calibrators' and carries current NATA certification (or if less than 2 years old, manufacturers certification).

Table 10 presents the broadband results from the unattended noise monitor.

Table 10 - Results from long term unattended noise monitor

Background & Ambient Noise Monitoring Results - NSW 'Noise Policy for Industry', 2017						
	LA90 Background Noise Levels ⁴			LAeq Ambient Noise Levels ⁶		
Date	Day ¹	Evening ²	Night ³	Day ¹	Evening ²	Night ³
Representative Weekday ⁵	48	47	40	62	61	54
Representative Weekend ⁵	45	46	41	61	60	53
Representative Week ⁵	47	47	40	61	61	53

Notes:

1. Day is 8:00am to 6:00pm on Sunday and 7:00am to 6:00pm at other times
2. Evening is 6:00pm to 10:00pm
3. Night is the remaining periods
4. Assessment Background Level (ABL) for individual days
5. Rating Background Level (RBL) for LA90 and logarithmic average for LAeq
6. Leq is calculated in the free field. 2.5dB is subtracted from results if logger is placed at façade

6.2.2 Attended noise monitoring

Attended noise measurements were undertaken from 11:30pm on Friday the 27th of September 2019 to 2:00am on Saturday the 28th of February 2019.

The results from the testing indicated that the noise emissions from the licensed premises may not be compliant with the conditions of consent to the existing residential receivers.

6.3 Assessment of noise impacts

Using the results of unattended noise monitoring, Renzo Tonin & Associates calculated the patron and music noise criteria to the nearest existing residential receivers. Then, assuming that the music and patron noise emitted by the licensed premises was compliant with its Development Consent at the existing receivers, predicted the resultant noise level to the proposed façade of the Wicks Park development.

The façade of the Wicks Park development has been designed for compliance with AS2021:2015 internally for noise from aircraft flyovers in proximity to the site. Taking into consideration the

transmission loss of the proposed façade, Renzo Tonin & Associates were able to predict the resultant internal noise level. Note: Due to the aircraft noise impacts on the site, the development is mechanically ventilated.

Before midnight, the predicted internal patron and music noise level into a bedroom was 23-25dB(A) $L_{eq}(15min)$ and 42-44dB(C) $L_{eq}(15min)$. Assuming windows closed, the predicted internal noise level at Wicks Park would be quieter than at existing residential receivers fitted with standard glazing.

After midnight, the licensed premises are conditioned to be inaudible in a habitable room of the worst affected residential receivers (assuming existing, although the consent doesn't specify), regardless of whether the window is open or closed. As Wicks Park is nearer to the source, the corresponding noise level would be louder and externally the music and patron noise could be audible at times hence the corresponding internal noise across an open window may also be audible.

After midnight, the predicted internal patron and music noise level into a bedroom of Wicks Park was in the order of 9dB(A) $L_{eq}(15min)$ and 39dB(C) $L_{eq}(15min)$. It was predicted that after midnight there could be times when music and patron noise could be faintly audible (being close to the Minimum Audible Field), however, considering the overall level it is unlikely that the internal music and patron noise would result in loss of amenity for the future resident. Further, it is possible that the associated internal mechanical plant noise (i.e. mechanical ventilation) could provide some masking of patron and music noise subject to detailed design for CC.

7 Internal Sound Insulation between Tenancies

Internal walls and floors shall comply with the National Construction Code Building Code of Australia 2016. All service pipes and entrance doors shall comply with the requirements of the NCC 2016. APPENDIX B presents a summary of acoustic provisions outlined in Part F5 of the NCC 2016.

8 External Noise Emission from Building Services

8.1 Noise Policy for Industry (NPfI)

The NSW EPA Noise Policy for Industry assessment has two components:

1. Controlling intrusive noise impacts in the short-term for residences; and
2. Maintaining noise level amenity for particular land uses for residences and other land uses;

8.1.1 Project intrusive noise levels

According to the NPfI, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the $L_{Aeq,15min}$ descriptor) does not exceed the background noise level measured in the absence of the source by more than 5dB(A). The project intrusiveness noise level, which is only applicable to residential receivers, is determined as follows:

$L_{Aeq,15minute}$ Intrusiveness noise level = Rating Background Level (RBL) plus 5dB(A)

8.1.2 Amenity noise trigger levels

The NPfI amenity trigger levels are designed to maintain noise level amenity for particular land uses, including residential and other land uses. The NPfI recommends base acceptable noise levels for various receivers, including residential, commercial, industrial receivers and other sensitive receivers in Table 2.2 of the NPfI. To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area a project amenity noise level applies for each new source of industrial noise as follows:

Project amenity noise level for industrial developments = recommended amenity noise level (NPfI Table 2.2) minus 5 dB(A)

Table 11: NPfI Amenity Criteria - Recommended L_{Aeq} noise levels from industrial noise sources [NSW NPfI Table 2.2]

Type of receiver	Indicative Noise Amenity Area	Time of day	Recommended amenity noise level $L_{Aeq(Period)}$
Residence	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60

Type of receiver	Indicative Noise Amenity Area	Time of day	Recommended amenity noise level $L_{Aeq(Period)}$
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	See column 4	See Column 4	5dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School classrooms - internal	All	Noisiest 1 hour period when in use	35
Hospital ward	All	Noisiest 1 hour period	
- internal			35
- external			50
Place of worship - internal	All	When in use	40
Area specifically reserved for passive recreation (e.g. National Park)	All	When in use	50
Active recreation area (e.g. school playground, golf course)	All	When in use	55
Commercial premises	All	When in use	65
Industrial premises	All	When in use	70
Industrial interface (applicable only to residential noise amenity areas)	All	All	Add 5dB(A) to the recommended noise amenity area

Note:

Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am

On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.

The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

8.1.3 Project amenity noise levels

The project amenity noise levels for different time periods of a day are determined in accordance with Section 2.4 of the NPfI. The NPfI recommends amenity noise levels ($L_{Aeq, period}$) for various receivers including residential, commercial, industrial receivers and sensitive receivers such as schools, hotels, hospitals, churches and parks. These "recommended amenity noise levels" represent the objective for **total** industrial noise experienced at a receiver location. However, when assessing a **single** industrial development and its impact on an area, "project amenity noise levels" apply.

To ensure that the total industrial noise level (existing plus new) remain within the recommended amenity noise levels for an area, the project amenity noise level that applies for each new industrial noise source is determined as follows:

$$L_{Aeq, period} \text{ Project amenity noise level} = L_{Aeq, period} \text{ Recommended amenity noise level} - 5\text{dB(A)}$$

Furthermore, given that the intrusiveness noise level is based on a 15 minute assessment period and the project amenity noise level is based on day, evening and night assessment periods, the NPfl provides the following guidance on adjusting the $L_{Aeq,period}$ level to a representative $L_{Aeq,15minute}$ level in order to standardise the time periods.

$$L_{Aeq,15minute} = L_{Aeq,period} + 3dB(A)$$

The following table presents the site-specific noise production criteria from industrial noise sources, namely mechanical plant from the residential component of the development.

Table 12: Project noise trigger level for noise emission from mechanical plant (EPA NPfI)

	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
Time of Day	Rating Background Level (RBL) L_{A90}	Intrusiveness Trigger Level, $L_{Aeq, 15minute}$ (RBL+5)	Recommended Amenity Noise Level (RANL), $L_{Aeq, period}$	Project Amenity Noise Level (PANL), $L_{Aeq, period}$	Measured $L_{Aeq, period}$ existing noise levels	Traffic noise exceed the RANL by more than 10dB?	Existing noise level likely to decrease in future?	Exceptions to PANL?	Project Noise Trigger Level $L_{Aeq, 15minute}$ dB(A)
Victoria Road Facade									
Day (7am to 6pm)	57	62	60	55	69	No	No	None	58
Evening (6pm to 10pm)	52	57	50	45	69	Yes	No	None	57
Night (10pm to 7am)	43	48	45	40	66	Yes	No	None	48
Day (7am to 6pm)	47	52	60	55	61	No	No	None	52
Evening (6pm to 10pm)	47	52	50	45	61	Yes	No	None	51
Night (10pm to 7am)	40	45	45	40	53	No	No	None	45
<p>Explanatory notes:</p> <p>Column 1 – RBL measured in accordance with the NPfI and outlined in the results of the long-term noise monitoring has been summarised in accordance with NPfI requirements and are presented in the section above.</p> <p>Column 4 – Project Amenity Noise Level determined based on 'Residential - urban' area in Table 2.2 (Amenity noise levels) of the EPA's NPfI minus 5dB</p> <p>Column 5 – Measured in accordance with the NPfI</p> <p>Column 8 - Determined in accordance with Section 2.4 of the NPfI.</p> <p>Column 9 – Project Noise Trigger Level is the lower value of project intrusiveness noise level and project amenity noise level. In accordance with Section 2.2 of the NPfI, $L_{Aeq, 15minute}$ is calculated as $L_{Aeq, period} + 3dB(A)$</p>									

8.2 Recommended noise control measures for mechanical plant

Where necessary, noise amelioration treatment will be incorporated in the design to ensure that noise levels comply with the recommended NPfl noise emission criteria noted above.

Although at this stage details of mechanical plant have not been finalised, the following in-principle advice is provided.

Acoustic assessment of mechanical services equipment will need to be undertaken during the detail design phase of the development to ensure that they shall not either singularly or in total emit noise levels which exceed the noise limits in NPfl and Council's requirements.

As noise control treatment can affect the performance of the mechanical services system, it is recommended that consultation with an acoustic consultant be made during the initial phase of mechanical services system design in order to reduce the need for revision of mechanical plant and noise control treatment;

Mechanical plant noise emission can be controllable by appropriate mechanical system design and implementation of common engineering methods that may include any of the following:

- procurement of 'quiet' plant,
- strategic positioning of plant away from sensitive neighbouring premises, maximising the intervening shielding between the plant and sensitive neighbouring premises,
- commercially available silencers or acoustic attenuators for air discharge and air intakes of plant;
- acoustically lined and lagged ductwork;
- acoustic screens and barriers between plant and sensitive neighbouring premises; and/or
- Partially-enclosed or fully-enclosed acoustic enclosures over plant.
- Mechanical plant shall have their noise specifications and their proposed locations checked prior to their installation on site; and
- Fans shall be mounted on vibration isolators and balanced in accordance with Australian Standard 2625 "Rotating and Reciprocating Machinery – Mechanical Vibration".

9 Construction Noise

The nature of the construction processes proposed for the development does not present difficulties in ensuring that the associated noise limits at surrounding properties are achieved. The major construction activities proposed on this site are excavation works, concrete pours and general building works.

Construction and building work will be adequately managed so as to minimise disruption to the local community and the environment.

Noise generated by construction activities will comply with the Department of Environment Climate Change & Water's (now EPA) Interim Construction Noise Guide (ICNG). APPENDIX C presents a summary ICNG's standard construction times and conditions.

10 Conclusion

Renzo Tonin & Associates have completed an assessment of the potential noise impacts onto the proposed residential development at 182-198 Victoria Street and 28-30 Faversham Street, Marrickville.

The study of external noise intrusion into the subject development has found that appropriate controls can be incorporated such as acoustic glazing into the building design to achieve compliance with acoustic requirement of Marrickville Council's DCP 2011, State Environmental Planning Policy (Infrastructure), Australian Standards AS2107 and AS2021.

Recommendations to comply with noise emission criteria for the site, including mechanical plant and construction noise have also been presented in the body of this report.

In conclusion, the proposed site is capable of complying with all relevant acoustic criteria through means of standard acoustic treatment.

APPENDIX A Assessment and Design Methodology

A.1 Marrickville Council Development Control Plan 2011

Marrickville Council has nominated acoustic control measures for external noise intrusion into proposed developments in Section 2.6 of DCP No 2011 which states the following;

"2.6.3 Controls

C1 Aircraft noise

- i. New development on land within an ANEF affected area must be designed and constructed in accordance with the relevant Australian Standard and other guidelines issued by relevant agencies and authorities; and*
- ii. The introduction of acoustic measures to reduce aircraft noise must not unacceptably detract from the streetscape value of individual buildings. Australian Standard AS 2021 Acoustics – aircraft noise intrusion – building, siting and construction provides standards for noise attenuation of buildings located within an ANEF affected area.*

C2 General acoustic privacy

- i. New dwellings close to high noise sources such as busy roads, rail lines and industry must be designed to locate habitable rooms and private open spaces away from noise sources or protect these areas with appropriate noise shielding devices. Development for the purpose of child care centres, educational establishments, hospitals, places of public worship and residential accommodation close to busy roads and rail lines must also comply with the relevant Australian Standards and State Environmental Planning Policies (SEPPs);*

Refer to Australian Standard AS 3671 Roads traffic noise intrusion, Australian Standard AS 2107- Acoustics – recommended design sound levels and reverberation times for building interiors and requirements under State Environmental Planning Policy (Infrastructure) 2007 SEPP (Infrastructure SEPP). AS 3671 sets out guidelines to determine the acceptability of indoor and outdoor spaces for specific activities in the presence of road traffic noise, and the extent of noise reduction or type of construction that might be needed to make such spaces acceptable. It also sets out guidelines to determine the acoustical adequacy of existing buildings near routes carrying more than 2,000 vehicles per day.

AS 2107 recommends design sound levels and reverberation times for different areas of occupancy in various categories of buildings. It also specifies methods of measuring the ambient sound level reverberation time. This Standard is intended for use in assessing the acoustic performance of buildings and building services. It does not apply to the evaluation of occupancy noise.

- ii. Decks, balconies and verandas alongside boundaries and noisy walking surfaces or elevated side passages must be avoided where they face a residential building; and*

iii. Recreation facilities such as swimming pools and barbecue areas must be located away from the bedroom areas of adjoining dwellings."

A.2 State Environmental Planning Policy (Infrastructure) 2007

The NSW State Environmental Planning Policy (Infrastructure) 2007 (known as 'ISEPP') came into force in NSW on 1 January 2008 to facilitate the effective delivery of infrastructure across the State. The aim of the policy includes identifying the environmental assessment category into which different types of infrastructure and services development fall and identifying matters to be considered in the assessment of development adjacent to particular types of infrastructure.

Pertinent to noise assessment, the ISEPP includes the following clauses:

87 Impact of rail noise or vibration on non-rail development

- 1. This clause applies to development for any of the following purposes that is on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration:*
 - a. a building for residential use,*
 - b. a place of public worship,*
 - c. a hospital,*
 - d. an educational establishment or child care centre.*
- 2. Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.*
- 3. If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*
 - a. in any bedroom in the building - 35 dB(A) at any time between 10 pm and 7am,*
 - b. anywhere else in the building (other than a garage, kitchen, bathroom or hallway) - 40 dB(A) at any time.*

102 Impact of road noise or vibration on non-road development

- 1. This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:*
 - c. a building for residential use,*
 - d. a place of public worship,*

- e. *a hospital,*
 - f. *an educational establishment or child care centre.*
2. *Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.*
 3. *If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*
 - a. *in any bedroom in the building - 35 dB(A) at any time between 10 pm and 7am,*
 - b. *anywhere else in the building (other than a garage, kitchen, bathroom or hallway) - 40 dB(A) at any time.*
 4. *In this clause, "freeway", "tollway" and "transitway" have the same meanings as they have in the Roads Act 1993*

A.2.1 Department of Planning publication 'Development near rail corridors and busy roads – Interim guideline'

To support the Infrastructure SEPP, the NSW Department of Planning released the *Development in Rail Corridors and Busy Roads – Interim Guideline* (December 2008). The Guideline assists in the planning, design and assessment of developments in, or adjacent to, major transport corridors in terms of noise, vibration and air quality. While the ISEPP applies only to roads with an AADT greater than 40,000 vehicles, the guideline is also recommended for other road traffic noise affected sites.

A.2.2 Clarification of ISEPP noise limits

The Guideline clarifies the time period of measurement and assessment. Section 3.4 '*What Noise and Vibration Concepts are Relevant*' and Table 3.1 of Section 3.6.1 confirms that noise assessment is based over the following time periods:

- Daytime 7:00am - 10:00pm $L_{Aeq(15hr)}$
- Night-time 10:00pm - 7:00am $L_{Aeq(9hr)}$

The noise criteria nominated in the ISEPP apply to internal noise levels with windows and doors closed. However as the preliminary noise assessment is based on measurements/predictions at external locations, equivalent external noise criteria has been established. The equivalent external noise criterion is used to determine which areas of the development may require acoustic treatment in order to meet the internal noise requirements of the ISEPP. The equivalent external goals have been determined on the following basis:

- The ISEPP states: "*If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that occupants*

can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia." The internal criteria with windows open is therefore 10dB(A) above the criteria explicitly outlined in the ISEPP.

- The generally accepted noise reduction through an open window from a free-field external position is 10dB(A). Windows/doors are assumed to be open no more than 5% of room floor area, in accordance with the Building Code of Australia (BCA) ventilation requirements.

Table 13 presents the ISEPP internal noise criteria along with the equivalent external noise criteria for residential premises.

Table 13: ISEPP noise criteria for new residential development

Room	Location	L _{Aeq} , 15hr Day 7am – 10pm	L _{Aeq} 9hr Night 10pm – 7am
Living rooms*	Internal, windows closed	40	40
	Internal, windows open	50	50
	External free-field (allowing windows to remain open)^	60	60
Bedrooms*	Internal, windows closed	40	35
	Internal, windows open	50	45
	External free-field (allowing windows to remain open)^	60	55

Notes: * Requisite for 40,000AADT Roads only under ISEPP 2007.

^ ISEPP Guideline states that where internal noise criteria are exceeded by more than 10dB(A) with windows open mechanical ventilation is required. External goals have been calculated on the basis of nominal 10dB(A) reduction through an open window to a free-field position. Windows open to 5% of floor area in accordance with the BCA 2011 requirements.

A.3 Australian/New Zealand Standard AS/NZS 2107:2000

As traffic noise levels are not constant, an L_{eq} noise level descriptor is used when assessing this type of noise source. The L_{eq} is the mean energy level of the noise being measured, and has been found to accurately describe the level of annoyance caused by traffic noise.

This standard provides recommended noise levels for steady state such as noise from building services and quasi-steady state sounds, such as traffic and industrial noise. The noise levels recommended in AS/NZS 2107:2000 take into account the function of the area and apply to the sound level measured within the space unoccupied although ready for occupancy.

This standard recommends the following noise levels for residential buildings.

Table 14: Recommended design sound levels for different areas of occupancy in buildings

Type of occupancy/ activity	Recommended design sound level, L _{Aeq} , dB(A)		Recommended reverberation time (T),s
	Satisfactory	Maximum	
7 RESIDENTIAL BUILDINGS (see Note 7 and Clause 5.2)			
Houses in areas with negligible transportation -			
Sleeping areas	25	30	-

Type of occupancy/ activity	Recommended design sound level, L_{Aeq} , dB(A)		Recommended reverberation time (T),s
	Satisfactory	Maximum	
Houses and apartments near minor roads -			
Living areas	30	40	-
Sleeping areas	30	35	-
Work areas	35	40	-
Apartment common areas (e.g. foyer, lift lobby)	45	55	See Note 3
Houses and apartments near major roads -			
Living areas	35	45	-
Sleeping areas	30	40	-
Work areas	35	45	-
Apartment common areas (e.g. foyer, lift lobby)	45	55	See Note 3
8 SHOP BUILDINGS			
Enclosed carparks	55	65	-
Show rooms	45	50	See Note 3
Small retails stores (general)	45	50	See Note 3
Specialty Shops (where detailed discussion is necessary in transactions)	40	45	See Note 3

NOTES:

1. The recommended design sound levels are for a fully fitted out and completed building. Attention is drawn to the additive noise effect of many machines within the same area and adjacent areas. Allowance for the total number and type of noise sources should therefore be made in the selection of equipment and in the design of building spaces. A building owner or developer may consider an allowance of 3-5 dB(A) to be appropriate.
2. Recommended reverberation time is 10 percent to 20 percent higher than Curve 1 of Appendix A.
3. Reverberation time should be minimized as far as practicable for noise control.
4. Certain teaching spaces, including those intended for students with learning difficulties and students with English as a second language, should have reverberation times at the lower end of the specified range.
5. Specialist advice should be sought for these spaces.
6. A very wide range of noise levels can occur in the occupied state in spaces housing manufacturing processes, and the levels are primarily subject to control as part of a noise management program (see AS/NZS 1269.2). The possibilities for segregating very noisy processes from quieter ones by partitioning vary between particular industries and plants. For reasons such as these, it is difficult to make generalized recommendations for desirable, or even maximum, design levels for the unoccupied state, but one guiding principle may still be observed - when the activity in one area of a manufacturing plant is halted, it is desirable that the local level should if possible drop to 70 dB(A) or lower to permit speech communication without undue effort.
7. In situations where traffic noise levels may vary widely over a 24-hour period, measurements to assess compliance with this Standard should be taken at the relevant time and for an appropriate measurement period according to the area of occupancy or activity in the building. Where traffic noise fluctuates rapidly with the passage of individual vehicles, the community reaction may not correlate well with the equivalent continuous noise level as measured.
8. The overall sound pressure level in dB(A) should conform to the recommended design sound level given in Table 1. In these spaces, a balanced sound pressure level across the full frequency range is essential. These spaces should therefore be evaluated in octave bands across the full frequency spectrum. The recommended maximum sound pressure levels for the individual octave bands corresponding to the overall dB(A) value are given in Appendix C.
9. In spaces in which high quality sound recordings are to be made, the levels set for low frequency octave bands should not be exceeded (see Appendix C). Subsequent replay of the recordings may cause an amplification of the ambient sound resulting in an overemphasis of its low-frequency components. Specialist advice should always be sought when these spaces are being designed. In some circumstances, for purposes of very high quality recording, lower levels than those specified in Table 1 may be required.

A.4 Australian Standard AS2021:2015

A.4.1 Zoning

Table 2.1 of Australian Standard AS2021:2015 – “Acoustics – Aircraft Noise Intrusion – Building Siting and Construction” provides zoning information for sites subjected to aircraft noise. The table lists three ANEF Zones, namely, Acceptable, Conditionally Acceptable and Unacceptable, and recommends suitable ANEF levels for different types of buildings.

Table 15: Building Site Acceptability Based on ANEF Zones (Table 2.1 AS2021)

Building Type	ANEF Zone of Site		
	Acceptable	Conditionally Acceptable	Unacceptable
House, home unit, flat, caravan park	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

Note: within 20 ANEF to 25 ANEF, some people may find that land is not compatible with residential or educational uses. Land use authorities may consider that the incorporation of noise control features in the construction of residences or schools is appropriate.

In **Acceptable** zones there is usually no need for the building construction to provide protection specifically against aircraft noise.

In **Conditionally Acceptable** zones the maximum aircraft noise levels for the relevant aircraft and the required noise reduction should be determined from the procedures of Clause 3.1 and 3.2, and the aircraft noise attenuation to be expected from the proposed construction should be determined in accordance with Clause 3.3.

In **Unacceptable** zones – construction of the proposed development should not normally be considered.

A.4.2 Aircraft Noise Internal Criteria for Residential Development

Australian Standard AS2021-2000 – “Acoustics – Aircraft Noise Intrusion – Building Siting and Construction” recommends the following internal design noise levels for this development:

Table 16: Indoor Design Sound Levels (Table 3.3 AS2021)

Building Type and Activity	Max Noise Level, Lmax dB(A)
Residential	
Sleeping areas, dedicated lounges	50
Other habitable spaces	55
Bathrooms, toilets, laundries	60
Commercial Buildings, Offices and Shops	
Private Offices, conference rooms	55
Drafting, open offices	65
Typing, data processing	70
Shops, supermarkets, showrooms	75
Commercial/ Industrial	
Inspection, analysis, precision work	75
Light machinery, assembly, bench work	80
Heavy machinery, warehouse, maintenance	85

Notes:

The above internal sound design levels are the maximum levels from an aircraft flyover which, when heard inside the specified area by the average listener, will be judged as not intrusive or annoying by that listener while carrying out the specified activity. Owing to the variability of subjective responses to aircraft noise, these figures will not provide sufficiently low interior noise levels for occupants who have a particular sensitivity to aircraft noise.

Some of these levels, because of the short duration of individual aircraft flyovers, exceed some other criteria published by Standards Australia for indoor background noise levels (See AS 2107).

APPENDIX B Internal Sound Insulation

B.1 National Construction Code of Australia 2016

The National Construction Code of Australia (NCC) outlines minimum requirements for inter-tenancy (party) walls and ceiling/ floors to maintain privacy. This includes the incorporation of penetration of a service through a floor or through more than one sole-occupancy unit.

NCC 2016 nominates required Weighted Sound Reduction Indexes (R_w) and spectrum adaptation factor (C_{tr}) for partition constructions, of different space/ activity types in adjoining units. The R_w and $R_w + C_{tr}$ are single number descriptors for quantifying the attenuating performance of partitions for typical intrusive noises produced inside residences. The higher the rating, the greater the isolation provided by the partition.

Spectrum adaptation factors are commonly used to compensate for the fact that certain kinds of sounds are more readily transmitted through insulating materials than others insulate.

The adaptation factor C_{tr} has now been introduced for most building elements which require an airborne sound insulation rating. The only exception is a wall which separates a dwelling from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification. Therefore, both the C_{tr} factor and the R_w of the building element will need to be considered in most cases.

The C_{tr} factor takes into account lower frequency level sounds, and has been chosen in large part, in recognition of the problem of the high bass frequency outputs of modern home theatre systems and music reproduction equipment.

The Deemed-to-Satisfy Provisions also have impact sound insulation requirements for floors. The terms to describe the impact sound insulation of the floor is the weighted normalised impact sound pressure level ($L_{n,w}$) plus the spectrum adaptation term (C_i). The lower the $L_{n,w} + C_i$ of the floor, the better the performance of the floor in terms of impact sound insulation.

The following section represents a summary of acoustic provisions outlined in the Part F5 of the NCC 2016.

B.2 Sound Insulation Provision of NCC of Australia 2016

The acoustic provisions for inter-tenancy walls in Class 3 buildings are outlined in the National Construction Code of Australia and the following is an extract from the NCC:

"F5.2 Determination of airborne sound insulation ratings

A form of construction required to have an airborne sound insulation rating must –

- a. have the required value for weighted sound reduction index (R_w) or weighted sound reduction index with spectrum adaptation term ($R_w + C_{tr}$) determined in accordance with AS/NZS 1276.1 or ISO 717.1 using results from laboratory measurements; or
- b. comply with Specification F5.2.

F5.3 Determination of impact sound insulation ratings

- a. A floor in a building required to have an impact sound insulation rating must –
 - i. have the required value for weighted normalised impact sound pressure level ($L_{n,w}$) determined in accordance with AS/ISO 717.2 using results from laboratory measurements; or
 - ii. comply with Specification F5.2.
- b. A wall in a building required to have an impact sound insulation rating must –
 - i. for a Class 2 or 3 building be of discontinuous construction;
- c. For the purposes of this part, discontinuous construction means a wall having a minimum 20 mm cavity between 2 separate leaves, and
 - i. for masonry, where wall ties are required to connect leaves, the ties are of the resilient type; and
 - ii. for other than masonry, there is no mechanical linkage between leaves except at the periphery.

F5.4 Sound insulation rating of floors

- a. A floor in a Class 2 or 3 building must have an $R_w + C_{tr}$ (airborne) not less than 50 and an $L_{n,w}$ (impact) not more than 62 if it separates –
 - i. sole-occupancy units; or
 - ii. a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification.

F5.5 Sound insulation rating of walls

- a. A wall in a Class 2 or 3 building must –
 - i. have an $R_w + C_{tr}$ (airborne) not less than 50, if it separates sole-occupancy units; and
 - ii. have an R_w (airborne) not less than 50, if it separates a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification; and
 - iii. comply with F5.3(b) if it separates:
 - (A) a bathroom, sanitary compartment, laundry or kitchen in one sole-occupancy unit from a habitable room (other than a kitchen) in an adjoining unit; or

- (B) a sole-occupancy unit from a plant room or lift shaft.*
- b. A door may be incorporated in a wall in a Class 2 or 3 building that separates a sole-occupancy unit from a stairway, public corridor, public lobby or the like, provided the door assembly has an R_w not less than 30.*
 - c. Where a wall required to have sound insulation has a floor above, the wall must continue to –*
 - i. the underside of the floor above; or*
 - ii. a ceiling that provides the sound insulation required for the wall.*

F5.6 Sound insulation rating of services

- a. If a duct, soil, waste or water supply pipe, including a duct or pipe that is located in a wall or floor cavity, serves or passes through more than one sole-occupancy unit, the duct or pipe must be separated from the rooms of any sole-occupancy unit by construction with an $R_w + C_{tr}$ (airborne) not less than –*
 - i. 40 if the adjacent room is a habitable room (other than a kitchen); or*
 - ii. 25 if the adjacent room is a kitchen or non-habitable room.*
- b. If a storm water pipe passes through a sole-occupancy unit it must be separated in accordance with (a)(i) and (ii).*

F5.7 Sound insulation of pumps

A flexible coupling must be used at the point of connection between the services pipes in a building and any circulating or other pumps."

APPENDIX C Construction Noise

C.1 Environmental Protection Authority's Construction Noise Guideline

The Environmental Protection Authority (EPA) recently released its *Interim Construction Noise Guideline* (ICNG) in 2009. This document is being referred to as EPA's standard policy for assessing construction noise on new projects.

The key components of the guideline that are incorporated into this assessment include:

- Use of L_{Aeq} as the descriptor for measuring and assessing construction noise.

NSW noise policies, including the INP, RNP and RING have moved to the primary use of L_{Aeq} over any other descriptor. As an energy average, L_{Aeq} provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the L_{A10} descriptor.
- Application of reasonable and feasible noise mitigation measures
- As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice, and is practical to build given the project constraints.
- Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects.

The ICNG provides two methods for assessment of construction noise, being either a quantitative or a qualitative assessment. A quantitative assessment is recommended for major construction projects of significant duration, and involves the measurement and prediction of noise levels, and assessment against set criteria. A qualitative assessment is recommended for small projects with a duration of less than three weeks and focuses on minimising noise disturbance through the implementation of reasonable and feasible work practices, and community notification.

Table 17 below (reproduced from Table 2 of the ICNG) sets out the noise management levels and how they are to be applied for residential receivers. The guideline intends to provide respite for residents exposed to excessive construction noise outside the recommended standard hours whilst allowing construction during the recommended standard hours without undue constraints.

The rating background level (RBL) is used when determining the management level. The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours).

Table 17: Noise management levels at residential receivers

Time of day	Management level L _{Aeq} (15 min)	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured L _{Aeq} (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Sensitive Land Use

Table 18 below (reproduced from Table 3 of the ICNG) sets out the noise management levels for various sensitive land use developments.

Table 18: Noise management levels at other noise sensitive land uses

Land use	Where objective applies	Management level L _{Aeq} (15 min)
Classrooms at schools and other educational institutions	Internal noise level	45 dB(A)
Hospital wards and operating theatres	Internal noise level	45 dB(A)
Places of worship	Internal noise level	45 dB(A)
Active recreation areas	External noise level	65 dB(A)
Passive recreation areas	External noise level	60 dB(A)
Community centres	Depends on the intended use of the centre.	Refer to the 'maximum' internal levels in AS2107 for specific uses.
Commercial premises	External noise level	70 dB(A)
Industrial premises	External noise level	75 dB(A)

Notes: Noise management levels apply when receiver areas are in use only.

APPENDIX D Noise Survey Locations and Results

D.1.1 Ambient and Background Noise Survey

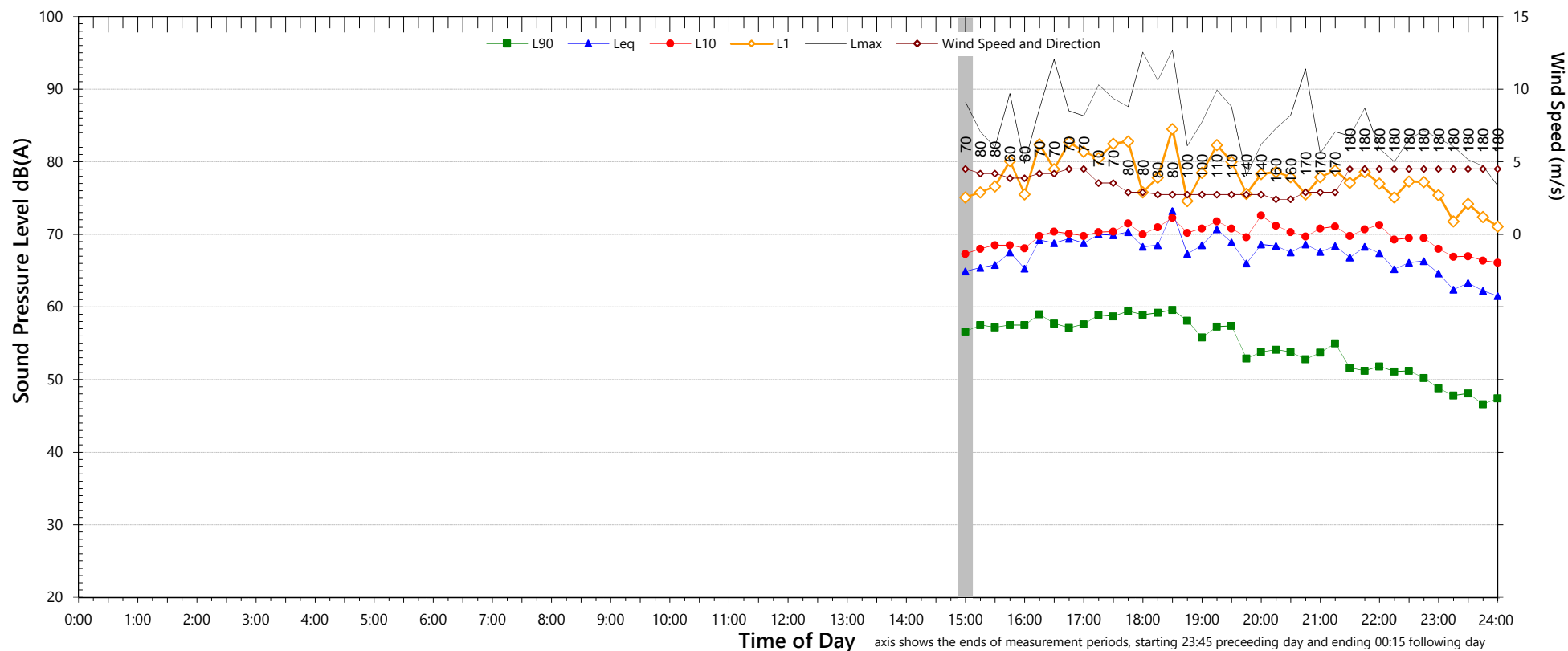
Unattended Noise Monitoring Location 1: 173 Victoria Road, Marrickville



Unattended Noise Monitoring Results

173 Victoria Road, Marrickville

Monday, 17 December 2018



NSW Noise Policy for Industry (Free Field)			
Descriptor	Day ²	Evening ³	Night ^{4,5}
L ₉₀	-	52	44
LA _{eq}	-	69	65

Night Time Maximum Noise Levels		(see note 7)	
L _{Max} (Range)	80	to	90
L _{Max} - L _{eq} (Range)	19	to	23

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured in free-field; tabulated results facade corrected

4. "Night" relates to the remaining periods

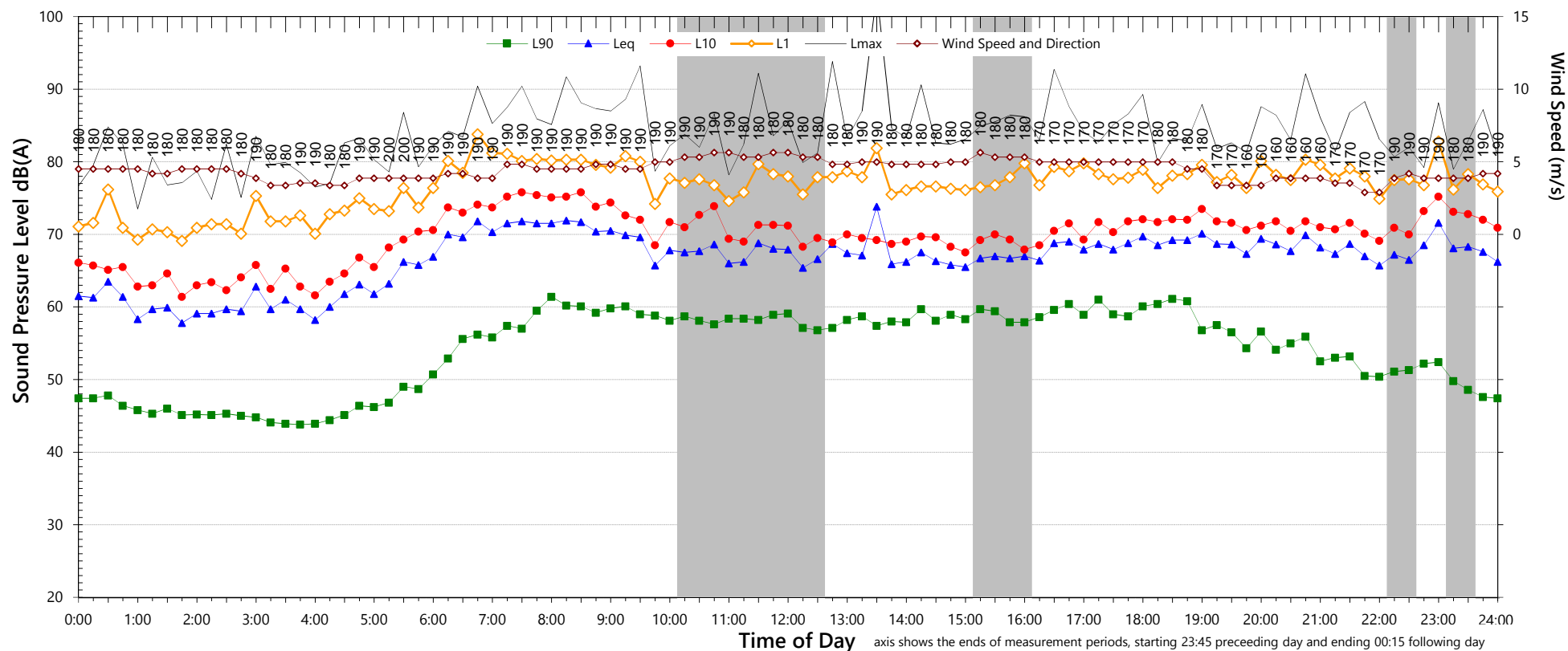
7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - L_{eq} ≥ 15dB(A)

NSW Road Noise Policy (1m from facade) (see note 6)		
Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	71	67
L _{eq} 1hr upper 10 percentile	72	69
L _{eq} 1hr lower 10 percentile	70	62

Unattended Noise Monitoring Results

173 Victoria Road, Marrickville

Tuesday, 18 December 2018



NSW Noise Policy for Industry (Free Field)			
Descriptor	Day ²	Evening ³	Night ^{4,5}
L ₉₀	-	52	-
LA _{eq}	-	69	-

Night Time Maximum Noise Levels		(see note 7)	
L _{Max} (Range)	80	to	88
L _{Max} - L _{eq} (Range)	16	to	21

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured in free-field; tabulated results facade corrected

4. "Night" relates to the remaining periods

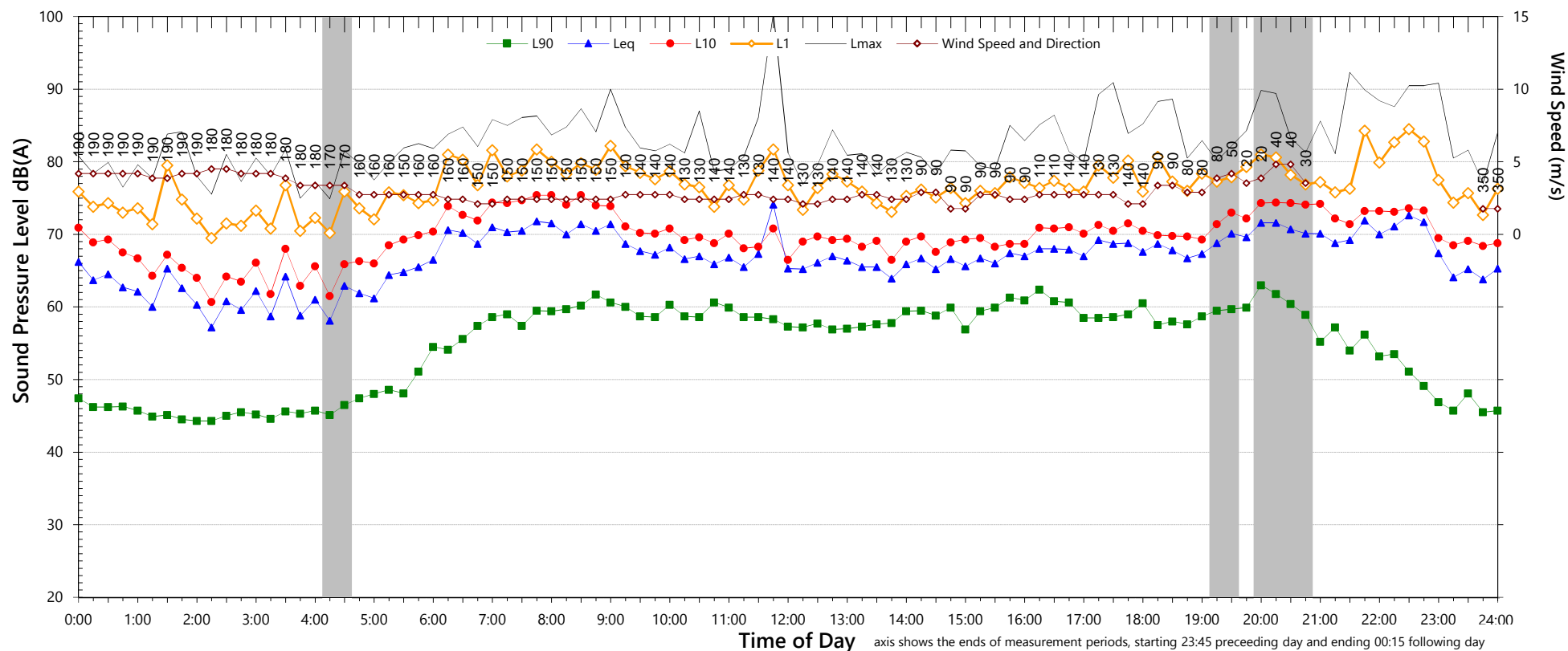
7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - L_{eq} ≥ 15dB(A)

NSW Road Noise Policy (1m from facade) (see note 6)		
Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	72	68
L _{eq} 1hr upper 10 percentile	74	73
L _{eq} 1hr lower 10 percentile	70	64

Unattended Noise Monitoring Results

173 Victoria Road, Marrickville

Wednesday, 19 December 2018



NSW Noise Policy for Industry (Free Field)			
Descriptor	Day ²	Evening ³	Night ^{4,5}
L ₉₀	57	-	43
LA _{eq}	68	-	68

Night Time Maximum Noise Levels		(see note 7)	
L _{Max} (Range)	82	to	95
L _{Max} - L _{eq} (Range)	18	to	28

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured in free-field; tabulated results facade corrected

NSW Road Noise Policy (1m from facade) (see note 6)		
Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	71	69
L _{eq} 1hr upper 10 percentile	73	73
L _{eq} 1hr lower 10 percentile	69	65

4. "Night" relates to the remaining periods

7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - L_{eq} ≥ 15dB(A)

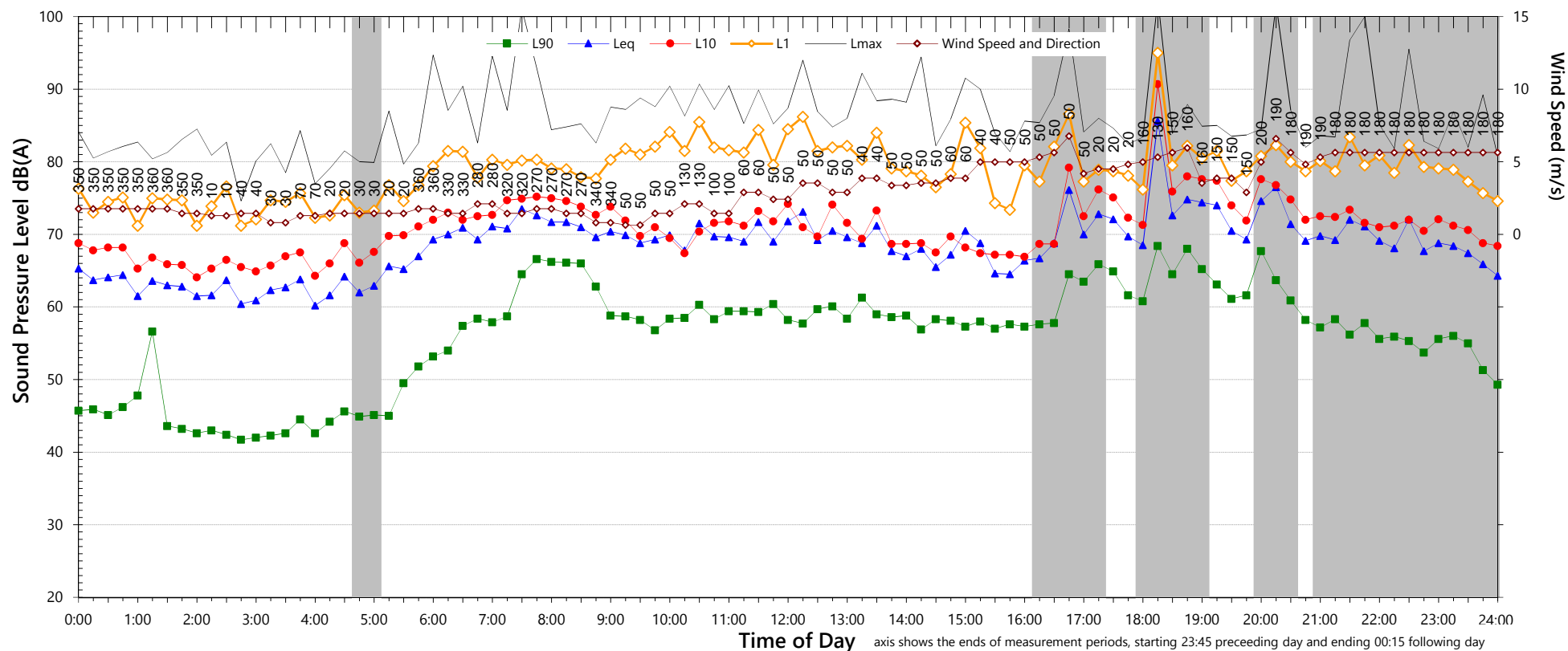
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days

5. "Night" relates to period from 10pm on this graph to morning on the following graph.

Unattended Noise Monitoring Results

173 Victoria Road, Marrickville

Thursday, 20 December 2018



NSW Noise Policy for Industry (Free Field)			
Descriptor	Day ²	Evening ³	Night ^{4,5}
L ₉₀	57	-	-
LA _{eq}	70	-	-

Night Time Maximum Noise Levels		(see note 7)	
L _{Max} (Range)	-	to	-
L _{Max} - L _{eq} (Range)	-	to	-

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured in free-field; tabulated results facade corrected

4. "Night" relates to the remaining periods

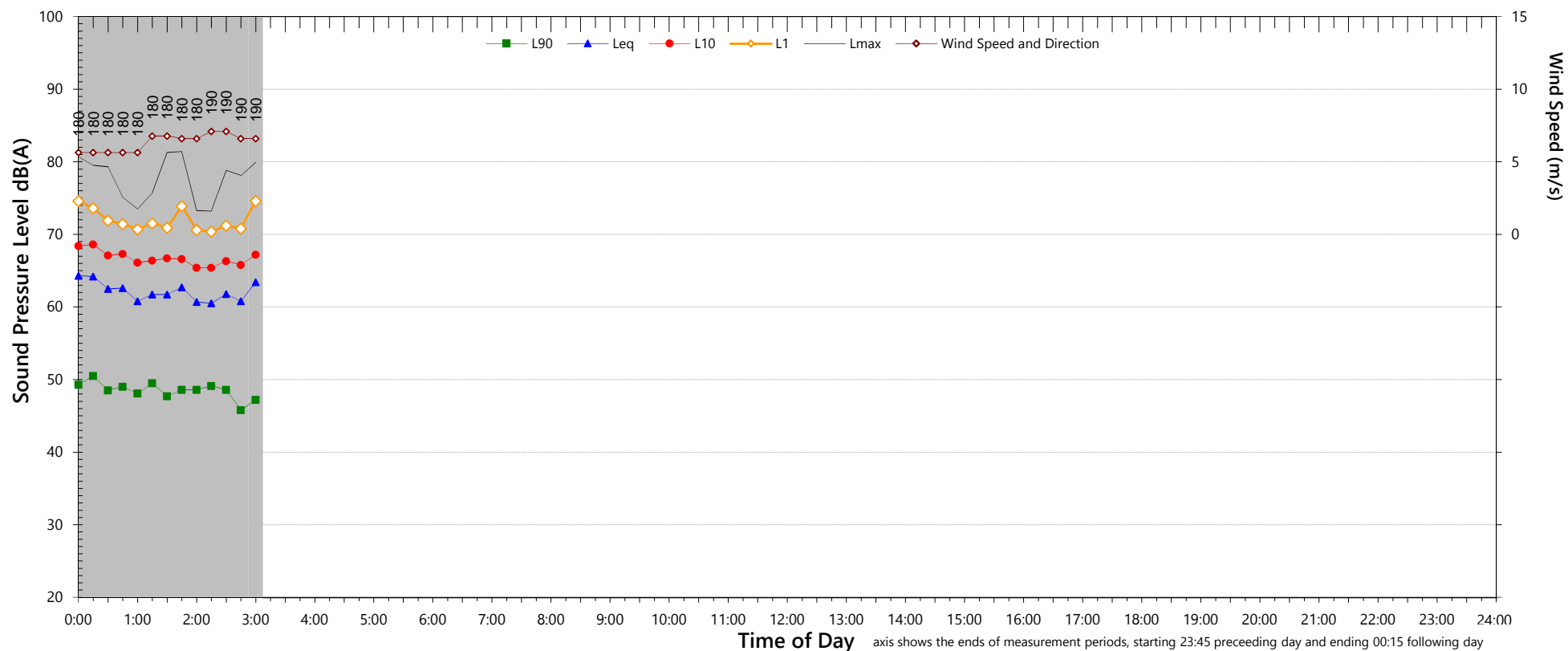
7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - L_{eq} ≥ 15dB(A)

NSW Road Noise Policy (1m from facade) (see note 6)		
Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	73	-
L _{eq} 1hr upper 10 percentile	74	-
L _{eq} 1hr lower 10 percentile	71	-

Unattended Noise Monitoring Results

173 Victoria Road, Marrickville

Friday, 21 December 2018



NSW Noise Policy for Industry (Free Field)			
Descriptor	Day ²	Evening ³	Night ^{4,5}
L ₉₀	-	-	-
LA _{eq}	-	-	-
Night Time Maximum Noise Levels (see note 7)			
L _{Max} (Range)	-	to	-
L _{Max} - L _{eq} (Range)	-	to	-

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured in free-field; tabulated results facade corrected

4. "Night" relates to the remaining periods

7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - L_{eq} ≥ 15dB(A)

NSW Road Noise Policy (1m from facade) (see note 6)		
Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	-	-
L _{eq} 1hr upper 10 percentile	-	-
L _{eq} 1hr lower 10 percentile	-	-

2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days

5. "Night" relates to period from 10pm on this graph to morning on the following graph.

D.1.2 | Ambient and Background Noise Survey

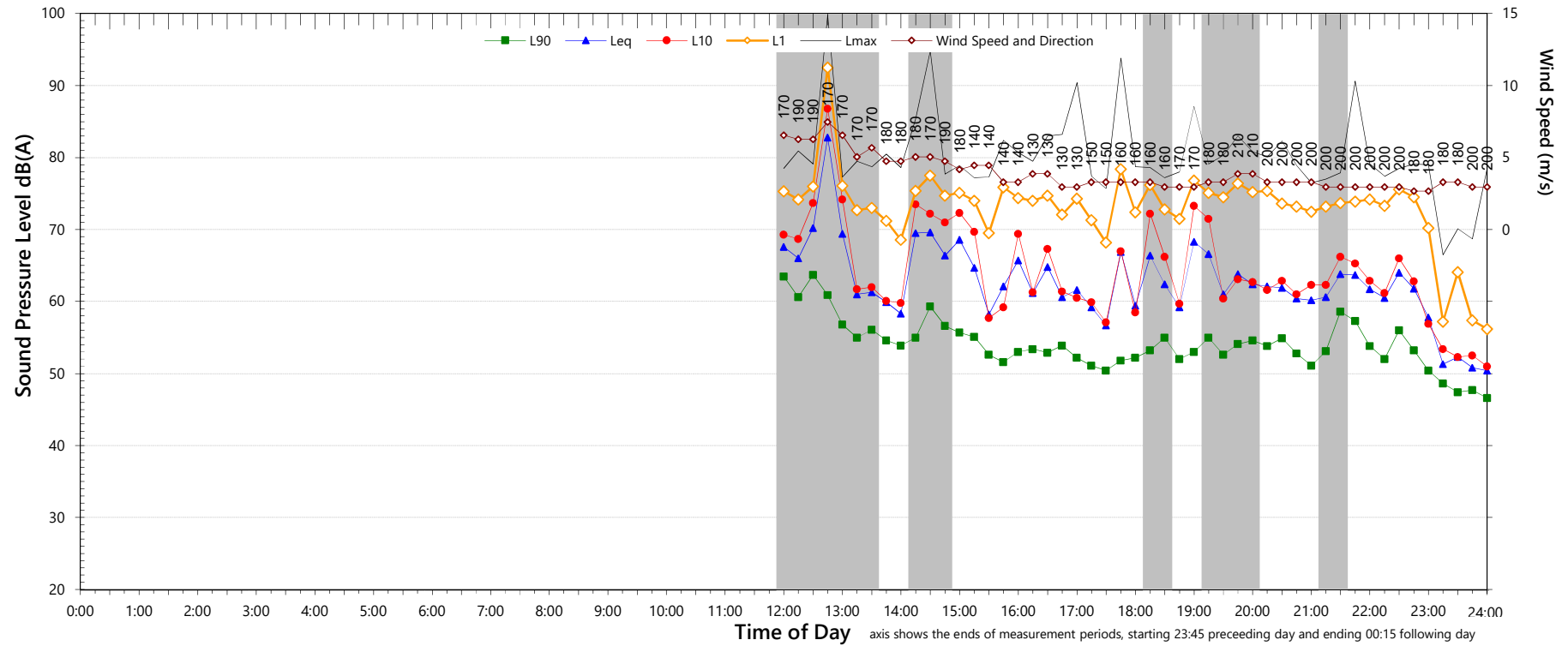
Unattended Noise Monitoring Location 2: 26 Faversham Street, Marrickville



Unattended Noise Monitoring Results

26 Faversham Street, Marrickville

Wednesday, 18 September 2019



NSW Noise Policy for Industry (Free Field)			
Descriptor	Day ²	Evening ³	Night ^{4 5}
L ₉₀	-	-	-
LAeq (see note 6)	-	-	-

Night Time Maximum Noise Levels		(see note 7)	
L _{Max} (Range)	67	to	85
L _{Max} - L _{eq} (Range)	16	to	27

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured 1m from facade; tabulated results free-field corrected

4. "Night" relates to the remaining periods

7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - Leq ≥ 15dB(A)

NSW Road Noise Policy (1m from facade)		
Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	63	57
L _{eq} 1hr upper 10 percentile	67	62
L _{eq} 1hr lower 10 percentile	61	49

2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days

5. "Night" relates to period from 10pm on this graph to morning on the following graph.

Data File: 2019-09-18_SLM_000_123_Rpt_Report.txt

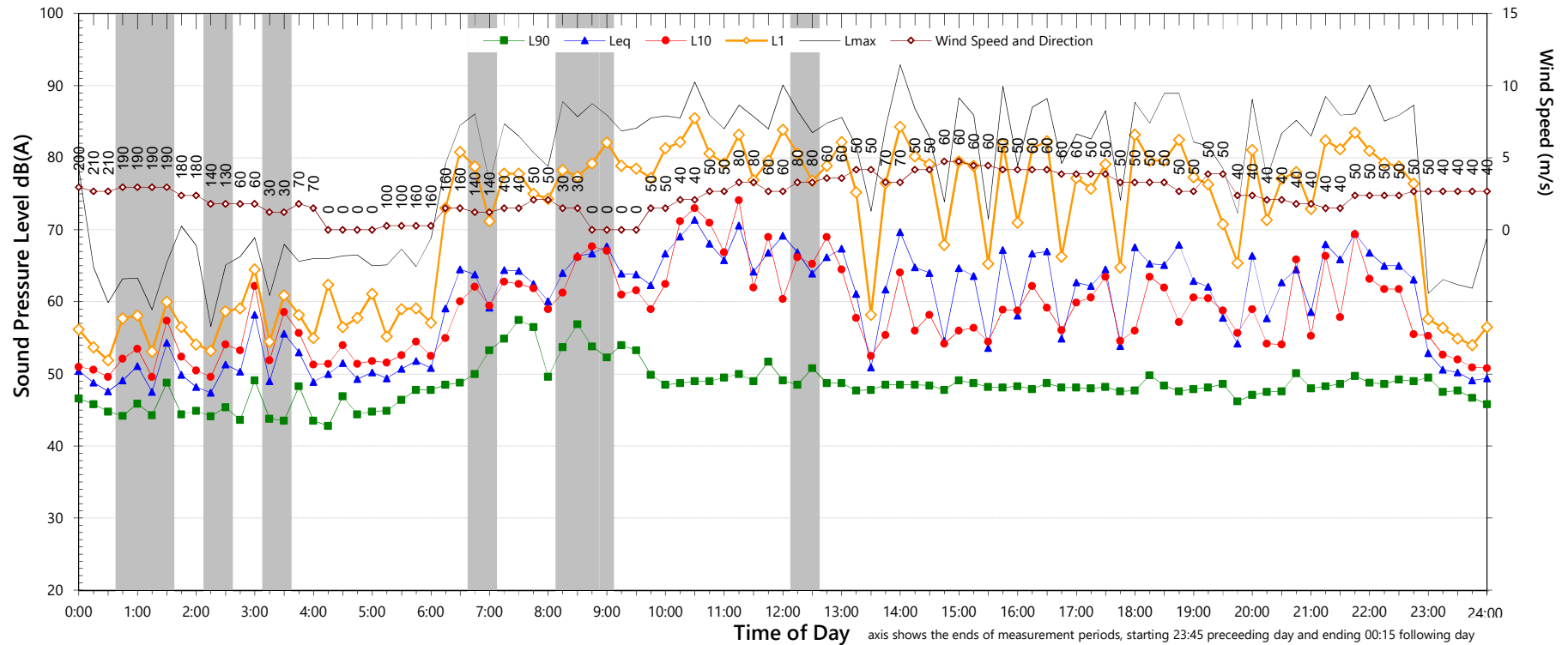
TK484-03L01 26 Faversham St (r0)

QTE-26 Logger Graphs Program (r30)

Unattended Noise Monitoring Results

26 Faversham Street, Marrickville

Thursday, 19 September 2019



NSW Noise Policy for Industry (Free Field)

Descriptor	Day ²	Evening ³	Night ^{4 5}
L ₉₀	48	47	39
L _{Aeq} (see note 6)	63	63	54

Night Time Maximum Noise Levels

(see note 7)

L _{Max} (Range)	66	to	87
L _{Max} - L _{eq} (Range)	19	to	35

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured 1m from facade; tabulated results free-field corrected

4. "Night" relates to the remaining periods

7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - L_{eq} ≥ 15dB(A)

NSW Road Noise Policy (1m from facade)

Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	66	57
L _{eq} 1hr upper 10 percentile	68	62
L _{eq} 1hr lower 10 percentile	63	46

Data File: 2019-09-18_SLM_000_123_Rpt_Report.txt

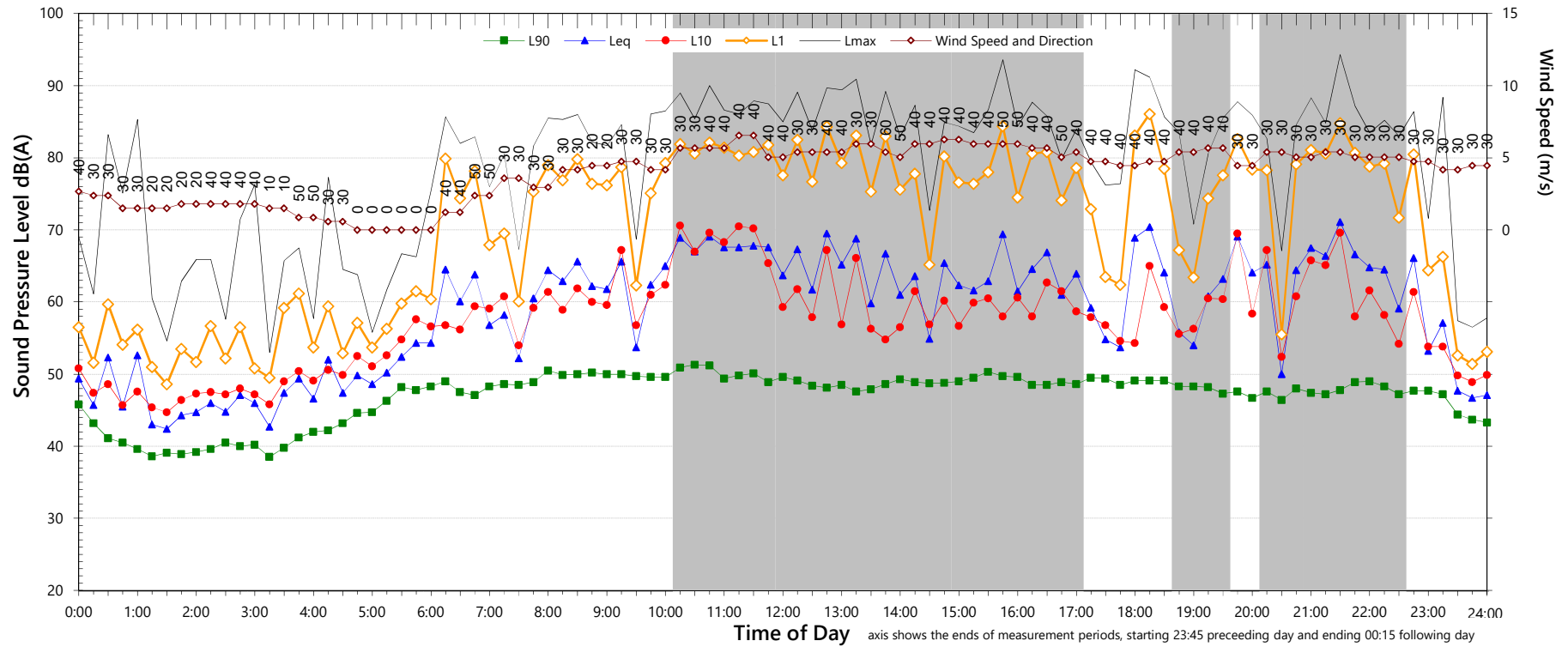
TK484-03L01 26 Faversham St (r0)

QTE-26 Logger Graphs Program (r30)

Unattended Noise Monitoring Results

26 Faversham Street, Marrickville

Friday, 20 September 2019



NSW Noise Policy for Industry (Free Field)

Descriptor	Day ²	Evening ³	Night ^{4 5}
L ₉₀	-	-	39
LA _{eq} (see note 6)	-	-	53

Night Time Maximum Noise Levels

(see note 7)

L _{Max} (Range)	73	to	88
L _{Max} - L _{eq} (Range)	18	to	36

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured 1m from facade; tabulated results free-field corrected

4. "Night" relates to the remaining periods

7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - L_{eq} ≥ 15dB(A)

NSW Road Noise Policy (1m from facade)

Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	64	56
L _{eq} 1hr upper 10 percentile	68	60
L _{eq} 1hr lower 10 percentile	62	43

2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days

5. "Night" relates to period from 10pm on this graph to morning on the following graph.

Data File: 2019-09-18_SLM_000_123_Rpt_Report.txt

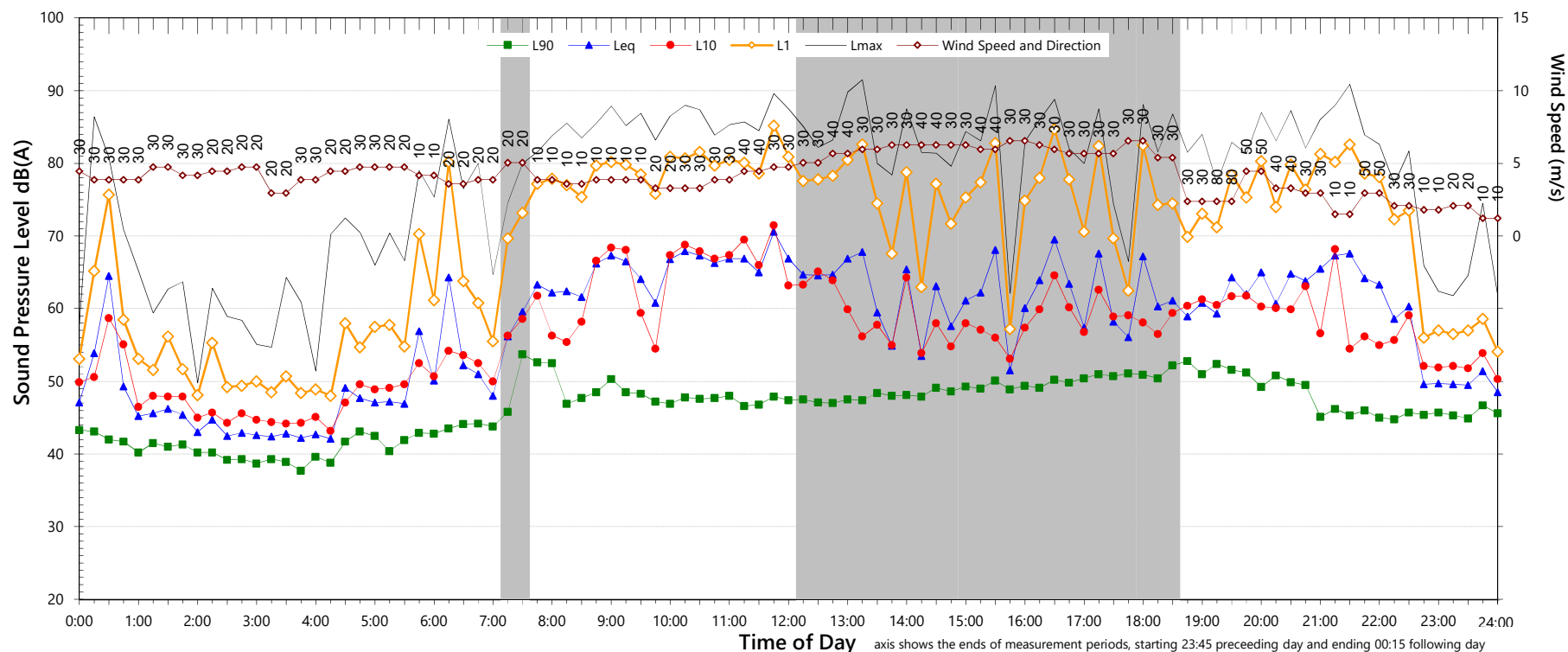
TK484-03L01 26 Faversham St (r0)

QTE-26 Logger Graphs Program (r30)

Unattended Noise Monitoring Results

26 Faversham Street, Marrickville

Saturday, 21 September 2019



NSW Noise Policy for Industry (Free Field)

Descriptor	Day ²	Evening ³	Night ^{4 5}
L ₉₀	-	45	40
LA _{eq} (see note 6)	-	62	53

Night Time Maximum Noise Levels

(see note 7)

L _{Max} (Range)	66	to	83
L _{Max} - L _{eq} (Range)	18	to	25

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured 1m from facade; tabulated results free-field corrected

4. "Night" relates to the remaining periods

7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - Leq ≥ 15dB(A)

2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days

5. "Night" relates to period from 10pm on this graph to morning on the following graph.

NSW Road Noise Policy (1m from facade)

Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	65	53
L _{eq} 1hr upper 10 percentile	67	58
L _{eq} 1hr lower 10 percentile	62	44

Data File: 2019-09-18_SLM_000_123_Rpt_Report.txt

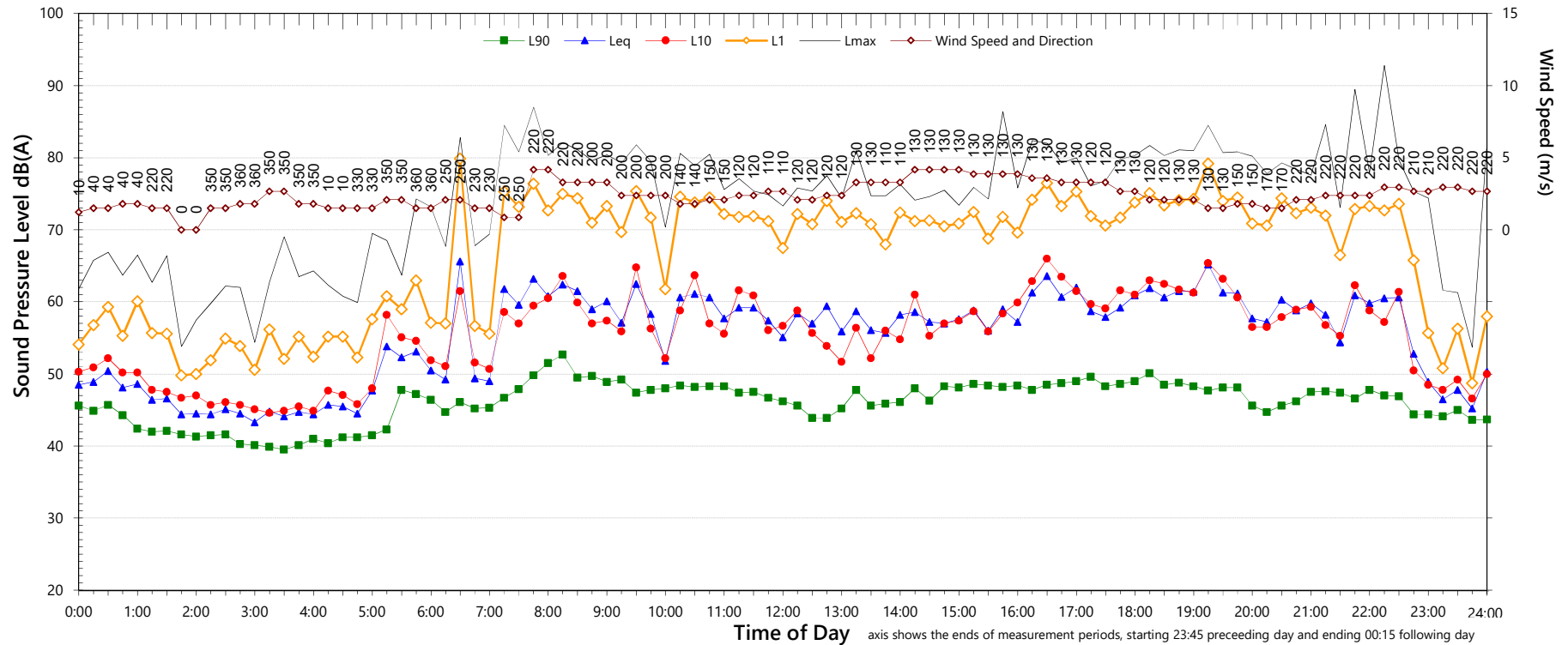
TK484-03L01 26 Faversham St (r0)

QTE-26 Logger Graphs Program (r30)

Unattended Noise Monitoring Results

26 Faversham Street, Marrickville

Sunday, 22 September 2019



NSW Noise Policy for Industry (Free Field)

Descriptor	Day ²	Evening ³	Night ^{4 5}
L ₉₀	46	46	42
L _{Aeq} (see note 6)	57	58	53

Night Time Maximum Noise Levels

(see note 7)

L _{Max} (Range)	75	to	93
L _{Max} - L _{eq} (Range)	17	to	35

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured 1m from facade; tabulated results free-field corrected

4. "Night" relates to the remaining periods

7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - L_{eq} ≥ 15dB(A)

NSW Road Noise Policy (1m from facade)

Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	60	55
L _{eq} 1hr upper 10 percentile	62	59
L _{eq} 1hr lower 10 percentile	58	46

2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days

5. "Night" relates to period from 10pm on this graph to morning on the following graph.

Data File: 2019-09-18_SLM_000_123_Rpt_Report.txt

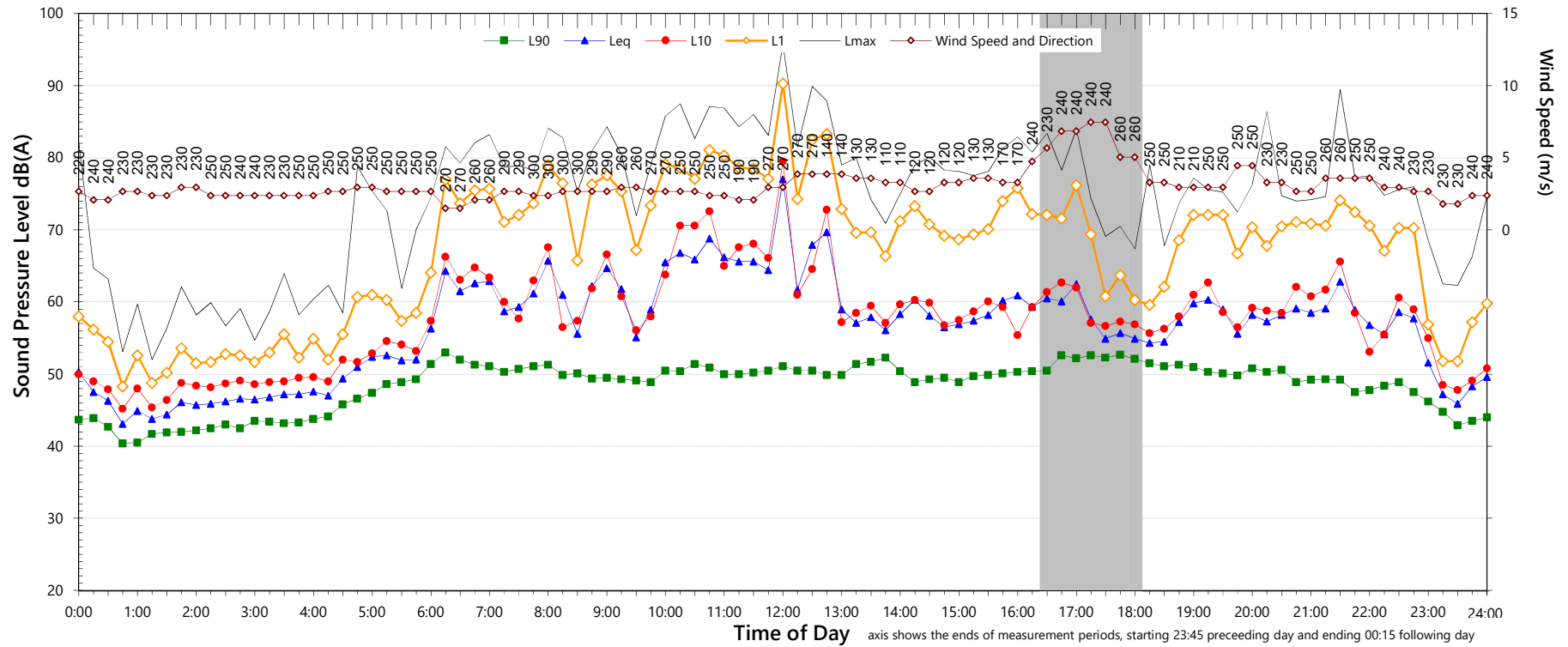
TK484-03L01 26 Faversham St (r0)

QTE-26 Logger Graphs Program (r30)

Unattended Noise Monitoring Results

26 Faversham Street, Marrickville

Monday, 23 September 2019



NSW Noise Policy for Industry (Free Field)

Descriptor	Day ²	Evening ³	Night ^{4 5}
L ₉₀	49	48	43
LA _{eq} (see note 6)	63	56	53

Night Time Maximum Noise Levels

(see note 7)

L _{Max} (Range)	67	to	86
L _{Max} - L _{eq} (Range)	16	to	35

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured 1m from facade; tabulated results free-field corrected

4. "Night" relates to the remaining periods

7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - Leq ≥ 15dB(A)

NSW Road Noise Policy (1m from facade)

Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	64	56
L _{eq} 1hr upper 10 percentile	67	58
L _{eq} 1hr lower 10 percentile	58	47

2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days

5. "Night" relates to period from 10pm on this graph to morning on the following graph.

Data File: 2019-09-18_SLM_000_123_Rpt_Report.txt

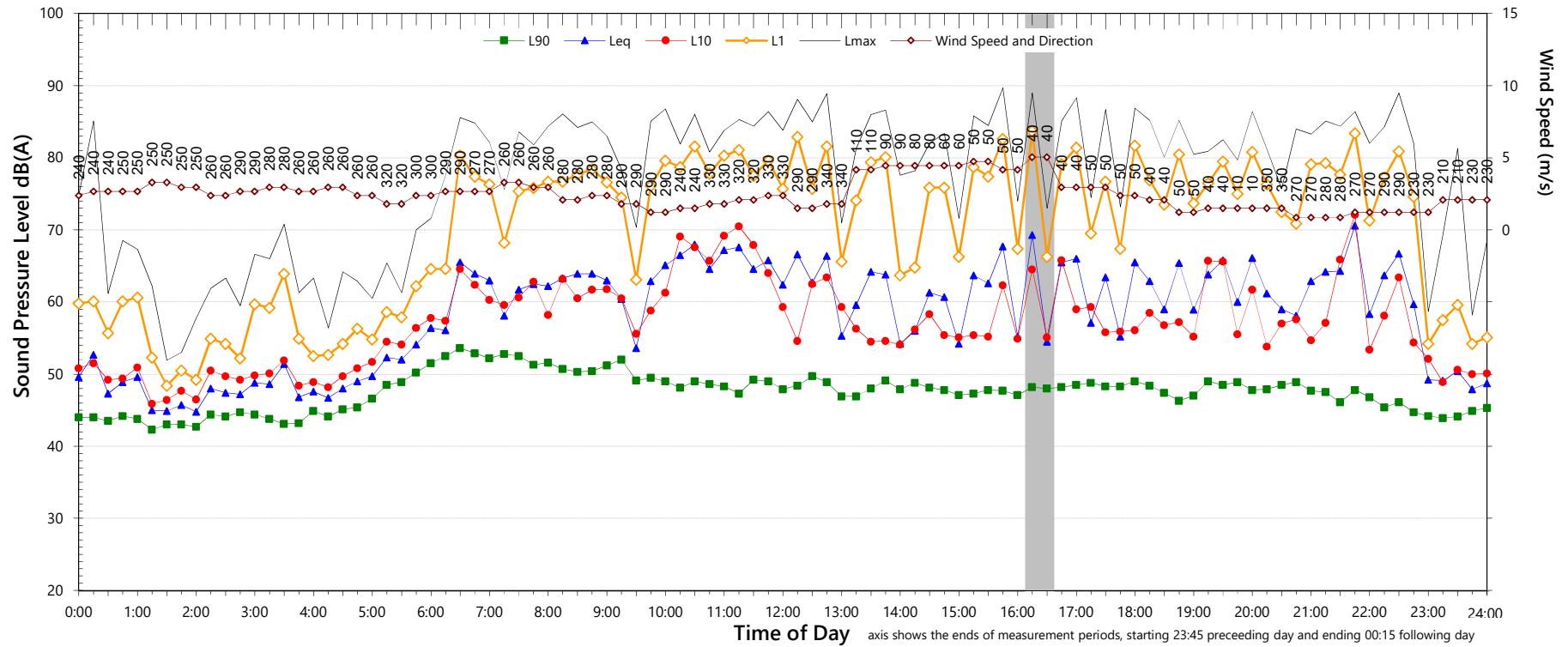
TK484-03L01 26 Faversham St (r0)

QTE-26 Logger Graphs Program (r30)

Unattended Noise Monitoring Results

26 Faversham Street, Marrickville

Tuesday, 24 September 2019



NSW Noise Policy for Industry (Free Field)

Descriptor	Day ²	Evening ³	Night ^{4 5}
L ₉₀	47	47	44
L _{Aeq} (see note 6)	61	62	54

Night Time Maximum Noise Levels

(see note 7)

L _{Max} (Range)	67	to	89
L _{Max} - L _{eq} (Range)	16	to	32

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
6. Graphed data measured 1m from facade; tabulated results free-field corrected
7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - L_{eq} ≥ 15dB(A)

NSW Road Noise Policy (1m from facade)

Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	64	56
L _{eq} 1hr upper 10 percentile	66	61
L _{eq} 1hr lower 10 percentile	61	48

2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days

5. "Night" relates to period from 10pm on this graph to morning on the following graph.

Data File: 2019-09-18_SLM_000_123_Rpt_Report.txt

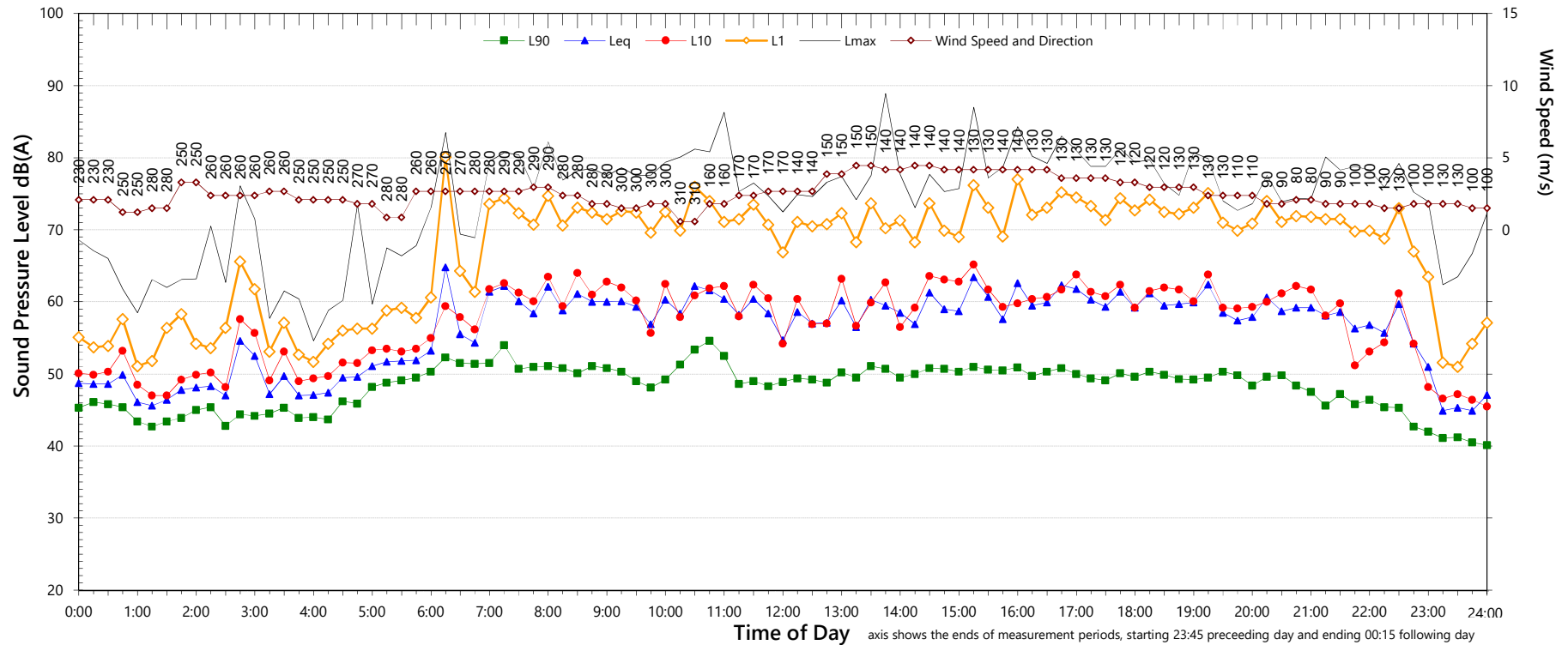
TK484-03L01 26 Faversham St (r0)

QTE-26 Logger Graphs Program (r30)

Unattended Noise Monitoring Results

26 Faversham Street, Marrickville

Wednesday, 25 September 2019



NSW Noise Policy for Industry (Free Field)

Descriptor	Day ²	Evening ³	Night ^{4 5}
L ₉₀	49	46	40
L _{Aeq} (see note 6)	58	57	53

Night Time Maximum Noise Levels

(see note 7)

L _{Max} (Range)	68	to	93
L _{Max} - L _{eq} (Range)	20	to	32

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured 1m from facade; tabulated results free-field corrected
7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - L_{eq} ≥ 15dB(A)

NSW Road Noise Policy (1m from facade)

Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	60	56
L _{eq} 1hr upper 10 percentile	61	58
L _{eq} 1hr lower 10 percentile	58	46

Data File: 2019-09-18_SLM_000_123_Rpt_Report.txt

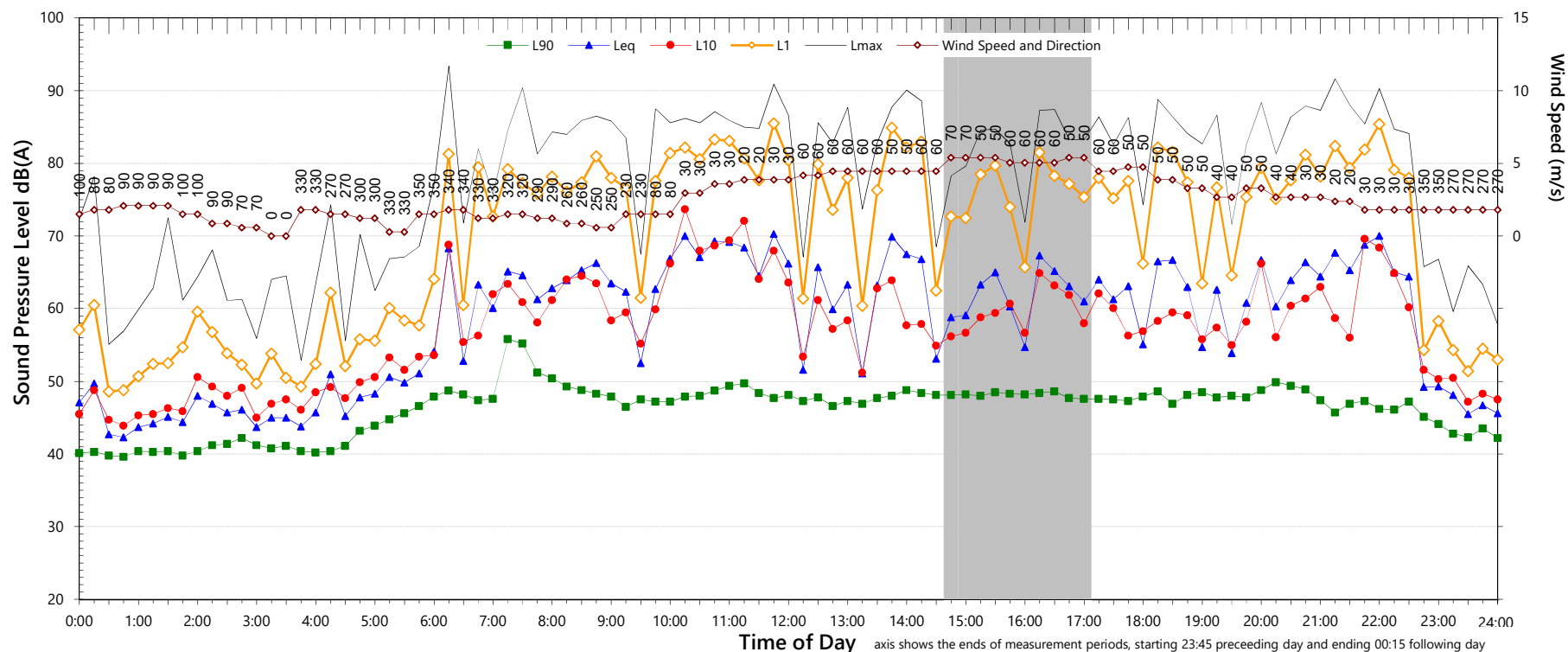
TK484-03L01 26 Faversham St (r0)

QTE-26 Logger Graphs Program (r30)

Unattended Noise Monitoring Results

26 Faversham Street, Marrickville

Thursday, 26 September 2019



NSW Noise Policy for Industry (Free Field)

Descriptor	Day ²	Evening ³	Night ^{4 5}
L ₉₀	-	47	40
LA _{eq} (see note 6)	-	63	54

Night Time Maximum Noise Levels

(see note 7)

L _{Max} (Range)	66	to	95
L _{Max} - L _{eq} (Range)	18	to	40

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured 1m from facade; tabulated results free-field corrected

4. "Night" relates to the remaining periods

7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - Leq ≥ 15dB(A)

2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days

5. "Night" relates to period from 10pm on this graph to morning on the following graph.

NSW Road Noise Policy (1m from facade)

Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	66	57
L _{eq} 1hr upper 10 percentile	68	62
L _{eq} 1hr lower 10 percentile	63	46

Data File: 2019-09-18_SLM_000_123_Rpt_Report.txt

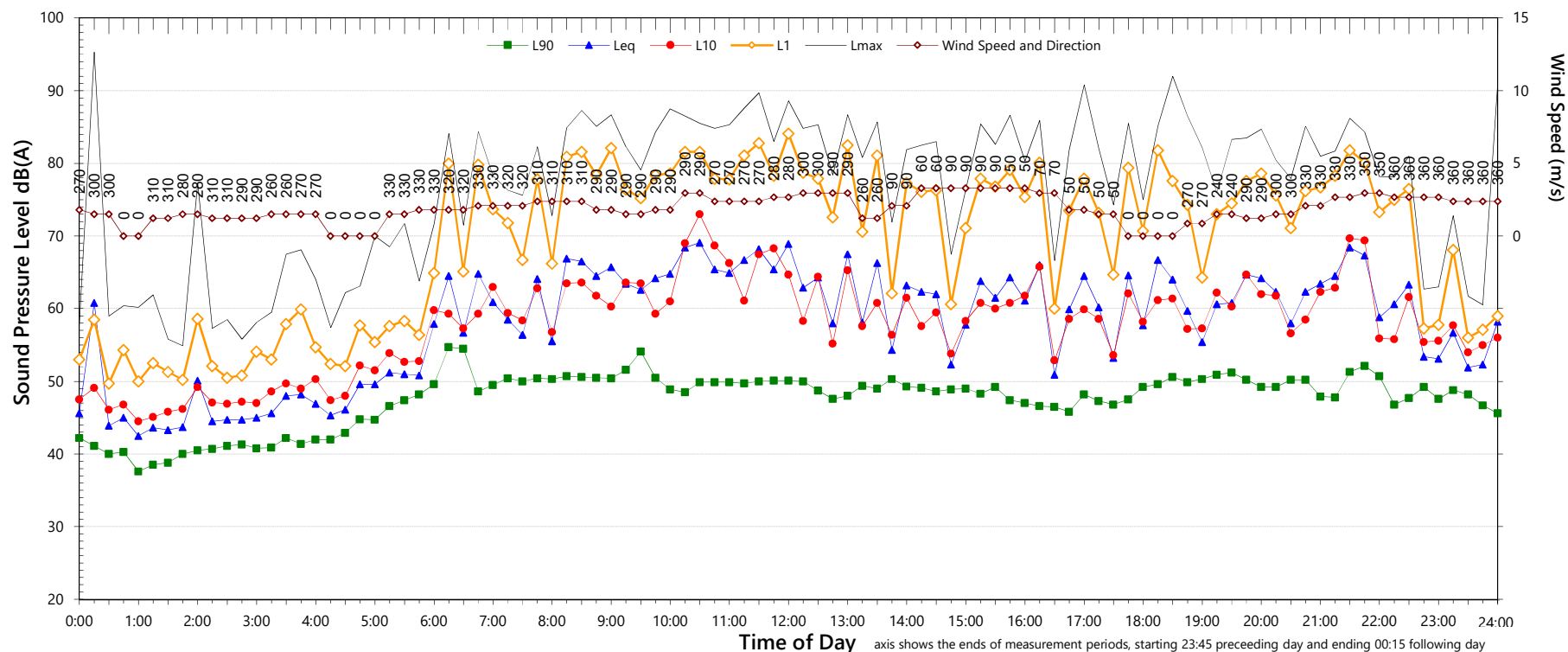
TK484-03L01 26 Faversham St (r0)

QTE-26 Logger Graphs Program (r30)

Unattended Noise Monitoring Results

26 Faversham Street, Marrickville

Friday, 27 September 2019



NSW Noise Policy for Industry (Free Field)

Descriptor	Day ²	Evening ³	Night ^{4 5}
L ₉₀	47	49	-
L _{Aeq} (see note 6)	62	61	-

Night Time Maximum Noise Levels

(see note 7)

L _{Max} (Range)	68	to	91
L _{Max} - L _{eq} (Range)	17	to	35

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured 1m from facade; tabulated results free-field corrected

4. "Night" relates to the remaining periods

7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - L_{eq} ≥ 15dB(A)

NSW Road Noise Policy (1m from facade)

Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	64	54
L _{eq} 1hr upper 10 percentile	67	58
L _{eq} 1hr lower 10 percentile	60	45

2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days

5. "Night" relates to period from 10pm on this graph to morning on the following graph.

Data File: 2019-09-18_SLM_000_123_Rpt_Report.txt

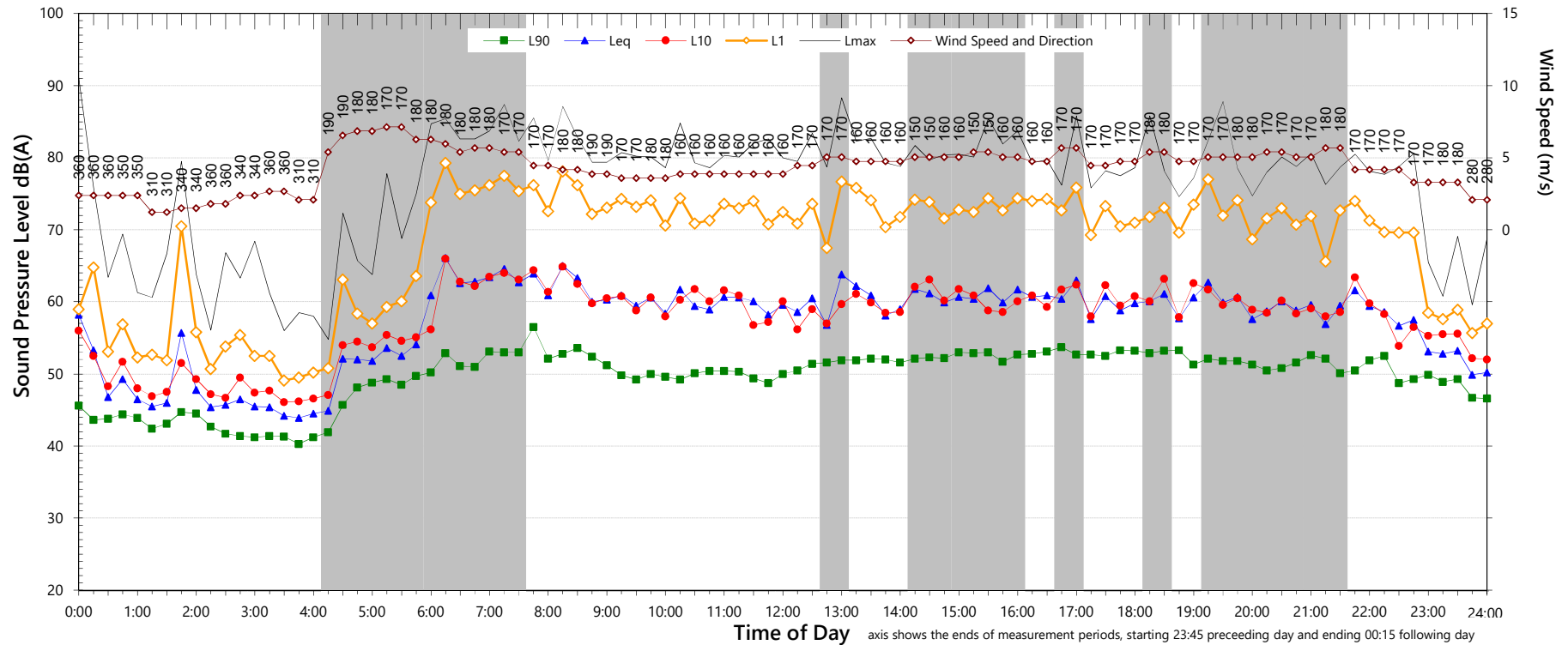
TK484-03L01 26 Faversham St (r0)

QTE-26 Logger Graphs Program (r30)

Unattended Noise Monitoring Results

26 Faversham Street, Marrickville

Saturday, 28 September 2019



NSW Noise Policy for Industry (Free Field)

Descriptor	Day ²	Evening ³	Night ^{4 5}
L ₉₀	-	-	41
L _{Aeq} (see note 6)	-	-	53

Night Time Maximum Noise Levels

(see note 7)

L _{Max} (Range)	68	to	88
L _{Max} - L _{eq} (Range)	16	to	29

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days
3. "Evening" is the period from 6pm till 10pm
4. "Night" relates to the remaining periods
5. "Night" relates to period from 10pm on this graph to morning on the following graph.
6. Graphed data measured 1m from facade; tabulated results free-field corrected
7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - L_{eq} ≥ 15dB(A)

NSW Road Noise Policy (1m from facade)

Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	61	55
L _{eq} 1hr upper 10 percentile	63	58
L _{eq} 1hr lower 10 percentile	59	44

Data File: 2019-09-18_SLM_000_123_Rpt_Report.txt

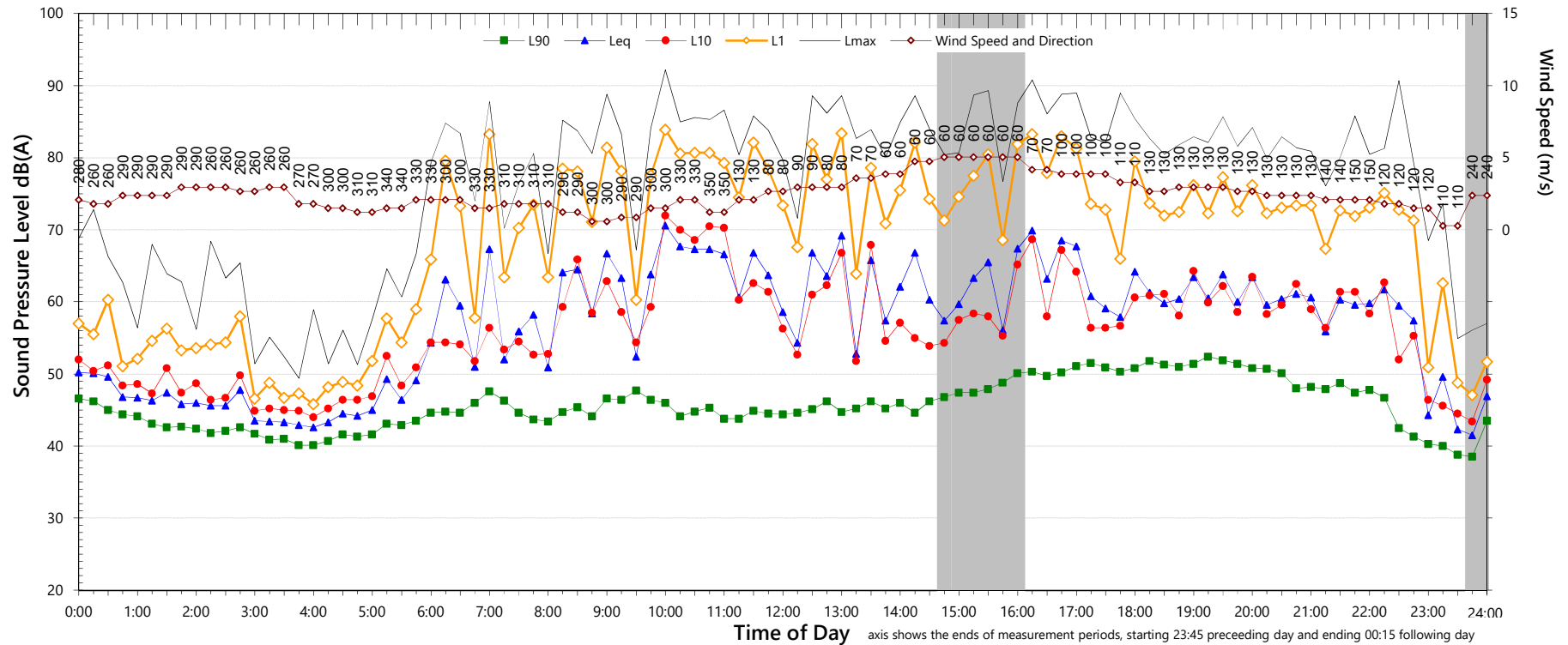
TK484-03L01 26 Faversham St (r0)

QTE-26 Logger Graphs Program (r30)

Unattended Noise Monitoring Results

26 Faversham Street, Marrickville

Sunday, 29 September 2019



NSW Noise Policy for Industry (Free Field)

Descriptor	Day ²	Evening ³	Night ^{4 5}
L ₉₀	44	48	39
L _{Aeq} (see note 6)	63	58	53

Night Time Maximum Noise Levels

(see note 7)

L _{Max} (Range)	66	to	91
L _{Max} - L _{eq} (Range)	19	to	32

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured 1m from facade; tabulated results free-field corrected

4. "Night" relates to the remaining periods

7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - L_{eq} ≥ 15dB(A)

NSW Road Noise Policy (1m from facade)

Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	64	56
L _{eq} 1hr upper 10 percentile	67	60
L _{eq} 1hr lower 10 percentile	60	44

2. "Day" is the period from 8am till 6pm on Sundays and 7am till 6pm on other days

5. "Night" relates to period from 10pm on this graph to morning on the following graph.

Data File: 2019-09-18_SLM_000_123_Rpt_Report.txt

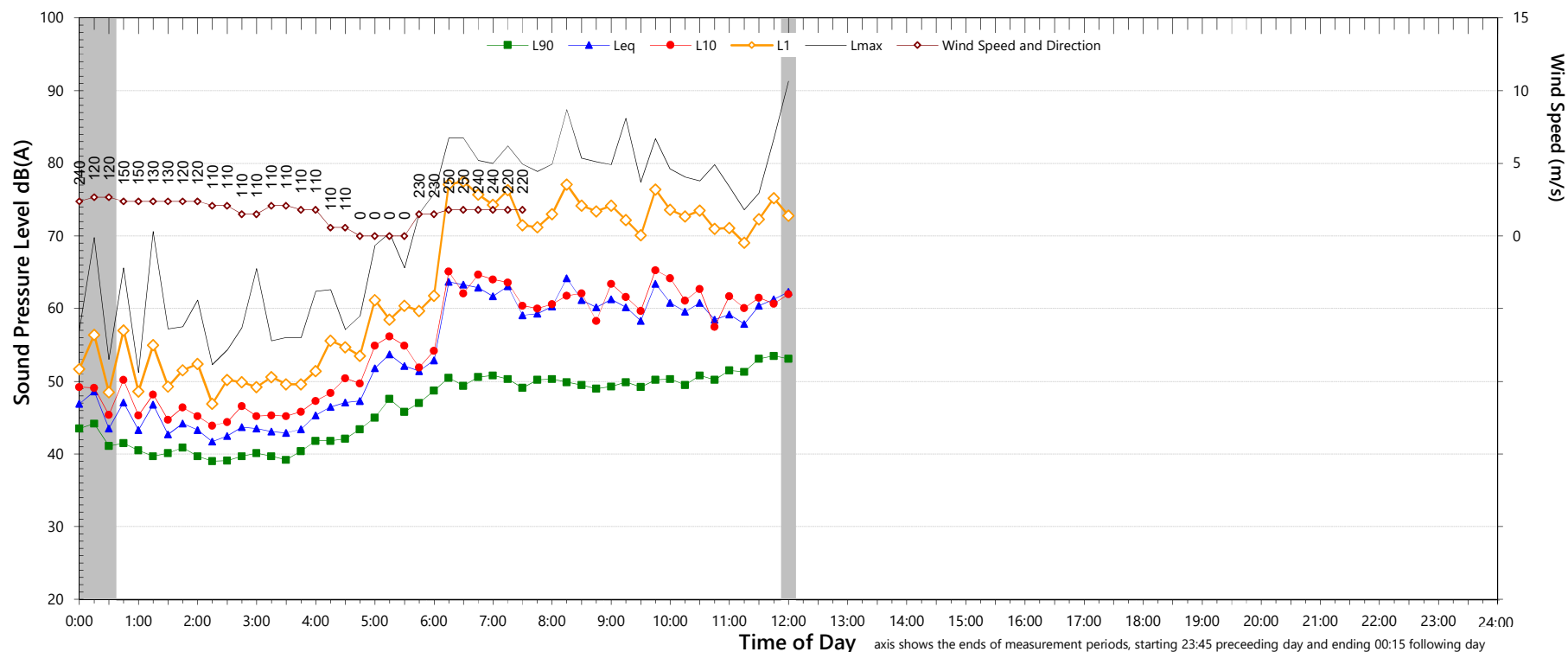
TK484-03L01 26 Faversham St (r0)

QTE-26 Logger Graphs Program (r30)

Unattended Noise Monitoring Results

26 Faversham Street, Marrickville

Monday, 30 September 2019



NSW Noise Policy for Industry (Free Field)			
Descriptor	Day ²	Evening ³	Night ^{4 5}
L ₉₀	-	-	-
L _{Aeq} (see note 6)	-	-	-

Night Time Maximum Noise Levels		(see note 7)	
L _{Max} (Range)	-	to	-
L _{Max} - L _{eq} (Range)	-	to	-

Notes:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

3. "Evening" is the period from 6pm till 10pm

6. Graphed data measured 1m from facade; tabulated results free-field corrected

4. "Night" relates to the remaining periods

7. Night time L_{Max} values are shown only where L_{Max} > 65dB(A) and where L_{Max} - L_{eq} ≥ 15dB(A)

NSW Road Noise Policy (1m from facade)		
Descriptor	Day	Night ⁵
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	61	-
L _{eq} 1hr upper 10 percentile	62	-
L _{eq} 1hr lower 10 percentile	60	-

Data File: 2019-09-18_SLM_000_123_Rpt_Report.txt

TK484-03L01 26 Faversham St (r0)

QTE-26 Logger Graphs Program (r30)

182-198 VICTORIA ROAD AND 28-30 FAVERSHAM STREET, MARRICKVILLE

Aircraft Noise Information Report - Mixed use Development

11 November 2019

TOGA Wicks Park Developments Pty Ltd

TK484-04F03 Aircraft Noise Information Report (r3)

Document details

Detail	Reference
Doc reference:	TK484-04F03 Aircraft Noise Information Report (r3)
Prepared for:	TOGA Wicks Park Developments Pty Ltd
Address:	Level 5, 45 Jones Street Ultimo NSW 2007
Attention:	Matt Dobbs

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Authorised
30.1.2019	Issue to Client	-	0	RCorbett		RCorbett
13.2.2019	Minor amendments	-	1	RCorbett		RCorbett
31.10.2019	Issue to Client	-	2	RCorbett / HPearce		HPearce
11.11.2019	Minor amendments	-	3	RCorbett / HPearce		HPearce

Important Disclaimer:

The work presented in this document was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

This document is issued subject to review and authorisation by the Team Leader noted by the initials printed in the last column above. If no initials appear, this document shall be considered

as preliminary or draft only and no reliance shall be placed upon it other than for information to be verified later.

This document is prepared for the particular requirements of our Client referred to above in the 'Document details' which are based on a specific brief with limitations as agreed to with the Client. It is not intended for and should not be relied upon by a third party and no responsibility is undertaken to any third party without prior consent provided by Renzo Tonin & Associates. The information herein should not be reproduced, presented or reviewed except in full. Prior to passing on to a third party, the Client is to fully inform the third party of the specific brief and limitations associated with the commission.

In preparing this report, we have relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, we have not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

We have derived data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination and re-evaluation of the data, findings, observations and conclusions expressed in this report.

We have prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

The information contained herein is for the purpose of acoustics only. No claims are made and no liability is accepted in respect of design and construction issues falling outside of the specialist field of acoustics engineering including and not limited to structural integrity, fire rating, architectural buildability and fit-for-purpose, waterproofing and the like.

Supplementary professional advice should be sought in respect of these issues.

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1 Introduction

Renzo Tonin & Associates was engaged to prepare an Aircraft Noise Information Report for the proposed mixed use development at 182-198 Victoria Road and 28-30 Faversham Street, Marrickville. This report recommends noise attenuation measures to comply with the internal noise criteria in accordance with Australian Standard AS2021-2015, Inner West Council Development Control Plan (DCP) 2013 and Local Environmental Plan (LEP) 2013 for the site. This report only addresses aircraft noise intrusion into the proposed dwelling.

The site is located approximately 2.5km north of Sydney's Kingsford Smith Airport.

The information contained herein is for the purpose of acoustic design only. No claims are made and no liability is accepted in respect of design and construction issues falling outside of the specialist field of acoustics engineering including and not limited to structural integrity, fire rating, architectural buildability and fit-for-purpose, waterproofing and the like. Supplementary professional advice may need to be sought in respect of these issues

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

2 Aircraft noise criteria

2.1 Inner West Council Development Control Plan

Inner West Council requires new developments within proximity of the Sydney Airport to be designed and constructed in accordance with Australian Standard AS2021 'Acoustics - Aircraft Noise Intrusion - Building Siting and Construction'.

Relevant sections from Council's DCP are as follows:

C4. Where for a new dwelling in locations that are exposed to high levels of external noise, including aircraft noise from Sydney Airport and road noise from main roads such as Parramatta Road, City West Link and Victoria Road, an acoustic report that demonstrates compliance with these objectives and controls prepared by a suitably qualified and experienced professional and is to be submitted as part of a development application.

As such, the site is to be designed to comply with the requirements of AS2021-2015 - 'Acoustics - Aircraft noise intrusion - Building siting and construction'.

2.2 AS2021-2015 – aircraft noise intrusion

Aircraft noise intrusion from take-off, landing and circuit training operations at civil aerodromes or military airfields is assessed using Australian Standard AS2021-2015 – 'Acoustics – Aircraft Noise Intrusion – Building Siting and Construction'. This section of the report outlines the application of AS2021. The site-specific assessment is presented in Section 3.

The scope of AS2021 is stated as:

This Standard, together with the relevant Australian Noise Exposure Forecast (ANEF) chart provides guidelines for determining-

whether the extent of aircraft noise intrusion makes building sites 'acceptable', 'unacceptable' or 'conditionally acceptable' for the types of activity to be, or being, undertaken (Clause 2.3);

for 'conditionally acceptable' sites, the extent of noise reduction required to provide acceptable noise levels indoors for the types of activity to be, or being, undertaken; and

the type of building construction necessary to provide a given noise reduction, provided that external windows and doors are closed.

2.2.1 Building site acceptability

AS2021 contains advice on the acceptability of building sites based on Australian Noise Exposure Forecast (ANEF) zones. The ANEF chart provides a predicted cumulative exposure to aircraft flyover noise in communities near aerodromes. The chart presents zones represented by noise contours

overlaid on a locality map specific to an airport. The ANEF system was developed as a land use planning tool aimed at controlling encroachment on airports by noise sensitive buildings.

Table 2.1 of AS2021 sets acceptability zones for different building types and land uses. The table categorises building sites as either 'Acceptable', 'Conditionally Acceptable' or 'Unacceptable' relative to different ANEF levels. Table 1 reproduces the sections of AS2021 Table 2.1 relevant to the subject site.

Table 1: Building site acceptability based on ANEF zones (Table 2.1 of AS2021)

Building type	ANEF zone of site		
	Acceptable	Conditional	Unacceptable
House, home unit, flat, caravan park	Less than ANEF 20 ¹	20 to 25 ANEF ²	Greater than 25 ANEF
Commercial Building	Less than ANEF 25	25 to 35 ANEF	Greater than 35 ANEF

- Notes:
1. The actual location of the ANEF 20 contour is difficult to define accurately, mainly because of variation in aircraft flight paths. Because of this, the procedure of Clause 2.3.2 may be followed for building sites outside or near the ANEF 20 contour.
 2. Within ANEF 20 to ANEF 25, some people may find that the land is not compatible with residential or educational uses. Land use authorities may consider that the incorporation of noise control features in the construction of residences or schools is appropriate.
 3. This Standard does not recommend development in unacceptable areas. However, where the relevant planning authority determines that any development may be necessary within existing built-up areas designated as unacceptable, it is recommended that such development should achieve the required ANR determined according to Clause 3.2. For residences, schools, etc., the effect of aircraft noise on outdoor areas associated with the buildings should be considered.
 4. AS2021 does not recommend development in unacceptable areas. However, where the relevant planning authority determines that any development may be necessary within existing built-up areas designated as unacceptable, it is recommended that such development should achieve the required ANR determined according to Clause 3.2. For residences, schools, etc., the effect of aircraft noise on outdoor areas associated with the buildings should be considered.

Table 2: Description of building site acceptability

Zone	Description
Acceptable	If from Table 2.1, the building site is classified as 'acceptable', there is usually no need for the building construction to provide protection specifically against aircraft noise. However, it should not be inferred that aircraft noise will be unnoticeable in areas outside the ANEF 20 contour. (See Notes 1, 2 and 3 of Table 2.1.)
Conditionally Acceptable	If from Table 2.1, the building site is classified as 'conditionally acceptable', the maximum aircraft noise levels for the relevant aircraft and the required noise reduction should be determined from the procedure of Clauses 3.1 and 3.2, and the aircraft noise attenuation to be expected from the proposed construction should be determined in accordance with Clause 3.3 (see Notes 1 and 3 of Table 2.1).
Unacceptable	If, from Table 2.1 the building site is classified as 'unacceptable', construction of the proposed building should not normally be considered. Where in the community interest redevelopment is to occur in such areas, e.g. a hotel in the immediate vicinity of an aerodrome, refer to the notes to Table 2.1.

2.2.2 Building treatment

As outlined, where a building type is deemed 'unacceptable' in Table 2.1 of AS2021, the building construction of the proposed development needs to be designed to reduce aircraft noise to the maximum internal noise levels stipulated in Table 3.3 of the Standard.

2.2.2.1 Indoor design sound levels for determination of aircraft noise reduction

The indoor design sound level for the activity or building type under consideration is outlined in AS2021 Table 3.3. Table 3 reproduces the criteria relevant to the subject site.

Table 3: Indoor design sound levels for determination of aircraft noise reduction (Table 3.3 from AS2021)

Building type and activity	Indoor design sound level*, dB(A)
Houses, home units, flats, caravan parks	
Sleeping areas, dedicated lounges	50
Other habitable spaces	55
Bathrooms, toilets, laundries	60
Commercial buildings – shops	75

Notes * These indoor design sound levels are not intended to be used for measurement of adequacy of construction. For measurement of the adequacy of construction against aircraft noise intrusion see Appendix D of the Standard.

1. The indoor design sound levels in Column 2 are hypothesized values based on Australian experience. A design sound level is the maximum level (dB(A)) from an aircraft flyover which, when heard inside a building by the average listener, will be judged as not intrusive or annoying by that listener while carrying out the specified activity. Owing to the variability of subjective responses to aircraft noise, these figures will not provide sufficiently low interior noise levels for occupants who have a particular sensitivity to aircraft noise.
2. Some of these levels, because of the short duration of individual aircraft flyovers, exceed some other criteria published by Standards Australia for indoor background noise levels (see AS/NZS 2107).
3. The indoor design sound levels are intended for the sole purpose of designing adequate construction against aircraft noise intrusion and are not intended to be used for assessing the effects of noise. Land use planning authorities may have their own internal noise level requirements which may be used in place of the levels above.
4. For opera and concert halls and theatres, and for recording, broadcast and television studios and similar buildings where noise intrusion is unacceptable, specialist acoustic advice should always be obtained.
5. Certain activities in schools may be considered particularly noise sensitive and 50 dB(A) may be a more desirable indoor sound level to select for any teaching areas used for such activities. However, the effect of other noise sources should be considered.
6. The provisions of this Standard relating to different internal design sound levels for different indoor spaces could result in the use of different construction and materials in contiguous spaces, and require the construction of substantial barriers between habitable spaces, e.g. heavy self-closing internal doors, detracting from the amenity of the building. Therefore consideration should be given to a uniform perimeter insulation approach.

3 Aircraft noise assessment

3.1 Site assessment - building acceptability

Based on the ANEF 2033 chart the subject site is located within the ANEF 25 to 30 contours, as shown in Figure 1. According to the ANEF map, the residential component of the property lies within the **Unacceptable** zone nominated in Australian Standards AS2021-2015 – “Acoustics – Aircraft Noise Intrusion – Building Siting and Construction”.

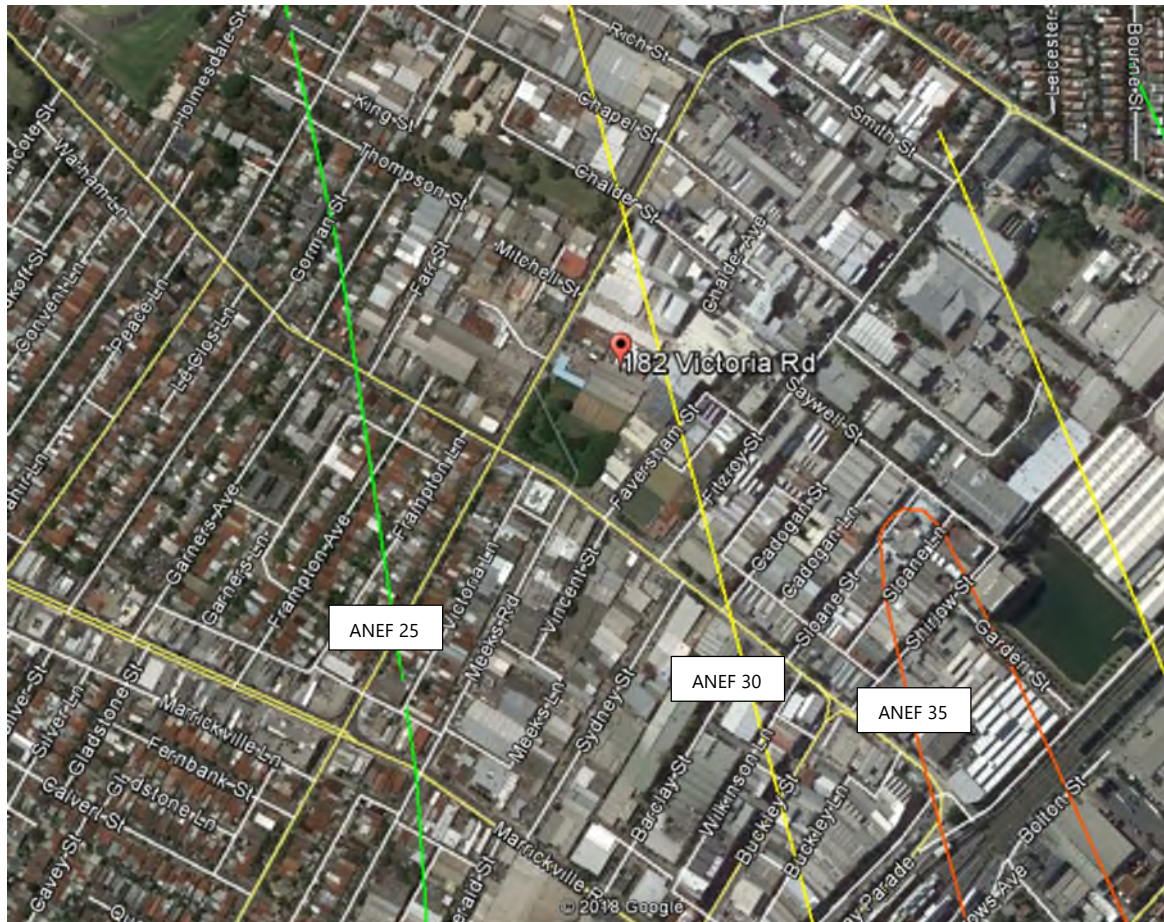


Figure 1: Subject site and ANEF overlay

For the identified ANEF zones, Table 1 summarises the acceptability of proposed uses for the subject site.

According to the ANEF map, the property lies within the Unacceptable zone nominated in Australian Standards AS2021-2015 – “Acoustics – Aircraft Noise Intrusion – Building Siting and Construction”. As such, the residential property has been assessed and recommended acoustic treatment to control aircraft noise intrusion to the limits recommended in Table 3.3 of AS2021.

3.2 Maximum aircraft noise levels

Aircraft noise exposure levels were calculated for the development site based on Australian Standard AS2021:2015. Buildings are required to be designed to meet the relevant internal noise levels presented in Table 3. The Aircraft Noise Reduction (ANR) for the building type construction is determined using the maximum external aircraft noise level and the indoor design sound level.

To determine resultant aircraft noise levels the following factors were considered as specified in the Standard;

- The site's position relative to each runway, including take-off and landing distances and runway centre line offsets;
- Elevation of the site compared with the elevation of the runways; and,
- Type of aircraft and associated maximum noise level during take-off and landing.

Using these factors, the resultant maximum noise levels were determined for each aircraft type. This calculation is not based on ANEF contours but on the location of the site relative to the runways.

The proposed development site is most impacted by the operation of the main north-south runways (landings on runway 16R and take offs on runway 34L) from Kingsford Smith Airport.

Sydney Airport has an imposed curfew between 11pm and 6am daily. The preferred runway selection published in the Sydney Airport Long Term Operating Plan nominate runways 16R for landings and 34L for take offs at any time between 6am and 10.45pm. Aircraft movements over the proposed development site may exceed 250 movements per day.

Aircraft noise movement statistics were obtained for the year 2018 to date from documents published by Air Services Australia in particular, the Sydney Airport Operational Statistics produced monthly and from the Sydney Airport Australian Noise Exposure Indexes produced quarterly.

In accordance with Clause 3.1.4 of the Standard, "where there is evidence that the particular aircraft type and movement which produced that noise level do not constitute a typical operation, then the noise level can be ignored and the next lowest noise level selected".

In accordance with clause 3.1.4, the upper 5% of movements are assumed to "not constitute a typical operation" and were excluded. The standard includes a comprehensive list of noise levels for all current aircraft including the popular Airbus A380, Boeing 737 aircraft and the Boeing 787 Dreamliner.

The maximum external noise level resulting from aircraft flyovers has been calculated in accordance with AS2021:2015.

The table below shows the maximum design noise level at the development site.

Table 4: Maximum Noise Levels at Assessment Location as per AS2021

Aircraft Type	Maximum Noise Level dB(A)	
	Arrivals (Runway 16R)	Departure (Runway 34L - long-range curved flightpath)
Airbus A320	75	77
Airbus A380	79	85
Boeing 737-800	79	84
Boeing 787	76	80

It should be noted that variations in flight paths and aircraft operational characteristics may generate external noise levels greater than calculated here.

The required aircraft noise reductions (**ANR**) for areas in the proposed development are as follows:

Table 5: Required Aircraft Noise Reduction for the Proposed Development

Area	Required ANR
Residential	
Sleeping areas, dedicated lounges	35
Other Habitable spaces	30
Bathrooms, toilets, laundries	25
Commercial	
Shops	10

4 Recommendations

Appendix G of AS2021:2015 provides one method for determining appropriate building materials and constructions to achieve a required ANR value. While Appendix G is intended to serve only as a guide to the types of construction, it has been used here to demonstrate the ability of proposed building types to satisfy the internal noise levels required of AS2021.

In general, where a specific ANR is required, buildings require external windows and doors to be kept closed, as when opened for ventilation purposes the aircraft noise reduction of the building envelope will be significantly reduced. Where it is necessary to close windows and doors to comply with this Standard, building ventilation should be designed in accordance with the Building Code of Australia on the assumption that windows and doors are not operable. Mechanical ventilation or air conditioning systems complying with AS 1668.2 should be installed.

The ANR is calculated by subtracting the indoor design level from the maximum aircraft noise level. The resulting value is an estimate of the aircraft noise reduction (**ANR**) in dB(A) to be achieved by the building's envelope.

AS2021 also provides guidance on the type of construction necessary to achieve the required ANR. Various rooms in a building may require different indoor design levels and consequently different treatment.

For the subject site, in-principle treatment for building construction has been established in order to demonstrate the ability of the buildings to be designed appropriately for the proposed uses.

For typical residential buildings, the weakest elements of the building construction in regard to noise intrusion are doors and windows (glazed). Table 6 outlines the calculated Weighted Sound Reduction Index (R_w) Ratings for windows, doors, wall structures, and the roof/ceiling structure associated with typical residential building design based on the Maximum Aircraft Noise Level of 85dB(A).

In addition to this, noise calculations were performed using design software developed in this office which take into account external noise levels, facade transmission loss and room sound absorption characteristics.

The resulting R_w rating required for each glazed element is summarised in Table 6 below.

Table 6: Recommended Glazing Construction

Level	Facade	Occupancy Type	Recommended Minimum Sound Insulation Rating of Glazing Assembly	Typical Compliance Configuration	Laboratory Test Reference
Residential					
All Levels	Western Facade facing Victoria Road	Bedrooms – total glazed area up to 3.8m ² (or 41% of the floor area)	Rw 37	Heavy laminated glass (nominally 12.5mm vlam hush or acoustically approved equivalent) to achieve require Rw rating and spectral characteristics	ESTIMATE
		Bedrooms – total glazed area up to 12.2m ² (or 120% of the room floor area)	Rw 43-44	Double Glazing: Reynaers CP 155 double glazing system: 6mm and 6mm with double interlayer / 16mm airgap / 8mm and 8mm with double interlayer; Schuco ASS70: 14.28mm laminated / 24mm airgap / 14.28mm laminated Schuco ASS70 14mm float / 24mm airgap / 10mm float	ESTIMATE
		Living/Dining/Kitchen–glazed area facing Victoria Rd up to 30% of the room floor area	Rw 35	Nominal selection 10.38mm laminated	ESTIMATE
		Corner Living/Dining/ Kitchen – glazed area up to 47% of the room floor area	Rw 37	Heavy laminated glass (nominally 12.5mm vlam hush or acoustically approved equivalent) to achieve require Rw rating and spectral characteristics	ESTIMATE
	East facade	Living/Dining/Kitchen – glazed area up to a total 52% of the room floor area overall (i.e. additional glazing is permitted on the façade protected from traffic noise, up to a total of 52% of room floor area))	Rw 35	Nominal selection 10.38mm laminated	ESTIMATE
	Remaining facades	Bedrooms – total glazed area up to 3.8m ² (or 41% of the floor area)	Rw 37	Heavy laminated glass (nominally 12.5mm vlam hush or acoustically approved equivalent) to achieve require Rw rating and spectral characteristics	ESTIMATE

Level	Facade	Occupancy Type	Recommended Minimum Sound Insulation Rating of Glazing Assembly	Typical Compliance Configuration	Laboratory Test Reference
		Bedrooms – total glazed area >3.8m ² up to 12.2m ² (or 120% of the room floor area)	Rw 43-44	Double Glazing: Reynaers CP 155 double glazing system: 6mm and 6mm with double interlayer / 16mm airgap / 8mm and 8mm with double interlayer; Schuco ASS70: 14.28mm laminated / 24mm airgap / 14.28mm laminated Schuco ASS70 14mm float / 24mm airgap / 10mm float	ESTIMATE
		Living/Dining/Kitchen – glazed area up to a total 52% of the room floor area overall	Rw 35	Nominal selection 10.38mm laminated	ESTIMATE
Commercial					
G	All	Shops	Rw 28	6mm Float	ESTIMATE

By way of explanation, the Sound Insulation Rating Rw is a measure of the noise reduction property of the partition, a higher rating implying a higher sound reduction performance.

Note that the Rw rating of systems measured as built on site (R'w Field Test) may be up to 5 points lower than the laboratory result.

LEGEND where no appropriate test certificate exists:

1. ESTIMATE: The client is advised not to commence detailing or otherwise commit to partition construction systems which have not been tested in an approved laboratory or for which an opinion only is available. Testing of partition construction systems is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested partition construction systems, estimates or opinions. The advice provided here is in respect of acoustics only.
2. ESTIMATE – APPROVED FOR CONSTRUCTION: Use of the form of construction is approved prior to laboratory certification. To complete the quality control of the design process and confirm the acoustical performance of the construction, we recommend testing in a laboratory to confirm the Rw rating as soon as practicable. In the case of impact rating for floor systems, no particular impact rating is guaranteed to comply with either the Building Code of Australia or Strata Scheme Management Act and hence carpet runners may still be required.
3. ESTIMATE – TEST NOT REQUIRED: Use of the form of construction is approved without laboratory certification. The STC/Rw of the form of construction exceeds the project requirements.
4. The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

NOTES FOR GLAZING CONSTRUCTIONS:

5. The information in this table is provided for the purpose of Council approvals process and cost planning and shall not be used for construction unless otherwise approved in writing by the acoustic consultant.
6. The design in this table is preliminary and a comprehensive assessment shall be conducted prior to Construction Certification.
7. Before committing to any form of construction or committing to any builder, advice should be sought from an acoustic consultant to ensure that adequate provisions are made for any variations which may occur as a result of changes to the form of construction where only an "estimate" is available for the sound insulation properties of recommended materials.
8. The glazing supplier shall ensure that installation techniques will not diminish the Rw performance of the glazing when installed on site.
9. All openable glass windows and doors shall incorporate full perimeter acoustic seals equivalent to Q-Lon, which enable the Rw rating performance of the glazing to not be reduced.
10. The above glazing thicknesses should be considered the minimum thicknesses to achieve acoustical ratings. Greater glazing thicknesses may be required for structural loading, wind loading etc.

Level	Facade	Occupancy Type	Recommended Minimum Sound Insulation Rating of Glazing Assembly	Typical Compliance Configuration	Laboratory Test Reference
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GENERAL

11. The sealing of all gaps in partitions is critical in a sound rated construction. Use only sealer approved by the acoustic consultant.
12. Check design of all junction details with acoustic consultant prior to construction.
13. Check the necessity for HOLD POINTS with the acoustic consultant to ensure that all building details have been correctly interpreted and constructed.
14. The information provided in this table is subject to modification and review without notice.
15. The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

External walls are proposed to be upgraded double stud metal clad, concrete, brick veneer or acoustically approved construction subject to detailed design. The acoustic rating of the wall system is to be 15 points better than the corresponding acoustic rating of the glazed system. This can be achieved using the upgraded light weight metal clad wall or masonry constructions proposed in conjunction with acoustic insulation materials.

Most apartments are not exposed to aircraft noise through the roof/ ceiling. For top floor apartments, the proposed roof construction is in-situ concrete with thermal insulation and a suspended ceiling below. Additional acoustic treatment is not required.

Before committing to any form of construction or committing to any contractor, advice should be sought from an acoustic consultant to certify that the forms of construction selected comply with the criteria nominated in this report and adequate provisions are made for any variations which may occur as a result of changes to the recommended forms of construction.

4.1 Construction Supervision

Site inspections during construction are recommended, followed by compliance testing once the dwelling is commissioned. This will allow an approach based on risk minimisation to certify that the design complies with acceptable noise limits.

APPENDIX A Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. The A-weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L _{Max}	The maximum sound pressure level measured over a given period.
L _{Min}	The minimum sound pressure level measured over a given period.

L ₁	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L ₁₀	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L ₉₀	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L _{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain L _{eq} sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.