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1105-1107 BARRENJOEY ROAD, PALM BEACH

DA Acoustic Assessment for Shop Top Housing

2 December 2020

Forest Apartments Pty Ltd c/- PBD Architects

TK309-01F02 Acoustic Assessment for DA (r1)

35 1982-2017 ACOUSTIC ENGINEERING EXCELLENCE

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Contents

List of tables

List of figures

1 Introduction

Renzo Tonin & Associates was engaged to assess noise impacts onto the proposed mixed use development (shoptop housing), located at 1105-1107 Barrenjoey Road, Palm Beach.

This study examines the effects of external noise intrusion on the proposed development (predominantly from road traffic) and assesses external noise emissions generated from the site onto neighbouring properties. Noise surveys were conducted by Renzo Tonin & Associates between Tuesday 27th October and Friday 6th November 2020 at the development site to determine the existing levels of ambient noise at the site.

As a result of our assessment, the following potential acoustic items were identified and assessed:

- Road traffic noise from Barrenjoey Road; and
- External noise emissions from the use of mechanical plant impacting on the existing and surrounding sensitive receivers (base building);
- Noise emission from the use retail spaces is the responsibility of the future tenants in their Development Applications for the use of the tenancy/tenancies (with exception of base building plant and equipment).

The assessment of the above acoustic components was undertaken in accordance with Pittwater Council's (now a part of Northern Beaches Council) Development Control Plan (DCP) 2009, State Environmental Planning Policy (Infrastructure) 2007, NSW EPA Noise Policy for Industry (NPfI) and Australian Standards.

The predicted environmental noise levels at the building facades were used to determine the sound insulation rating requirements for the external building elements in accordance with the acoustic criteria nominated for this development.

In regard to acoustic privacy between internal spaces, this is generally satisfied through the requirements of the National Construction Code - Building Code of Australia which all new residential developments would need to comply. The particular constructions for compliance would be determined through the detailed design phase of work (i.e. is not covered in this assessment).

This assessment is based on the project Development Application (DA) drawings summarised below.

Table 1: Drawing summary

Drawing No.	Date	Title
DA100	20/11/2020	Basement Plan
DA101	20/11/2020	Ground Floor Plan
DA102	20/11/2020	Level 1 Plan
DA103	20/11/2020	Level 2 Plan

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 Site and surrounds

The proposed shoptop housing, located at 1105-1107 Barrenjoey Road, Palm Beach, is to consist of the following:

- Underground basement car park for 30 vehicles;
- Ground floor - 5 Retail tenancies facing Barrenjoey Road and 3 serviced apartments at the rear facing Iluka Road;
- Level 1 and Level 2 - Residential apartments.

Existing commercial receivers are located North and South of the Site. Additionally, residential receivers are located East and West of the site. The site location and its surroundings are shown in Figure 1.

Figure 1: Site, surrounds and monitoring location

3 Existing acoustic environment

3.1 Long-term and short-term noise survey

Two RTA Technology Environmental Noise Loggers were set up for the ambient noise survey from Tuesday 27th October and Friday 6th November 2020. The noise monitoring locations are summarised below.

Location M1 – 1105-1107 Barrenjoey Road, Palm Beach (front balcony)

The noise monitor was installed at the front of the site facing Barrenjoey Road. The noise monitor was located on the first floor balcony 1.5m above the first floor level and approximately 1m from the facade. The noise environment was dominated by traffic noise from Barrenjoey Road.

Location M2 – 1105-1107 Barrenjoey Road, Palm Beach (rear courtyard)

The noise monitor was installed in the rear courtyard near the south-western corner of the site. The noise logger was placed 1.5m above the ground level and in the free field. The noise environment consisted of general neighbourhood noise, distant traffic noise from Barrenjoey Road and noise from animals.

The noise logger records noise levels on a continuous basis and stores data every fifteen minutes. The noise logger was 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 dates of measurement and the results obtained from the logger survey are shown in APPENDIX C.

3.2 Measured traffic noise level

The measured traffic noise levels for the day time (7am to 10pm) and night time (10pm-7am) periods during the monitoring period are summarised in Table 2 below.

Table 2: Representative day and night traffic noise levels, $L_{Aeq, period}$

Address	Logger location	Measured traffic noise level $L_{Aeq, period}$, dB(A) at 1m from a facade	
		Day[1]	Night[1]
1105-1107 Barrenjoey Road, Palm Beach	M1 - Front of the site	63	57
	M2 - Rear of the site	52[2]	44[2]

Notes: 1. Day is defined as 7am to 10pm; Night is defined as 10pm to 7am
2. Free field monitoring location corrected for facade reflections (i.e. +2.5dB correction added)

3.3 Existing noise environment at development site

The results of the long-term noise monitoring have been summarised in accordance with Noise Policy for Industry (NPfI) requirements published by NSW Environmental Protection Authority (EPA) and are presented in Table 3 below.

Table 3: Measure background and ambient noise levels, dB(A)

Location	L_{A90} Background noise levels			L_{Aeq} Ambient noise levels		
	Day[1]	Evening[2]	Night[3]	Day[1]	Evening[2]	Night[3]
M1 - Front of the site	48	38	33	61	59	55
M2 - Rear of the site	39	35	30	50	47	45

Notes: 1. Day is defined as 7:00am to 6:00pm, Monday to Saturday; 8:00am to 6:00pm Sundays & Public Holidays.
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 noise levels measured at M1 would be representative of the background and ambient noise levels at nearby sensitive receivers that face Barrenjoey Road. Alternatively, for nearby sensitive receivers that do not have a line of sight to Barrenjoey Road (for example the residential receivers located on Iluka Road) the noise levels measured at M2 would be more representative.

3.4 Calculated noise levels

Results from the noise surveys were used to calculate internal noise levels within the proposed development. Noise calculations were performed using glazing design software developed in this office which take into account external noise levels, facade transmission loss and room sound absorption characteristics.

4 Noise intrusion assessment

4.1 Noise intrusion criteria

The following documents were considered in determining suitable acoustic criteria for the proposed development site. Additionally, a summary of the sections relating to acoustics has been reproduced in APPENDIX B.

1. Pittwater Council's (now a part of Northern Beaches Council) Development Control Plan (DCP) 2009;
2. AS NZS 2107-2016 "Acoustics – Recommended design sound levels and reverberation times for building interiors";
3. State Environment Planning Policy (Infrastructure) 2007 (ISEPP); and
4. Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008 (DoP Guideline).

Pittwater Council's Development Control Plan does not provide any specific internal noise criteria for mixed-use developments. Additionally, the Roads and Maritime Services (currently known as Transport for NSW) do not identify this section of Barrenjoey Road as a road requiring an acoustic assessment.

However, based on the measured noise levels, described in Section 3.2, the proposed development is potentially impacted by road traffic noise along Barrenjoey Road.

Given that the DCP does not provide specific criteria and that the mixed-use development has potential to be impacted by road traffic noise, the acoustic criteria as determined in the ISEPP Clause (and quantified in the DoP Guideline) have been adopted for this assessment. The criteria for this assessment are summarised in Table 4 below.

Table 4: Internal noise criteria - ISEPP and DoP Guideline

Occupancy	Windows & Doors Condition	Design Noise Level	
		Day, $L_{Aeq\ (T)}$	Night, $L_{Aeq\ (T)}$
Bedrooms	Closed	-	35 dB(A), 9 hour
	Open	-	45 dB(A), 9 hour
All Other Habitable Areas	Closed	40 dB(A), 15 hour	40 dB(A), 9 hour
	Open	50 dB(A), 15 hour	50 dB(A), 9 hour

Notes: 1. Day and Night assessment periods are defined as follows: Day is defined as 7:00am to 10:00pm. Night is defined as 10.00pm to 7.00am

Furthermore, AS NZS 2107-2016 provides recommended internal noise criteria for different types of spaces and has been used to determine the internal noise criteria for the retail spaces within the development, detailed below.

Table 5: Internal noise criteria for commercial spaces

Occupancy	Period	Maximum Noise Level
Retail	7am – 10pm	< 50 dB(A) $L_{eq,\ 15hr}$
Speciality shops (where detailed discussion is necessary in transactions)	7am – 10pm	< 45 dB(A) $L_{eq,\ 15hr}$

4.2 Control of external noise

4.2.1 Glazing

For the purpose of this assessment the following room and glazing dimensions were assumed for this development.

Table 6: Assumed room and glazing dimensions

Occupancy	Room dimensions (m), (L x W x H)	Glazing dimensions (m), (W x H)
Bedroom	3.6 x 3.4 x 2.7	3.4 x 2.7
Open plan living[1]	6.2 x 6.3 x 2.7	10.4 x 2.7
Retail	6.2 x 6.2 x 2.7	6.2 x 2.7

Notes: 1. Typical open plan living room dimensions and glazing. Dimensions are not applicable for Unit 203. Assumed dimensions for Unit 203 are as follows: Room dimension (10 x 7.0 x 2.7 m) and glazing dimension (15.4 x 2.7 m)

Table 7 below presents recommended glazing treatment for the building facades to achieve compliance with the internal noise levels nominated in Table 4 and Table 5 above.

Table 7: Recommended glazing treatment

Facade	Levels	Occupancy Type	Recommended Minimum Sound Insulation Rating of Glazing Assembly	Typical Compliance Glazing Configuration	Laboratory Test Reference
Residential Spaces					
Eastern	Level 1-2	Bedroom	R_w 33	6.38mm laminated glass with full perimeter acoustic seals	ESTIMATE
Northern	Level G-2	Bedroom	R_w 29	4mm monolithic glass with full perimeter acoustic seals	ESTIMATE
Western	Level G-2	Bedroom	R_w 29	4mm monolithic glass with full perimeter acoustic seals	ESTIMATE
Eastern	Level 1	Open plan living	R_w 33	6.38mm laminated glass with full perimeter acoustic seals	ESTIMATE
Northern	Level G-2	Open plan living	R_w 29	4mm monolithic glass with full perimeter acoustic seals	ESTIMATE
Western	Level G-2	Open plan living	R_w 29	4mm monolithic glass with full perimeter acoustic seals	ESTIMATE
Retail					
Eastern	Ground floor	Retail	R_w 29	4mm monolithic glass with full perimeter acoustic seals	ESTIMATE

Facade	Levels	Occupancy Type	Recommended Minimum Sound Insulation Rating of Glazing Assembly	Typical Compliance Glazing Configuration	Laboratory Test Reference
Northern	Ground floor	Retail	R_w 29	4mm monolithic glass with full perimeter acoustic seals	ESTIMATE

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

Note that the R_w 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/R_w 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.

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.

4.2.2 External Walls

The dominant path of external noise ingress into building interior is via window and doors. Assessment and recommendations in regard to external noise intrusion has accordingly been made with respect to the windows and doors. It is therefore recommended that the external walls have a sound isolation rating (R_w) at least 15dB higher than that of the glazing specified in Table 7 above, to maintain the acoustic integrity of the overall facade system.

4.2.3 Roof and Ceiling

Similar to the external wall design, the roof/ceiling construction can generally provide acoustic performances well in excess of glazing or doors. The roof construction should have a sound isolation rating (R_w) at least 10dB higher than that of the glazing on its facade.

4.2.4 Glazing Assembly Requirements

The following acoustic measures should also be incorporated into the building design:

s1. All operable 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.

s2. The glazing thicknesses outlined in Table 7 should be considered the minimum thicknesses to achieve acoustical ratings. Greater glazing thicknesses may be required for structural loading, wind loading etc.

s3. The glazing supplier shall ensure that installation techniques will not diminish the R_w performance of the glazing when installed on site. Sliding door meeting tiles should form an airtight seal when closed and locked.

s4. The perimeter of all window and door frames are to be sealed airtight in the external facade using the following methods:

- For gaps less than 10mm - Fill all gaps around the window perimeter with an acoustic mastic sealer (minimum specific gravity 1.6sg) equivalent to Promat Promaseal. The depth of sealer shall be at least equal to the width of the gap.
- If the gap is greater than 10mm, fill the cavity with polyester insulation and a backing rod. Seal the gap airtight an acoustic mastic sealer (min specific gravity 1.6sg) equivalent to Promat Promaseal. The depth of sealer shall be at least equal to the width of the gap. The gaps between frames shall also be sealed using aluminium angle brackets (approximately 25 x 25 x 3mm).

4.3 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

However, the Department of Planning's Apartment Design Guide, July 2015 Objective 4B-1 requires that all habitable rooms are naturally ventilated, within an apartment complex.

Section 4J, *Noise and Pollution*, of the Apartment Design Guide nominates design solutions that may assist with delivering both the natural ventilation requirements and the internal noise levels (windows open) through careful design solutions. These may include wintergardens with operable facades, partially shielded and insulated balconies, building design and orientation, apartment setbacks and selection of acoustic materials for the building construction.

The following Apartment Design Guide suggestions have been incorporated in the design of the development:

- Ground floor retail tenancies have been located at the front of the site facing Barrenjoey Road, providing separation from the ground floor residential apartments to the noise source (Barrenjoey Road).

- Majority of the residential facades do not directly face Barrenjoey Road and are orientated away from the noise source.

- Partially shielded balconies have been incorporated for each apartment.

Further design details are to be investigated during the detailed design phase of the development.

5 External noise assessment

It is anticipated that noise from the shop top housing development will essentially emanate from the following sources:

- Noise emissions from the retail tenancies; and
- Mechanical plant servicing the development.

At this stage of the project the individual tenants for the retail spaces on the ground floor are yet to be nominated. Therefore, the acoustic impacts from the operation of the retail tenancies cannot be determined at this stage. It is recommended that the noise emissions from the retail tenancies should be reviewed at the detailed design stage when more information is available.

Similarly, the mechanical plant servicing the development is not available at this stage of the project (it is not typically selected until after development consent is granted). Acoustic assessment of mechanical services equipment will need to be undertaken during the detailed 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 determined in Section 5.1. Nevertheless, recommendations for general control of mechanical plant noise is provided in Section 5.2.

Additionally, the client has advised that the retail tenancies on the ground floor are Cold Shell tenancies. The tenants shall be responsible for acoustic assessment of noise emissions from their use of the tenancy and associated development application (where applicable).

The retail tenants should ensure that the operation of the mechanical plant servicing their space (operating simultaneously with the mechanical plant servicing the base building) complies with the nominated criteria below.

5.1 Noise emission criteria

Pittwater Council's Development Control Plan (DCP) 2009 states that noise from air conditioning units and the like shall not produce noise levels that exceed 5dB(A) above the background noise when measured from the nearest property boundary.

Furthermore, the NSW Environment Protection Agency's (EPA) Noise Policy for Industry (NPfI) 2017 also provides guidelines on assessing noise from mechanical plant. The guideline not only incorporates the 5dB(A) above background criterion but provides additional acoustic requirements in order to maintain acoustic amenities within an area.

Therefore, the criteria stipulated in the NPfI has been adopted for this project for a more detailed assessment. The requirements for the policy are provided in further detail in Section 5.1.1.

5.1.1 EPA Noise Policy for Industry

The assessment procedure in terms of the NPfI has two components:

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

In accordance with the NPfI, noise impact should be assessed against the project noise trigger level which is the lower value of the project intrusiveness noise levels and project amenity noise levels.

5.1.1.1 Intrusive noise impacts

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:

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

Table 8: NPfI Intrusive Noise Level at Residential Receivers, dB(A)

Monitoring Location	Period	Rating Background Level	Intrusiveness Noise Level, $L_{Aeq,15min}$
M1 (Front Balcony)	Daytime	48	48 + 5 = **53**
	Evening	38	38 + 5 = **43**
	Night	33	33 + 5 = **38**
M2 (Rear Courtyard	Daytime	39	39 + 5 = **44**
	Evening	35	35 + 5 = **40**
	Night	30	30 + 5 = **35**

5.1.1.2 Protecting Noise Amenity

The project amenity noise levels for different time periods of a day are determined in accordance with Section 2.4 of the NSW NPfI. The NPfI recommends amenity noise levels ($L_{Aeq, period}$) for various receivers including residential, commercial, industrial 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:

$L_{Aeq,period}$ Project amenity noise level = $L_{Aeq,period}$ Recommended amenity noise level - 5dB(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 NPfI provides the following guidance on adjusting the $L_{Aeq,period}$ level to a representative $L_{Aeq,15min}$ level in order to standardise the time periods.

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

The policy, in accordance with the NPfI, applies an adjustment of +3dB(A) to the recommended noise levels ($L_{Aeq,\ period}$) in order to standardise the time periods for the intrusiveness and amenity noise levels. It was observed that the Project was located within a suburban environment and therefore the suburban noise amenity noise levels have been adopted. The project amenity noise levels ($L_{Aeq,15min}$) applied for this project are reproduced in Table 9.

Table 9: NPfI Project Amenity Noise Levels, dB(A)

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Project Amenity Noise Level	
			$L_{Aeq,Period}$	$L_{Aeq,15min}$
Residence	Suburban	Day	55 - 5 = 50	50 + 3 = **53**
		Evening	45 - 5 = 40	40 + 3 = **43**
		Night	40 - 5 = 35	35 + 3 = **38**
Hotels/ holiday accommodation	Suburban	Day	60 - 5 = 55	55 + 3 = **58**
		Evening	50 - 5 = 45	45 + 3 = **48**
		Night	45 - 5 = 40	40 + 3 = **43**
Commercial premises	All	When in use	65 - 5 = 60	60 + 3 = **63**

5.1.1.3 Summary of Project Noise Trigger Levels

In accordance with the NPfI the project noise trigger levels, which is the lower (ie. more stringent) value of the project intrusiveness noise level and project amenity noise level, have been determined and reproduced in Table 10 below.

Table 10: Project Noise Trigger Levels, dB(A)

Receiver Location	$L_{Aeq,\ 15min}$ Project Noise Trigger Levels		
	Day	Evening	Night
Nearby residential receivers that face Barrenjoey Road	53	43	38
Nearby residential receivers with no line of sight to Barrenjoey Road	44	40	35

5.2 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 NPfI 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 NPfI 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".

6 Internal sound insulation

This section outlines the criteria for the separation of sole occupancy units from each other, from common space, and spaces of different classification. The particular constructions for compliance with these shall be determined through the detailed design stage.

6.1 NCC 2019

Internal walls and floors shall comply with the National Construction Code of Australia 2019 (formally Building Code of Australia). All services and doors shall comply with the requirements of the NCC 2019.

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.

A.1 Sound insulation provision of NCC

The acoustic provisions for inter-tenancy walls and floors in Class 2 and 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 with spectrum adaptation term ($L_{n,w}$) 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."

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.

7 Construction noise

7.1 Environmental protection authority's construction noise guidelines

The Environmental Protection Authority (EPA) 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 ICNG that can be incorporated into this assessment include:

1. Use of LAeq as the descriptor for measuring and assessing construction noise.

In recent years NSW noise policies including EPA's NSW Industrial Noise Policy (INP) and the NSW Environmental Criteria for Road Traffic Noise (ECRTN) 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 LA10 descriptor.

Consistent with the latest guideline (ICNG) the use of L_{Aeq} as the key descriptor for measuring and assessing construction noise may follow a 'best practice' approach.

2. Application of feasible and reasonable 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, including the cost of the measure.

3. Quantitative and qualitative assessment

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 short-term duration where works are not likely to affect an individual or sensitive land use for more than three weeks in total. It focuses on minimising noise disturbance through the implementation of feasible and reasonable work practices, and community notification.

Given the significant scale of the construction works proposed for this Project, a quantitative assessment is carried out herein, consistent with the ICNG's requirements.

4. Management Levels

Residences

Table 11 below (reproduced from Table 2 of the ICNG) sets out the noise management levels and how they are to be applied. 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 11: Noise at residences using quantitative assessment

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.

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Sensitive Land Use

Table 12 below (reproduced from Table 2 of the ICNG) sets out the noise management levels for various sensitive land use developments.

Table 12: Noise at other sensitive land uses using quantitative assessment

Land use	**Management level, $L_{Aeq\ (15\ min)}$ – applies when land use is being utilised**
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.

8 Conclusion

Renzo Tonin & Associates have completed an acoustic assessment of the proposed shop top housing including noise impacts on the site from road traffic noise and potential noise impacts from mechanical plant and equipment serving the site.

The study of external noise intrusion into the subject development has found that appropriate controls can be incorporated into the building design to achieve a satisfactory accommodation environment, consistent with the intended quality of the building and relevant standards and the Council's guidelines.

Noise emission goals for the operation of the development have been set in accordance with the Noise Policy for Industry. It is feasible that noise emissions from the subject site can comply with these criteria, subject to detailed design for Construction Certificate.

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 common sounds in our daytime environment:

threshold of hearing	0 dB	The faintest sound we can hear
	10 dB	Human breathing
almost silent	20 dB	
	30 dB	Quiet bedroom or in a quiet national park location
generally quiet	40 dB	Library
	50 dB	Typical office space or ambience in the city at night
moderately loud	60 dB	CBD mall at lunch time
	70 dB	The sound of a car passing on the street
loud	80 dB	Loud music played at home
	90 dB	The sound of a truck passing on the street
very loud	100 dB	Indoor rock band concert
	110 dB	Operating a chainsaw or jackhammer
extremely loud	120 dB	Jet plane take-off at 100m away
threshold of pain	130 dB	
	140 dB	Military jet take-off at 25m away

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 Leq 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.

APPENDIX B Assessment and design methodology

B.1 Pittwater Development Control Plan

Part C – Design Criteria for Residential Development states the following acoustic requirements relevant to this development:

C1.6 Acoustic Privacy

Controls

Noise-sensitive rooms, such as bedrooms, should be located away from noise sources, including main roads, parking areas, living areas and recreation areas and the like.

Walls and/or ceilings of attached dwellings shall have a noise transmission rating in accordance with Part F(5) of the Building Code of Australia. (Walls and ceilings of attached dwellings must also comply with the fire rating provisions of the Building Code of Australia).

Noise generating plants including pool/spa motors, air conditioning units and the like shall not produce noise levels that exceed 5dBA above the background noise when measured from the nearest property boundary.

Developments must comply in all respects with the Protection of the Environment Operations Act, 1997, and other relevant legislation.

C1.25 Plant, Equipment Boxes and Lift Over-Run

Controls

Where provided, plant and equipment boxes , air conditioning units and lift over-runs are to be integrated internally into the design fabric of the built form of the building. Council does not encourage air conditioning units on the roof of Multi Unit Housing. The location of air conditioning units shall be indicated on development assessment plans for approval at the time of DA lodgement.

Locate and design all noise generating equipment such as mechanical plant rooms, mechanical equipment, air conditioning units, mechanical ventilation from car parks, driveway entry shutters, garbage collection areas or similar to protect the acoustic privacy of workers, residents and neighbours.

C2.10 Pollution Control

All developments must be designed, constructed, maintained, and operated in a proper and efficient manner to prevent air, water, noise or land pollution.

Development and business operation must comply with the Protection of the Environment Operations Act, 1997, and any relevant legislation.

Compliance with the NSW Environment Protection Authority Industrial Noise Policy, January 2000.

C2.22 Plant, Equipment Boxes and Lift Over-Run

Where provided, plant and equipment boxes and lift over-runs are to be integrated internally into the design fabric of the built form of the building.

Locate and design all noise generating equipment such as mechanical plant rooms, mechanical equipment, air conditioning units, mechanical ventilation from car parks, driveway entry shutters, garbage collection areas or similar to protect the acoustic privacy of workers, residents and neighbours.

B.2 SEPP (Infrastructure) 2007

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:

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.

4. In this clause, "freeway", "tollway" and "transitway" have the same meanings as they have in the Roads Act 1993

B.3 Department of Planning Publication 'Development near rail corridors and busy roads - Interim guideline'

The Guideline provides direction for developments that may be impacted by rail corridors and/or busy roads and consideration for the Guideline is a requirement for development specified under the Infrastructure SEPP.

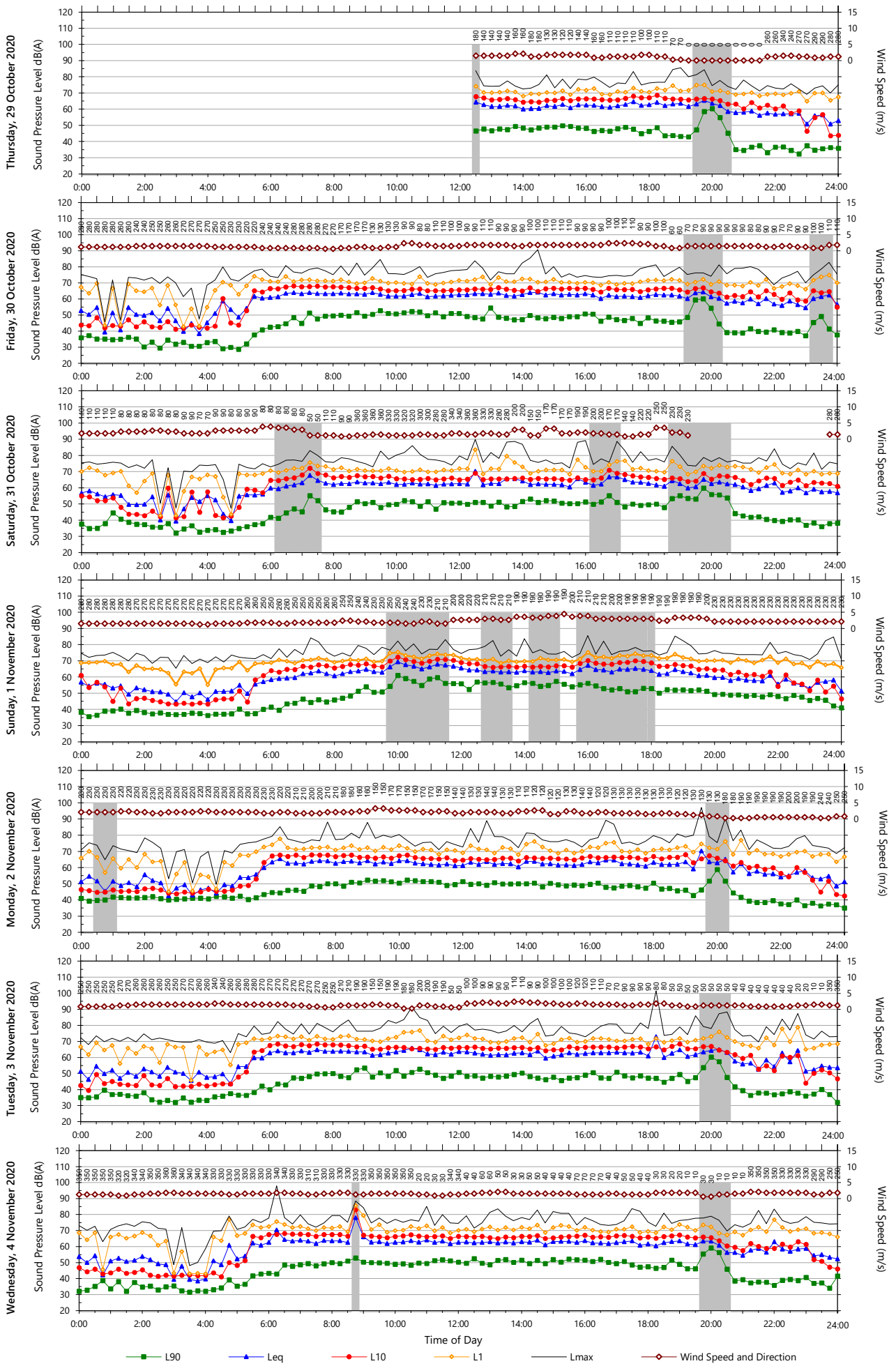
The Guideline recommends an acoustic traffic assessment be undertaken for roads having an AADT of greater than 20,000 and less than 40,000 vehicles per day and states an assessment is mandatory for roads having an AADT of greater than 40,000 vehicles per day. It also identifies assessment zones in which a rail noise and vibration assessment is required.

Table 3.1 of the Guideline summaries noise criteria for noise sensitive developments

Residential Buildings		
Type of occupancy	**Noise Level dBA**	**Applicable time period**
Sleeping areas (bedroom)	35	Night 10 pm to 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways	40	At any time

Note: airborne noise is calculated as Leq (9h) (night) and Leq (15h)(day). Ground-borne noise is calculated as Lmax (slow) for 95% of rail pass-by events.

APPENDIX C Long term noise monitoring graphs



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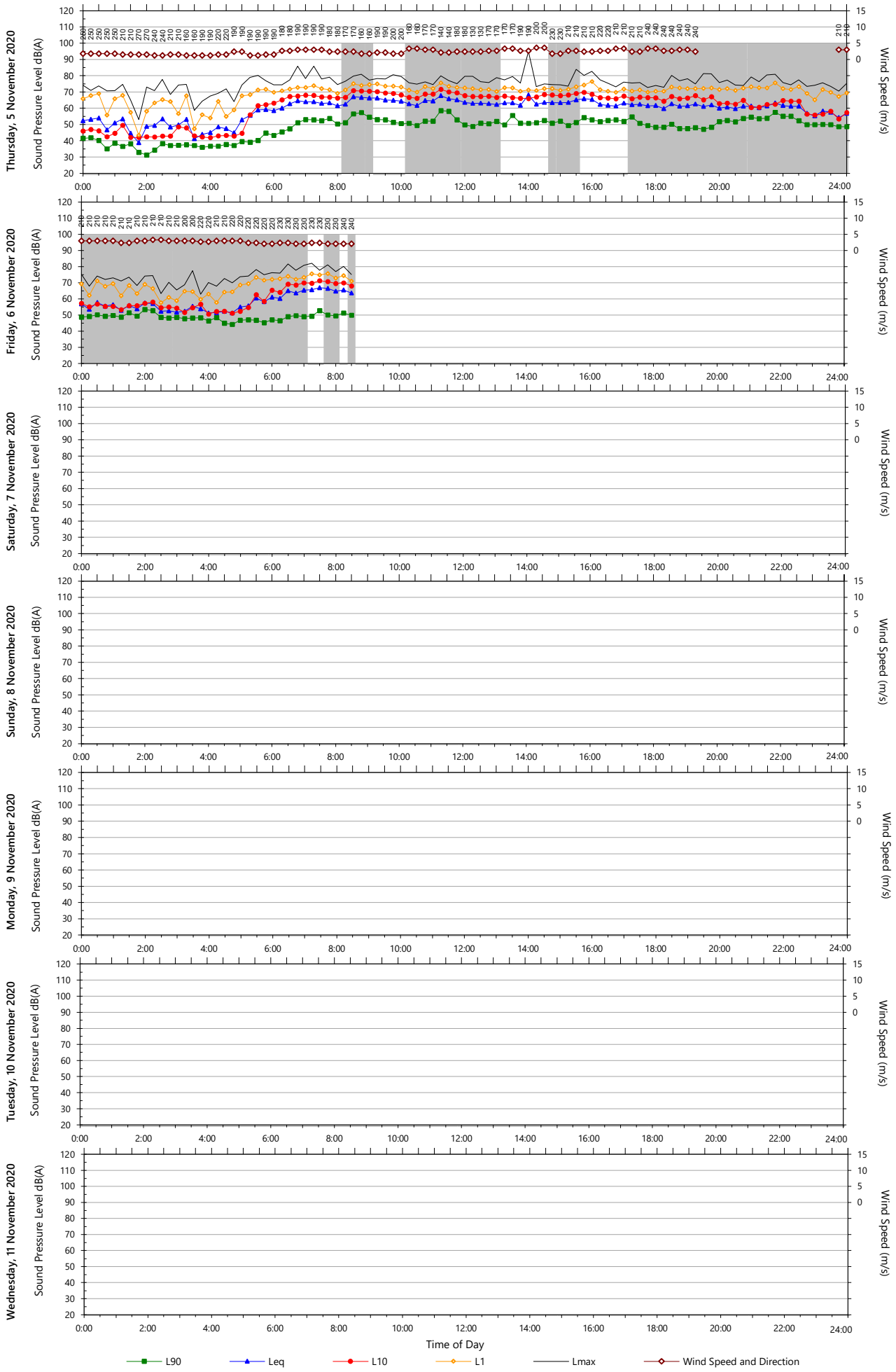

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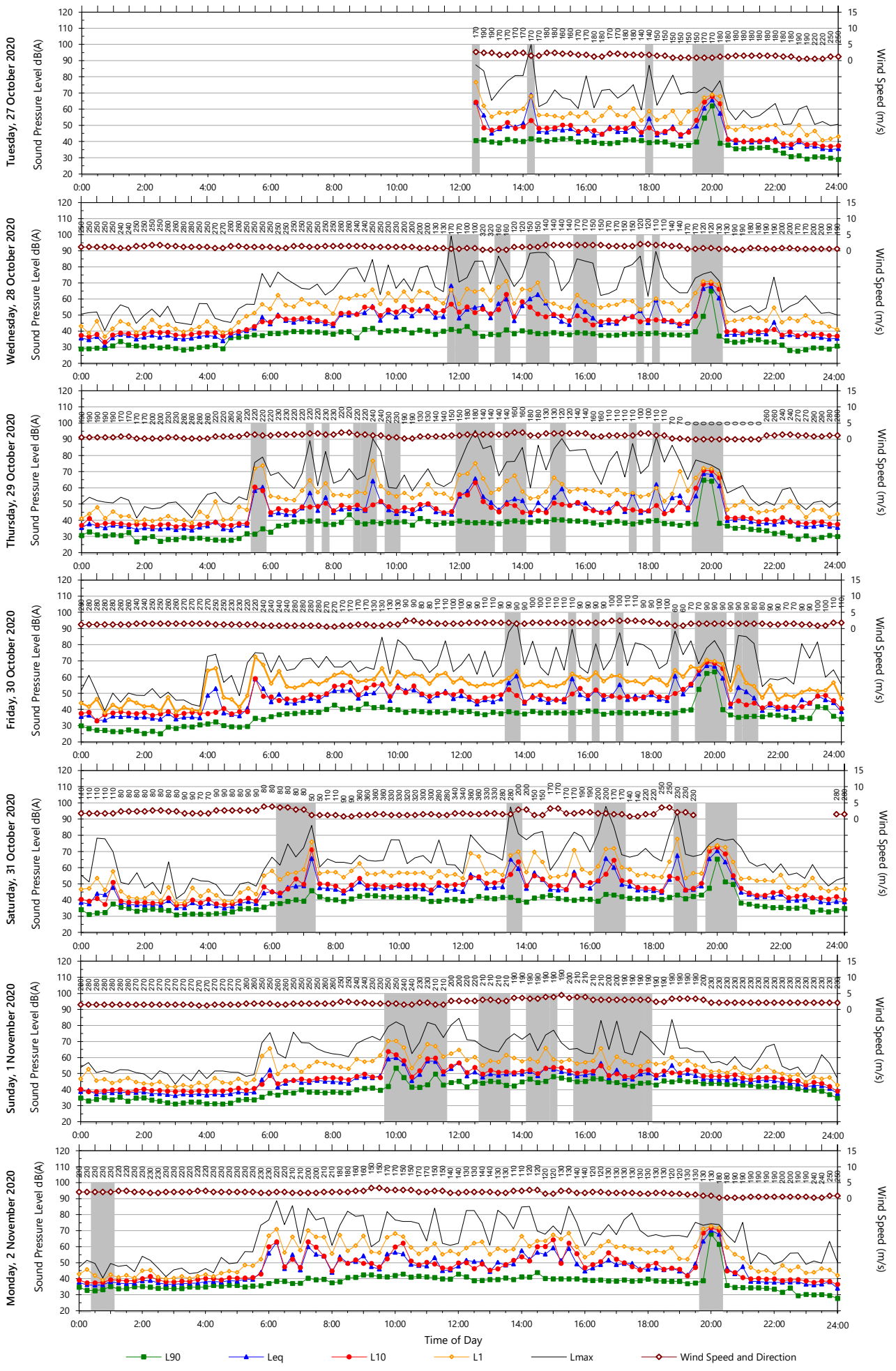

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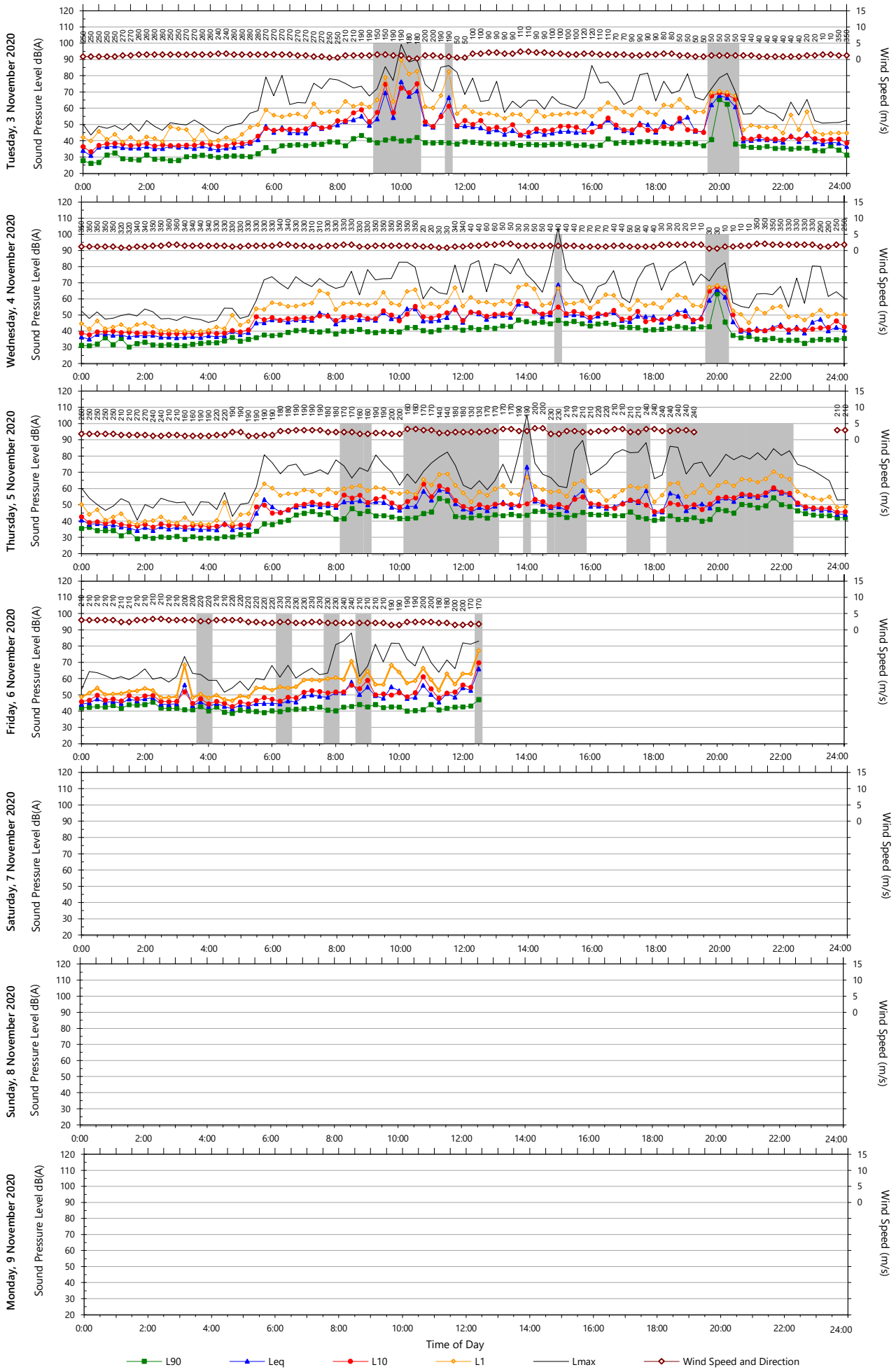

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