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MILPERRA WSU PLANNING PROPOSAL

Acoustic Assessment

Mirvac Residential Developments (NSW)

TL127-01F04 Acoustic Report (r6)

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1 Introduction

Renzo Tonin & Associates was engaged to conduct an environmental noise assessment of existing road traffic, and commercial and industrial premises to support the redevelopment of Western Sydney University (WSU) Milperra Campus.

The proposed development is approximately 430 low-rise residential houses, including an associated childcare, community facility and open spaces. The site adjoins the existing Mount St Joseph High School, and a section of the University site (south-eastern corner) is to be sold to the school.

This report quantifies the impact of external noise on the site (road traffic and industrial noise). In addition, operational noise from the proposed childcare centre, playground and sports ground are examined.

The noise impacts have been assessed in accordance with the requirements of the relevant guidelines as specified below and assessed in detail in the respective report sections.

Noise source	Guideline/Policy/Standard	Section
Road traffic and industrial noise impacts	State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) (Used for Road traffic noise impacts) Development in Rail Corridors and Busy Roads - Interim Guideline (December 2008) (Used for Road traffic noise impacts) Australian Standard AS2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors (Used for industrial noise impacts)	Section 4 and 5
Childcare centre	Association of Australasian Acoustical Consultants (AAAC) Guideline for Child Care Centre Acoustic Assessment (AAAC Guideline)	Section 6
Playground and sports ground • Mount St Joseph School Playground • Milperra Reserve	NSW EPA Noise Guideline for Local Government (NGLG)	Section 7

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 Project description

2.1 Site description and development overview

The site is bound by industrial premises to the east of the site on the opposite side of Horsley Road (Heatcraft Australia, etc.) and to the north on the opposite side of Bullecourt Avenue (Southern Steel Cash & Carry, etc.) with existing residential dwellings to the west on the opposite side of Ashford Avenue. There are also commercial/retail premises as well as existing sports ground (Milperra Reserve) to the north-west near the intersection of Ashford and Bullecourt Avenues. There is also an existing school and its proposed expansion on the south-eastern corner of the site (see Figure 1) and a childcare (Western Sydney University Early Learning) on the eastern part of the site. Regarding road traffic, the subdivision is subject to the road traffic along the M5 Motorway to the south.

Figure 1: Subject site

Figure 2: Milperra WSU Masterplan

2.2 Assessment methodology

In order to assess the potential noise impact on the subdivision site, the following methodology was used:

- Determine existing road traffic noise levels impacting on-site.
- Determine the extent of noise impacts at proposed residential lots using the results of the noise monitoring and predictive noise modelling.

- Identify where road traffic noise intrusion onto the site may exceed the relevant criteria.
- Identify industrial noise impacts on proposed residential lots using the results of the attended and unattended noise monitoring.
- Using the results of the noise monitoring and predictive noise modelling to determine the extent of noise impact at residential lots from playground, sports ground, and childcare.
- Identify where playground, sports ground or childcare noise intrusion onto the site may exceed the relevant criteria.
- Where external noise levels are predicted to exceed the noise criteria, in-principal recommendations are provided for building envelope design to achieve internal noise criteria.

2.3 Reference material

The following documentation was referenced for this report:

- Milperra WSU Masterplan package prepared by Mirvac [ref: Milperra WSU Masterplan-NewPark-Rev 4b2-28-07-2021-17.2m roads per CB dated 28 July 2021]
- Information on the children outdoor play area capacity provided in an email from WSU Early Learning [ref: RE WSU Early Learning Bankstown - Information Request for Acoustic Assessment.msg]

3 Existing noise environment

Long-term noise monitoring was conducted at the subject site between Wednesdays 27 November and Monday, 13 December 2019 in order to determine existing ambient noise levels from road traffic, industrial activity, and school playground. The long-term noise monitoring methodology is detailed in APPENDIX B., and noise level-vs-time graphs of the data are included in APPENDIX C.

The section below details the results of traffic and ambient noise conditions. In addition, a survey of the impact of existing industrial noise in the vicinity of the site was undertaken. This is detailed in section 5.

3.1 Noise measurement location

The long-term measurement locations are outlined in Table 1 and shown in Figure 3.

Table 1: Noise monitoring locations

ID	Location	Description
Long-term noise monitoring		
L1	WSU Oval South	The noise monitor was located on the southern boundary of the Masterplan and approximately 27m to the north of the closest lane of the M5 Motorway. The noise environment was dominated by road traffic from the M5 Motorway to the south. It is advised that the noise monitor was located behind the existing noise barrier in the free field.
L2	WSU East Parking - Horsley Road	The noise monitor was located on the eastern boundary of the Masterplan and approximately 9m to the west of Horsley Road. The noise environment was dominated by road traffic from the Horsley Road to the east. It is advised that the noise monitor was located in the free field.
L3	WSU Entrance - Bullecourt Avenue	The noise monitor was located on the northern boundary of the Masterplan and approximately 9m to the south of Bullecourt Avenue. The noise environment was dominated by road traffic and industrial premises from the Bullecourt Avenue to the north. It is advised that the noise monitor was located in the free field.
L4	Mount St Joseph School Sports Field	The noise monitor was located on the north boundary of the existing school adjacent to the Masterplan. It was located approximately 11m to the north of the school's sports field. The noise environment was dominated by school activities and distant road traffic from the Horsley Road to the east. It is advised that the noise monitor was located in the free field.
L5	WSU Village Entrance - Ashford Avenue	The noise monitor was located on the western boundary of the Masterplan and approximately 11m to the east of Ashford Avenue. The noise environment was dominated by road traffic from the Ashford Avenue to the west. It is advised that the noise monitor was located in the free field.

Figure 3: Long-term noise monitoring locations

3.2 Long-term noise measurement results and discussion

Results from long-term noise monitoring are presented in Table 2 below.

Table 2: Long-term noise monitoring results

Monitoring location	L_{A90} background noise levels			L_{Aeq} ambient noise levels	
	Day[1]	Evening[1]	Night[1]	Day[2]	Night[2]
L1 - WSU Oval South	52	50	43	60	57
L2 - WSU East Parking - Horsley Road	49	45	41	64	59
L3 - WSU Entrance - Bullecourt Avenue	53	47	39	70	65
L4 - Mount St Joseph School Sports Field	43	44	39	57	50
L5 - WSU Village Entrance - Ashford Avenue	52	50	43	59	57

Notes: 1. Day: 07:00-18:00, Evening: 18:00-22:00, Night: 22:00-07:00
2. Day: 7:00am to 10:00pm; Night: 10:00pm to 7:00am

The noise environment at logger locations L2 and L3 were dominated by road traffic and subjectively the noise emission from the industrial facilities from across the roads are deemed not to contribute to the existing measured L_{Aeq}. Therefore, further assessment against the NSW EPA NPfI is not deemed necessary.

4 Road traffic noise assessment noise impact study

4.1 State Environmental Planning Policy (Infrastructure) 2007 noise limits

In NSW, the SEPP (Infrastructure) 2007, also known as the ISEPP, commenced 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.

Clause 102 of the ISEPP states as follows:

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 building for residential use,*
   - *a place of public worship,*
   - *a hospital,*
   - *an educational establishment or childcare 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:*
   - *in any bedroom in the building--35 dB(A) at any time between 10 pm and 7am,*
   - *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.*

4.1.1 ISEPP Guideline

To support the ISEPP, 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.

The Guideline clarifies the time period of measurement and assessment. As stated in the Guideline in Section 3.4 'What Noise and Vibration Concepts are Relevant' and Table 3.1 of Section 3.6.1, noise measurements are determined over the following relevant time periods:

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

L_{Aeq} is the Equivalent Continuous Noise Level and accounts for both the level of fluctuating noise and the number of noise events over the time period. The noise criteria nominated in the ISEPP are internal noise levels with windows and doors closed and the requirements are stated in the following table.

Table 3: ISEPP internal road traffic noise criteria

Internal space	Time period	Noise metric	Internal criteria^
Bedrooms	7am - 10pm	$L_{Aeq(15hrs)}$	40*
	10pm - 7am	$L_{Aeq(9hrs)}$	35
Other Habitable Rooms	Any Time	$L_{Aeq(15hrs)}$ and $L_{Aeq(9hrs)}$	40

Notes: ^ With windows and doors closed.

* Whilst not specified in the ISEPP, daytime criteria for bedrooms are set to 40dB(A), as per the other habitable rooms.

The Guideline in Section 3.6.1 'Airborne Noise' states as follows:

> *"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."*

As noise modelling is undertaken for external locations, the above criteria and guidelines have been used to establish equivalent external noise criteria. This external noise criterion is used to determine which building facades may require specific acoustic treatment to meet the requirements of the ISEPP. External goals have been calculated based on nominal 10dB(A) reduction through an open window to a free-field position. Windows open to 5% of floor area in accordance with the NCC 2019 requirements.

Table 4: ISEPP road and rail traffic 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

Room	Location	$L_{Aeq,\ 15hr}$ Day 7am - 10pm	$L_{Aeq\ 9hr}$ Night 10pm - 7am
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 based on nominal 10dB(A) reduction through an open window to a free-field position. Windows open to 5% of floor area in accordance with the National Construction Code (NCC) 2019 requirements.

4.2 Noise sources

Road traffic noise sound power levels were determined from the noise monitoring results. The following $L_{Aeq(9hrs)}$ sound power levels were used, which were validated to both logger locations in the noise modelling.

Table 5: Road traffic noise 9-hour equivalent sound power levels PWL/metre (re 1 Picowatt)

Noise source	Overall dB(A)	Octave band centre frequency - Hz								
		31.5	63	125	250	500	1k	2k	4k	8k
M5 Motorway	91	94	98	93	84	87	88	83	71	63
Horsley Road	73	73	77	73	64	67	68	62	51	43
Ashford Avenue	71	72	76	71	62	65	66	61	50	41
Bullecourt Avenue	78	78	82	78	69	72	73	67	56	48

4.3 Prediction methodology

The noise propagation calculations were carried out in accordance with ISO9613 as implemented by CadnaA computer modelling program (version 2020). The software considers sound radiation patterns, acoustic shielding and potential reflections from intervening building elements, and noise attenuation due to distance.

The noise prediction model was run for two (2) different receiver heights, 1.5m above ground level for ground floor and 4.5m above ground level for 1st floor.

The measured night-time road traffic noise levels indicate a greater impact and therefore, noise predictions were assessed to night-time criteria as compliance with the more stringent night-time criteria will results in compliance during the day.

4.4 Road traffic noise prediction results

The noise prediction results are set out in a graphical format in APPENDIX D of this report. The contour maps in APPENDIX D show that noise levels at some facades on the boundary of the Masterplan do not comply with the ISEPP noise limits. Noise control treatments to mitigate road traffic noise are discussed in Section 8.

5 Industrial noise impact study

In order to ensure that noise from pre-existing industrial development is considered in the design of new dwellings a survey of industrial noise at the site was undertaken.

5.1 Condition from the Department of Planning

Department of Planning's has made the following comment with respect to acoustics:

> *f. Address potential noise impacts from nearby industrial uses, and if there are significant impacts outline how these impacts will be mitigated by the future residential development.*

5.2 Internal noise level goals

AS2107:2016 internal noise goals will be adopted in setting noise targets for new residential development in areas impacted by industrial noise.

In Section 5 and Table 1 of the Australian Standard 2107 states the recommended A-weighted sound pressure level ranges for the design of the spaces in buildings.

The noise criteria nominated in the Australian Standard 2107 are internal noise levels with windows and doors closed and the requirements are stated in the following table. The table below presents target internal noise levels within dwellings based on AS2107 because of external industrial noise intrusion.

Table 6: AS2107 internal noise criteria

Type of occupancy	Internal space	Internal criteria (L_{Aeq})
Houses and apartments in suburban areas	Sleeping Areas	35
	Living Areas	40
	Apartment Common Areas	50

5.2.1 Equipment Used for Noise Assessment

Sound level measurements were undertaken in general accordance with AS1055.1-1997 "Acoustics – Description and Measurement of Environmental Noise" using an NTi Audio Type XL2 precision sound level analyser which is a class 1 instrument having accuracy suitable for field and laboratory use. Statistical noise levels were acquired in both overall and octave band frequencies. The instrument was calibrated prior and after 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).

5.2.2 Noise Measurement results

As part of this noise assessment, short term attended noise measurements were undertaken during the early morning of Wednesday, 27 July 2022, in order to determine the industrial noise contribution on the future residential development. The measurement locations were 1.5m above the ground level on 6 different locations around Western Sydney University (WSU) Milperra Campus.

A summary of measured L_{Aeq} noise levels is presented in below Table 7 and Table 8 for specified locations shown in Figure 4.

To assist, the L_{Aeq} noise levels presented in below Table 7 compares industrial noise contribution measured on Wednesday, 27 July 2022 and Night-time traffic noise levels as documented in Table 2.

Figure 4: Short-term noise monitoring locations

Table 7: Industrial noise levels (L_{Aeq}) compared to traffic noise levels (L_{Aeq})

Measurement Location number	Measurement Location description	Date/time	Industrial noise levels (L_{Aeq})	Traffic noise levels at Night (L_{Aeq})	Comment
S1	South-east corner of WSU Oval (Approximately 30m from South-Western Motor Way)	27/07/2022 01:11-01:26	N/A	57	L_{Aeq} was driven by traffic noise from South-Western Motorway. No industrial activity from 260-270 Horsley Road, Milperra was seen/heard. These industrial sites are approximately within 150m of location S2.
S2	In WSU carpark 2 near Mount St Joseph School, 273 Horsley Road (Approximately 8m away from Horsley Road)	27/07/2022 01:37-01:52	N/A	59	L_{Aeq} was driven by distinct traffic noise from South-Western Motorway. No industrial activity from 260-270 Horsley Road, Milperra was seen/heard. These industrial sites are approximately within 150m of location S2.
S3	On WSU footpath facing Southern Steel Cash and Carry, 319 Horsley Rd, Milperra (Approximately 5m away from Bullecourt Avenue and 54m away from the Southern Steel Cash and Carry, building roller door)	27/07/2022 01:59-02:14	48	65	L_{Aeq} was mostly driven by distinct traffic noise from South-Western Motorway and Bullecourt Avenue. Activities associated within the Southern Steel Cash and Carry, 319 Horsley Road building such as lifting long and heavy structural steel pipes and unloading them on the truck(53L_{Amax}) and truck moving(53L_{Amax}) can be faintly heard at locations S3 and S4.
S4	In WSU carpark 1 (Approximately 35m from Bullecourt Avenue and 75m away from the Southern Steel Cash and Carry, building roller door)	27/07/2022 02:17-02:32	48	65	L_{Aeq} was mostly driven by distinct traffic noise from South-Western Motor Way and Bullecourt Avenue. Activities associated within the Southern Steel Cash and Carry, 319 Horsley Road building such as lifting long and heavy structural steel pipes and unloading them on the truck(53L_{Amax}) and truck moving(53L_{Amax}) can be faintly heard at locations S3 and S4.
S5	In WSU carpark 1 (Approximately 35m from Bullecourt Avenue and 86m away from the Southern Steel Cash and Carry, building roller door)	27/07/2022 02:34-02:49	47	65	L_{Aeq} was mostly driven by distinct traffic noise from South-Western Motorway and Bullecourt Avenue. Some of the traffic noise from South-Western Motorway was masked by
S6	On WSU west footpath facing 150 Ashford Ave, Milperra (Approximately 5m from Ashford Avenue)	27/07/2022 02:55-03:10	N/A	57	L_{Aeq} was driven by distinct traffic noise from South-Western Motorway and Ashford Avenue. This measurement was taken to determine noise from industrial sites located to the north of WSU Milperra campus.

Table 8 represents an additional measurement that was recorded to determine the noise from the mechanical plant associated with the Southern Steel Cash and Carry, 319 Horsley Road building breaking out from the roller door which is located on the opposite side of Bullecourt Avenue.

Table 8: L_{Aeq} noise measurement result for mechanical plant associated with the Southern Steel Cash and Carry, 319 Horsley Road

Measurement Location number	Measurement Location description	Date/time	Measured L_{Aeq}	Comment
S7	Standing 5m from the industrial building roller door on opposite side of Bullecourt Avenue	27/07/2022 03:11-03:26	46	L_{Aeq} was driven by mechanical plant associated with the Southern Steel Cash and Carry, 319 Horsley Road building.

5.2.3 Discussion

Based on the above, road traffic noise levels are higher than industrial noise levels at the site.

- In above mentioned Table 7, measured noise levels at locations S1(south of WSU Milperra Campus) S2(east of WSU Milperra Campus) and S6(west of WSU Milperra Campus) demonstrates no activity from the industrial sites that are in proximity.

- Noise levels at locations S3(i.e., 48L_{Aeq}), S4(i.e., 48L_{Aeq}) and S5(i.e., 47L_{Aeq}), demonstrates noise levels that are well below the measured traffic noise level (i.e., 65L_{Aeq}). Noting that there were activities associated within the Southern Steel Cash and Carry, 319 Horsley Road building such as lifting long and heavy structural steel pipes and unloading them on the truck(53L_{Amax}) and truck moving(53L_{Amax}) were recorded.

- Noise from 319 Horsley Road building roller door (which is located on the opposite side of Bullecourt Avenue to WSU Campus) is lower than the road traffic noise levels on Bullecourt Road.

Overall, the industrial noise levels are much lower with respect to road traffic noise levels and hence, façade systems detailed in Section 8 are sufficient to address road noise and industrial noise intrusion.

Provided that the recommendations in section 8 are adopted, by road traffic noise and industrial noise will be attenuated such that suitable internal noise levels within dwellings will be achieved.

6 Childcare noise emission study

6.1 AAAC Guideline

The AAAC has issued a 'Guideline for Child Care Acoustic Assessment (2010)' (AAAC Guideline). The guideline contains the following suggested levels when assessing noise from a childcare centre.

Residential Receptors

Outdoor play area

> *For outdoor play of more than 2 hours per day, the Leq,15min noise level emitted from the outdoor play area shall not exceed the background noise level by more than 5dB.*
>
> *It is reasonable to allow a higher level of noise impact for a shorter duration of outdoor play. For outdoor play of up to 2 hours total per day, noise shall not exceed the background noise level by more than 10dB.*

The background noise level used for the noise criteria of this assessment is based on noise monitoring location L2 at Horsley Road on daytime.

6.2 Noise sources

Noise measurements of outdoor play were attempted but due to the bushfire situation at the time, the time when the children is allowed to be outside was restricted and therefore, this created a timing issue; and hence, the noise emission from the childcare centre is predicted as below.

The sound power levels recommended in the AAAC Guideline have been used in the noise calculations for the outdoor play areas. The AAAC Guideline gives a range of noise levels for different age groups of children playing as shown in Table 9.

Table 9: AAAC Sound power levels for groups of 10 children playing (dB re 10^{-12} watts)

Number of children	Sound Power Level dB(A)
10 children ages 0 to 2 years	77 to 80
10 children aged 2 to 3 years	83 to 87
10 children aged 3 to 6 years	84 to 90

By way of explanation the "sound power level" is not the same as the "sound pressure level". The "sound power level" is the source emission strength analogous to the wattage of a light bulb (a higher wattage producing a higher light intensity at any distance). Having established the sound power level of children at play, the sound pressure level then decreases with distance and is further reduced by interposed acoustic barriers.

Experience with other childcare centres shows that if one were to adopt the highest values in Table 9 for calculations, this predicts noise levels that are too high compared with the measured noise levels. Instead, if the logarithmic average of the highest and lowest values is used, this results in a realistic assessment for children engaged in active play. Taking the logarithmic average is skewed towards the higher values as shown in the following table:

Table 10: Adopted sound power levels for groups of 10 children in active play (dB re 10^{-12} watts)

Number of children	Sound Power Level dB(A)
10 children ages 0 to 2 years	78.8
10 children aged 2 to 3 years	85.4
10 children aged 3 to 6 years	88.0

In respect of groups of children engaging in passive play (ie. sandpit, seated activities, etc.) the lower range in Table 9 above are applicable.

The sound power levels are then scaled to take into consideration the actual number of children at the subject development in each age group to enable prediction of noise levels to receiver locations. The following assumptions are made:

1. There are 8 children 0-2yo, 8 children 2-3yo, and 18 children 3-6yo in the outdoor active play area. There are 8 children 0-2yo, 8 children 2-3yo, and 17 children 3-6yo in the outdoor passive play area. The plan of management must ensure that these numbers are not exceeded.

2. In the outdoor passive play area the lower range of sound power levels in Table 9 are adopted, and in the active play area the higher range in Table 11 are adopted. The plan of management must ensure that the type of play in the outside play area is controlled by staff supervision and by ensuring that there is no active play equipment in the outside passive play area.

Table 11 shows the sound power levels used in the calculations, when converted for the appropriate number of children in each age group.

Table 11: Sound power levels of children (dB re 10^{-12} watt)

Number of children	Sound Power Level dB(A)
8 children 0-2yo in the active play area and 8 children 0-2yo in the passive play area	81
8 children 2-3yo in the active play area and 8 children 2-3yo in the passive play area	88
18 children 3-6yo in the active play area and 17 children 3-6yo in the passive play area	94

Children between the aged of 0 to 3 years are modelled at a height of 1.0m and older children are modelled at a height of 1.2m.

6.3 Prediction methodology

The noise propagation calculations were carried out in accordance with ISO9613 as implemented by CadnaA computer modelling program (version 2020). The software considers sound radiation patterns, acoustic shielding and potential reflections from intervening building elements, and noise attenuation due to distance.

The noise prediction model was run for two (2) different receiver heights, 1.5m above ground level for ground floor and 4.5m above ground level for 1st floor at the nearest residential boundary on the western and eastern side of the childcare external area. The following figure shows the receiver locations closest to the childcare based on the subdivision masterplan.

Figure 5: Childcare receiver locations

6.4 Childcare noise prediction results

Based on the childcare capacity, noise source levels, and the above prediction methodology, the predicted noise impacts at the receiver locations are presented in the following table.

Table 12: Predicted $L_{Aeq,\ 15min}$ noise levels, dB(A)

Receiver locations	Predicted $L_{Aeq,\ 15min}$ noise level dB(A)	Noise criteria (dBA)
R1 - Western lots		
Ground Floor	47	54

Receiver locations	Predicted $L_{Aeq, 15min}$ noise level dB(A)	Noise criteria (dBA)
First Floor	50	54
R2 - Eastern lots		
Ground Floor	26	54
First Floor	29	54

The noise prediction results indicate that the childcare noise demonstrates compliance at all receivers and no noise mitigation measures are necessary.

7 School playground and sports ground noise emission study

7.1 NSW EPA Noise Guideline for Local Government (NGLG) intrusiveness criterion

In the absence of specific noise criteria stipulated by the consent authority, reference is made to the NSW *Noise Guide for Local Government* (NGLG). According to the NGLG, 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} descriptor) does not exceed the background noise level measured in the absence of the source by more than 5dB(A). The intrusiveness criterion is summarised as follows:

- $L_{Aeq,15minute} \leq$ Rating background level (RBL) plus 5dB(A)

The allowable $L_{Aeq\ 15minute}$ noise emission from a development is therefore dependant on the background noise level in an area without the subject development in operation. The background noise levels at time which the development is to operate therefore need to be quantified.

7.2 Noise sources

The noise levels obtained from the noise logger at logger location L4 have been used to calculate the sound power levels of Mount St Joseph school's playground. It is assumed that the same power levels are generated at Milperra Reserve sports ground. The following table presents the resulting sound power levels.

Table 13: Sound power level of typical activity at playground and sports ground (dB re 10^{-12} watts)

Noise source	Overall dB(A)	Octave band centre frequency - Hz								
		31.5	63	125	250	500	1k	2k	4k	8k
Milperra Reserve (L_W per sq. metre)	57	64	65	61	58	55	52	48	43	38
Mt St Joseph playground (L_W per sq. metre)	61	68	69	65	62	59	55	51	46	42

7.3 Prediction methodology

The noise propagation calculations were carried out in accordance with ISO9613 as implemented by CadnaA computer modelling program (version 2020). The software considers sound radiation patterns, acoustic shielding and potential reflections from intervening building elements, and noise attenuation due to distance.

The noise prediction model was run for two (2) different receiver heights, 1.5m above ground level for ground floor and 4.5m above ground level for 1st floor. The following figure shows the receiver locations closest to the school playground and sports ground based on the subdivision masterplan. The

background noise level used for the noise criteria of this assessment is based on noise monitoring location L4 at Mount St Joseph school for receiver locations R3 and R4 and noise monitoring location L3 at Bullecourt Avenue for receiver locations R5 and R6. It is assumed that the playground operates until 6:00pm and the sports ground operate until 10:00pm.

See Appendix E.

Figure 6: School playground and sports ground receiver locations

7.4 Playground and sports ground noise prediction results and recommendations

Based on the playground and sports ground noise levels and the above prediction methodology, the predicted noise impacts at the receiver locations are presented in the following table.

Table 14: Predicted $L_{Aeq,\ 15min}$ Noise Levels, dB(A)

Receiver Locations	Predicted $L_{Aeq,\ 15min}$ noise level dB(A)	Noise criteria (dBA)
R3 - North side of school playground		
Ground Floor	**54**	48
First Floor	**56**	48
R4 - West side of school playground		
Ground Floor	**61**	48

Receiver Locations	Predicted $L_{Aeq, 15min}$ noise level dB(A)	Noise criteria (dBA)
First Floor	**60**	48
R5 - South side of Milperra Reserve sports ground		
Ground Floor	**51**	45
First Floor	**52**	45
R6 - East side of Milperra Reserve sports ground		
Ground Floor	**48**	45
First Floor	**54**	45

Notes: **Bold** indicates exceedance.

The noise prediction results indicate that there are exceedances at all receiver locations and noise mitigation measures are deemed necessary.

Recommended noise controls are:

- For dwellings adjacent to the School playground:
    - Build 2.1m fences at the boundary between the residential lots and Mount St Joseph school and
    - Glazing treatments as per Appendix E.
- For dwellings adjacent to the sports field:
    - Glazing treatments as per Appendix E.

8 Noise control treatment recommendations

The noise modelling identified areas where the external noise goals were not met. Therefore, the affected areas of residential dwellings are to be designed to meet the relevant internal noise criteria.

The following provides in-principal noise control recommendations to reduce noise intrusion for residential premises. The recommendations are based on several assumptions relating to the built form. The advice provided here is in respect of acoustics only. Supplementary professional advice should be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

8.1 Building setbacks and layout

Dwellings constructed in road traffic noise affected areas can be designed so that their layouts minimise noise in living and sleeping areas. Less sensitive rooms (such as kitchens, laundries, and bathrooms) are recommended to be placed on the side of the building fronting the nearest noise source (being the road).

8.2 Indicative building construction

Based on the noise modelling, and in accordance with internal noise criteria set out in Section 4.1, recommendations for building element constructions are presented for the following room types. It is assumed that non-habitable rooms are separated from habitable spaces by doors (i.e., doors to studies, laundries, and ensuites/bathrooms etc.).

Table 15: Room parameters

Room	Item	Description
Bedroom	Dimensions (L x W x H)	Indicatively 3m x 3m x 2.7m or larger.
	Surface finishes	Carpeted floors with underlay, plasterboard walls and ceiling, and bed
Living room	Dimensions (L x W x H)	7m x 5m x 2.7m
	Surface finishes	Timber or tiled floors, plasterboard walls and ceiling
Lounge	Dimensions (L x W x H)	6m x 4m x 2.7m
	Surface finishes	Carpeted floors with underlay, plasterboard, and ceiling

The required acoustic treatment categories are presented graphically in APPENDIX F. The acoustic treatment corresponding to each category is specified in Table 16.

Table 16: Acoustic constructions for treatment categories (ISEPP)

Category	Room	Construction element	Indicative treatment	
Category 1 (Alternative ventilation not required)	Bedrooms and adjoining ensuites	Windows/glazed doors*	Less than $4m^2$ = R_W 24	No specific glass thickness required
			$4m^2$ – $8m^2$ = R_W 27	6mm float glass with acoustic seals
		Walls/roof/ceiling	Standard constructions	
	Lounge/living rooms	Windows/glazed doors*	Less than $8m^2$ = R_W 29	6mm float glass with acoustic seals
			$8m^2$ – $16m^2$ = R_W 32	6.38mm laminated glass with acoustic seals
		Timber doors	35mm solid core timber - acoustic seals	
		Walls/roof/ceiling	Standard constructions	
Category 2 (Alternative ventilation required)	Bedrooms and adjoining ensuites	Windows/glazed doors*	Less than $2m^2$ = R_W 24	No specific glass thickness required
			$2m^2$ – $4m^2$ = R_W 27	6mm float glass with acoustic seals
			$4m^2$ – $8m^2$ = R_W 30	6.38mm laminated glass with acoustic seals
		Walls/roof/ceiling	Standard constructions	
	Lounge/living rooms	Windows/glazed doors*	Less than $4m^2$ = R_W 29	6mm float glass with acoustic seals
			$4m^2$ – $8m^2$ = R_W 32	6.38mm laminated glass with acoustic seals
			$8m^2$ – $16m^2$ = R_W 35	10.38mm laminated glass with acoustic seals
		Timber doors	40mm solid core timber - acoustic seals	
		Walls/roof/ceiling	Standard constructions	
Category 3 (Alternative ventilation required)	Bedrooms and adjoining ensuites	Windows/glazed doors*	Less than $2m^2$ = R_W 27	6mm float glass with acoustic seals
			$2m^2$ – $4m^2$ = R_W 30	6.38mm laminated glass with acoustic seals
			$4m^2$ – $8m^2$ = R_W 33	10.38mm laminated glass with acoustic seals
		Roof/ceiling	Standard constructions	
		Walls	R_W 46	Brick veneer construction, standard internal plasterboard with R1.5 wall batts Or Reverse brick veneer construction, external metal or FC cladding with R1.5 wall batts Or Metal studs with 1 layer of 16mm fire-rated plasterboard inside, metal or FC external cladding, R1.5 wall batts
	Lounge/living rooms	Windows/glazed doors*	Less than $4m^2$ = R_W 32	6.38mm laminated glass with acoustic seals
			$4m^2$ – $8m^2$ = R_W 35	10.38mm laminated glass with acoustic seals
			$8m^2$ – $16m^2$ = R_W 38	Heavy laminated glass or double glazing with acoustic seals
		Timber doors	45mm solid core timber - acoustic seals	

Category	Room	Construction element	Indicative treatment	
		Roof/ceiling	Standard constructions	
		Walls	R_W 46	Brick veneer construction, standard internal plasterboard with R1.5 wall batts Or Reverse brick veneer construction, external metal or FC cladding with R1.5 wall batts Or Metal studs with 1 layer of 16mm fire-rated plasterboard inside, metal or FC external cladding, R1.5 wall batts
Category 4 (Alternative ventilation required)	Bedrooms and adjoining ensuites	Windows/glazed doors*	Less than $2m^2$ = R_W 30	6.38mm laminated glass with acoustic seals
			$2m^2 – 4m^2$ = R_W 33	10.38mm laminated glass with acoustic seals
			$4m^2 – 8m^2$ = R_W 36	12.38mm laminated glass with acoustic seals
		Roof/ceiling	Tiled or metal pitched roof / 2 x 13mm plasterboard ceiling / bulk insulation in cavity	
		Walls	R_W 49	Brick veneer construction, standard internal plasterboard with R1.5 wall batts Or Reverse brick veneer construction, external metal or FC cladding with R1.5 wall batts Or Metal studs with 2 layers of 16mm fire-rated plasterboard inside, metal or FC external cladding, R1.5 wall batts
	Lounge/living rooms	Windows/glazed doors*	Less than $4m^2$ = R_W 35	10.38mm laminated glass with acoustic seals
			$4m^2 – 8m^2$ = R_W 38	Heavy laminated glass or double glazing with acoustic seals
			$8m^2 – 16m^2$ = R_W 41	Double glazed with acoustic seals
		Timber doors	45mm solid core timber - acoustic seals	
		Roof/ceiling	Tiled or metal pitched roof / 2 x 13mm plasterboard ceiling / bulk insulation in cavity	
		Walls	R_W 49	Brick veneer construction, standard internal plasterboard with R1.5 wall batts Or Reverse brick veneer construction, external metal or FC cladding with R1.5 wall batts Or Metal studs with 2 layers of 16mm fire-rated plasterboard inside, metal or FC external cladding, R1.5 wall batts

Notes: * Area of windows and doors shall be the total of all glazing for the given room.

The acoustic requirements for windows and doors have been provided on an R_W basis to allow flexibility with the developer and variations in design due to other design requirements such as thermal performance. The R_W rating sets the basis of the recommended acoustic performance, and the constructions are provided for guidance only. The acoustic performance of specific building components should be confirmed by manufactures or suitably qualified professional prior to installation.

Unless otherwise specified, the base building envelope of dwellings is of standard constructions which are assumed to consist of the following:

- Walls of brick veneer construction, double brick, or light weight clad construction which could consist of fibre-cement cladding on the outside of timber stud walls and internal plasterboard lining. All walls are assumed to have minimum R1.5 insulation in the cavity. It is noted that both brick veneer and cavity double brick construction are of significantly higher acoustic performance than light weight cladding systems. In higher road traffic noise areas, there may be a requirement to upgrade light weight systems. These instances will be noted in the acoustic recommendations.
- Roof to be pitched, with concrete or terracotta tile or sheet metal roof with sarking, R3.0 insulation in the roof space (combination of below roof and above ceiling), and one layer of 10mm thick standard plasterboard fixed to ceiling joists.
- External doors to be solid core timber or glazed, fitted with acoustic seals around the perimeter. Pivot style doors are not recommended as full perimeter acoustic seals are not readily incorporated. The performance of any external doors should have the same acoustic performance as that required for general glazing.

8.3 Alternative ventilation

Where facades have been identified for acoustic treatment in Section 8.2, windows are to be kept closed to meet the internal noise goals. It is noted that windows are not required to be sealed shut/fixed and can be operable.

It is recommended that a mechanical engineer is consulted to ensure the ventilation requirements of the Building Code of Australia and Australian Standard 1668 "*The use of ventilation and air-conditioning in buildings*" are achieved. The internal noise goals are to be met with mechanical ventilation systems not operating.

Where alternative forms of ventilation are to be provided, it must be ensured that the solution does not provide a new noise leakage path into the dwelling and does not create a noise nuisance to neighbouring premises.

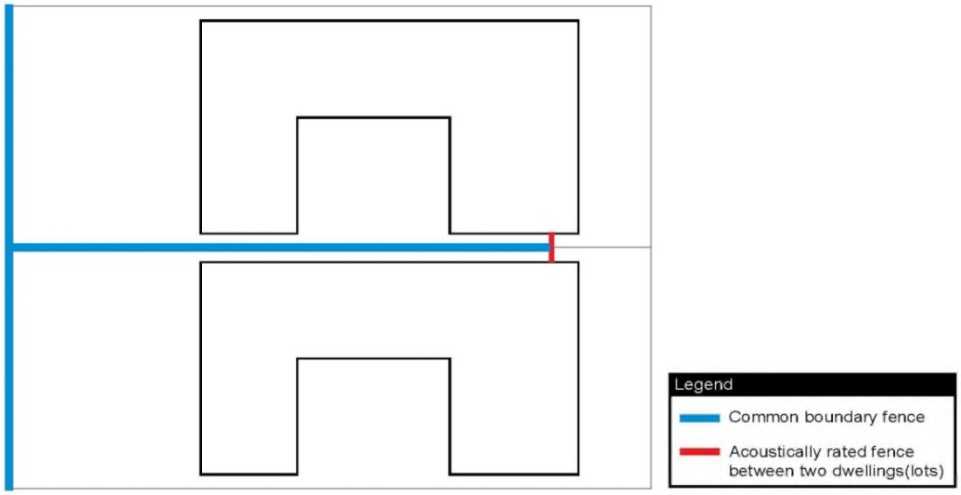
8.4 Scope of acoustic recommendations

The recommended mitigation measures for road traffic noise cannot consider the specific design of each dwelling as those details are not available at this stage of development. The recommendations have been developed for the approvals process and cost planning, and to provide the indicative measures required for each dwelling. Whilst it is the intent for the recommendations and this report to minimise the need for detailed acoustic assessment of each dwelling, it is recommended that an individual acoustic review of the 'Construction' drawings be carried out for each noise affected lot to ensure correct interpretation and application of the recommendations.

8.5 Boundary fences

Acoustically rated fences on the boundary of the lots should be considered if appropriate. Acoustically rated boundary fences are also recommended 'between' dwellings, as illustrated in Figure 7.

Figure 7: Fence locations



The provision of solid boundary fences between residential lots can be beneficial to the ground floor of properties that are directly exposed to the roads. Acoustically rated fences are not specifically required along common boundaries between individual dwellings, unless specified above.

An acoustically rated fence can be constructed of common building materials but needs to be from a durable material with sufficient mass (min. 10kg/m^2) to prevent direct noise transmission e.g., masonry, fibrous cement, lapped and capped timber fence, polycarbonate, or any combination of such materials, provided they withstand the weather elements. A natural barrier of trees or shrubs is not an effective noise screen. The boundary fence should be continuous with no gaps between panels or underneath panels (other than that required for gates). It is recommended that rebates be incorporated into any gates.

8.5.1 Playground and sports ground

The provision of solid boundary fences or earth mounds (berm) between residential lots and playground and sports ground are recommended as specified in Section 7.4 to minimise the noise impact from the sports ground's playground and sports ground. Figure 8 below shows the extent of the acoustic boundary fences.

Figure 8: Extent of acoustic boundary fences at residential lots adjacent to playground and sports ground

9 Conclusion

Renzo Tonin & Associates has completed an environmental noise assessment for the DA of the Milperra WSU Masterplan. The report has quantified the noise impact from existing noise sources around the project site. The report has been prepared in accordance with the relevant objectives as detailed in Section 1.

The results of the noise modelling indicate that:

- Exceedances of the ISEPP criteria are predicted at the residential lots along the southern portion of the Masterplan.
- For facades that are exposed to noise levels above the ISEPP, acoustic constructions for treatment are required to achieve the internal noise level criteria.
- As the industrial noise levels are much lower with respect to road traffic noise levels, façade systems detailed in Section 8 above are sufficient to address road noise and industrial noise intrusion.
- Where the internal criteria can only be achieved with windows closed, then mechanical ventilation or air conditioning that meets the requirements of the Building Code of Australia must also be provided to ensure fresh airflow inside the dwelling. It is important to ensure that mechanical ventilation does not provide a new noise leakage path into the dwelling and does not create a noise nuisance to neighbouring residential premises. It is noted that windows are not required to be sealed shut/fixed and can be operable.
- There is no exceedance predicted at the boundary of the residential lots with respect to operations of the childcare centre (especially noise associated with childcare outdoor play area); and therefore, it is deemed to comply with no additional acoustic mitigation measure.
- Exceedances of the NGLG criteria are predicted at the residential lots along the boundaries between the lots and Mount St Joseph School playground at the eastern part of the masterplan and between the lots and Milperra Reserve sports ground at the north-western part of the masterplan. Noise mitigation measures are specified in Sections 7.4 and 8.5.1.

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 everyday 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 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 Long-term noise monitoring methodology

B.1 Noise monitoring equipment

A long-term unattended noise monitor consists of a sound level meter housed inside a weather resistant enclosure. Noise levels are monitored continuously with statistical data stored in memory for every 15-minute period.

Long term noise monitoring was conducted using the following instrumentation:

Description	Type	Octave band data	Logger location
RTA06 & RTA07 (NTi Audio XL2, with low noise microphone)	Type 1	1/1	L1, L2, L3, L4, and L5

Note: All meters comply with AS IEC 61672.1 2004 "Electroacoustics - Sound Level Meters" and designated either Type 1 or Type 2 as per table and are suitable for field use.

The equipment was calibrated prior and after the measurement period using a Brüel & Kjær Type 4230 calibrator. No significant drift in calibration was observed.

B.2 Meteorology during monitoring

Measurements affected by extraneous noise, wind (greater than 5m/s) or rain were excluded from the recorded data in accordance with the NSW INP. Determination of extraneous meteorological conditions was based on data provided by the Bureau of Meteorology (BOM), for a location considered representative of the noise monitoring location(s). However, the data was adjusted to account for the height difference between the BOM weather station, where wind speed and direction is recorded at a height of 10m above ground level, and the microphone location, which is typically 1.5m above ground level (and less than 3m). The correction factor applied to the data is based on Table C.1 of ISO 4354:2009 '*Wind actions on structures*'.

B.3 Noise vs time graphs

Noise almost always varies with time. Noise environments can be described using various descriptors to show how a noise ranges about a level. In this report, noise values measured or referred to include the L_{10}, L_{90}, and L_{eq} levels. The statistical descriptors L_{10} and L_{90} measure the noise level exceeded for 10% and 90% of the sample measurement time. The L_{eq} level is the equivalent continuous noise level, or the level averaged on an equal energy basis. Measurement sample periods are usually ten to fifteen minutes. The Noise -vs- Time graphs representing measured noise levels, as presented in this report, illustrate these concepts for the broadband dB(A) results.

APPENDIX C Long-term noise monitoring results

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WSU Oval South, Milperra

Background & Ambient Noise Monitoring Results - NSW 'Noise Policy for Industry', 2017

	L_{A90} Background Noise Levels[4]			L_{Aeq} Ambient Noise Levels		
Date	**Day[1]**	**Evening[2]**	**Night[3]**	**Day[1]**	**Evening[2]**	**Night[3]**
Wednesday-27-November-2019	-	50	44	-	57	55
Thursday-28-November-2019	53	51	43	58	56	54
Friday-29-November-2019	53	51	43	58	56	53
Saturday-30-November-2019	52	48	40	58	53	51
Sunday-01-December-2019	50	49	41	56	54	55
Monday-02-December-2019	54	51	43	59	56	55
Tuesday-03-December-2019	52	50	42	59	55	55
Wednesday-04-December-2019	52	-	-	57	-	-
Representative Weekday[5]	**53**	**51**	**43**	**58**	**56**	**54**
Representative Weekend[5]	**51**	**49**	**41**	**57**	**54**	**53**
Representative Week[5]	**52**	**50**	**43**	**58**	**56**	**54**

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 7. Number in brackets represents the measured (actual) RBL value, which is below the minimum policy value of 30 dB(A) during the evening or night period or 35 dB(A) during the day period.

WSU Oval South, Milperra

Road / Rail Noise Monitoring Results (at one metre from façade)

	L_{Aeq} Noise Levels		$L_{Aeq\ 1hr}$ Noise Levels			
Date	**Day[1]**	**Night[2]**	**Day - Up[4]**	**Day - Low[5]**	**Night - Up[4]**	**Night - Low[5]**
Wednesday-27-November-2019	61	57	64	57	61	54
Thursday-28-November-2019	61	57	62	59	59	53
Friday-29-November-2019	60	55	61	58	57	52
Saturday-30-November-2019	60	54	62	55	56	50
Sunday-01-December-2019	58	57	59	56	60	53
Monday-02-December-2019	60	57	62	59	61	53
Tuesday-03-December-2019	61	57	61	57	61	53
Wednesday-04-December-2019	59	-	60	58	-	-
Representative Weekday[3]	**61**	**57**	**61**	**58**	**61**	**53**
Representative Weekend[3]	**59**	**55**	**60**	**56**	**58**	**51**
Representative Week[3]	**60**	**57**	**61**	**58**	**60**	**53**

Notes:

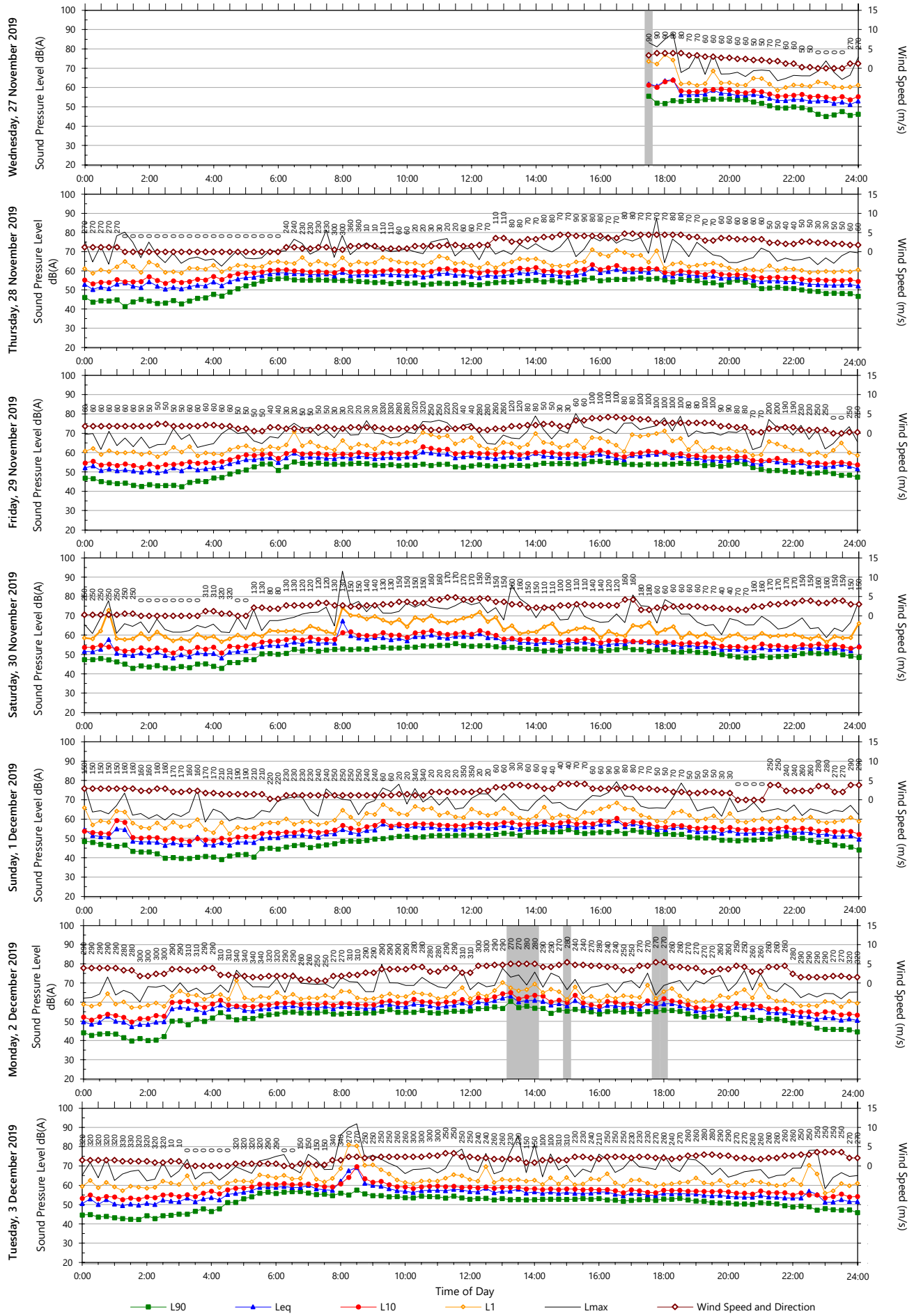
1. Day is 7:00am to 10:00pm 2. Night is 10:00pm to 7:00am 3. Median of daily L_{Aeq}

4. Upper 10th percentile $L_{Aeq\ 1hr}$ 5. Lower 10th percentile $L_{Aeq\ 1hr}$

6. Values are calculated at the facade. 2.5dB is added to results if logger is placed in the free field

Unattended Monitoring Results

Location: WSU Oval South, Milperra

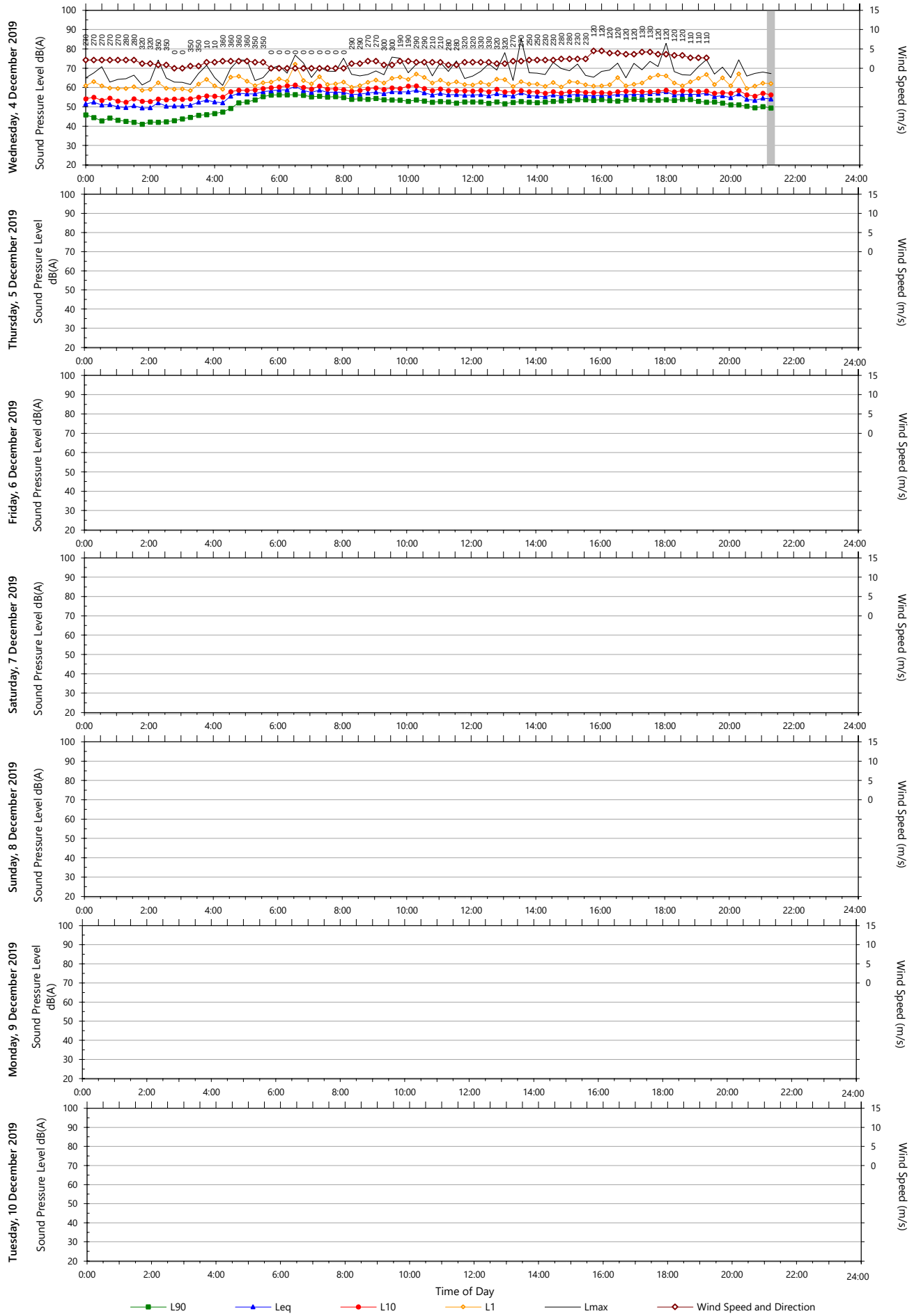


Data File: 2019-11-27_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r31)

Unattended Monitoring Results

Location: WSU Oval South, Milperra



Data File: 2019-11-27_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r31)

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Horsley Road, Milperra

Background & Ambient Noise Monitoring Results - NSW 'Noise Policy for Industry', 2017

	L_{A90} Background Noise Levels[4]			L_{Aeq} Ambient Noise Levels		
Date	**Day[1]**	**Evening[2]**	**Night[3]**	**Day[1]**	**Evening[2]**	**Night[3]**
Wednesday-27-November-2019	-	45	42	-	62	58
Thursday-28-November-2019	49	46	41	62	61	57
Friday-29-November-2019	49	47	42	62	60	56
Saturday-30-November-2019	48	41	37	63	59	55
Sunday-01-December-2019	44	40	38	60	58	57
Monday-02-December-2019	51	47	-	62	60	-
Representative Weekday[5]	**49**	**46**	**42**	**62**	**61**	**57**
Representative Weekend[5]	**46**	**41**	**37**	**61**	**59**	**56**
Representative Week[5]	**49**	**45**	**41**	**62**	**60**	**57**

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 7. Number in brackets represents the measured (actual) RBL value, which is below the minimum policy value of 30 dB(A) during the evening or night period or 35 dB(A) during the day period.

Horsley Road, Milperra

Road / Rail Noise Monitoring Results (at one metre from façade)

	L_{Aeq} Noise Levels		$L_{Aeq\ 1hr}$ Noise Levels			
Date	**Day[1]**	**Night[2]**	**Day - Up[4]**	**Day - Low[5]**	**Night - Up[4]**	**Night - Low[5]**
Wednesday-27-November-2019	65	61	68	62	64	53
Thursday-28-November-2019	64	59	67	61	63	54
Friday-29-November-2019	64	58	66	62	61	54
Saturday-30-November-2019	64	58	66	61	60	53
Sunday-01-December-2019	62	60	63	59	63	51
Monday-02-December-2019	64	57	65	62	57	57
Representative Weekday[3]	**64**	**59**	**66**	**62**	**62**	**54**
Representative Weekend[3]	**63**	**59**	**65**	**60**	**62**	**52**
Representative Week[3]	**64**	**59**	**66**	**62**	**62**	**54**

Notes:

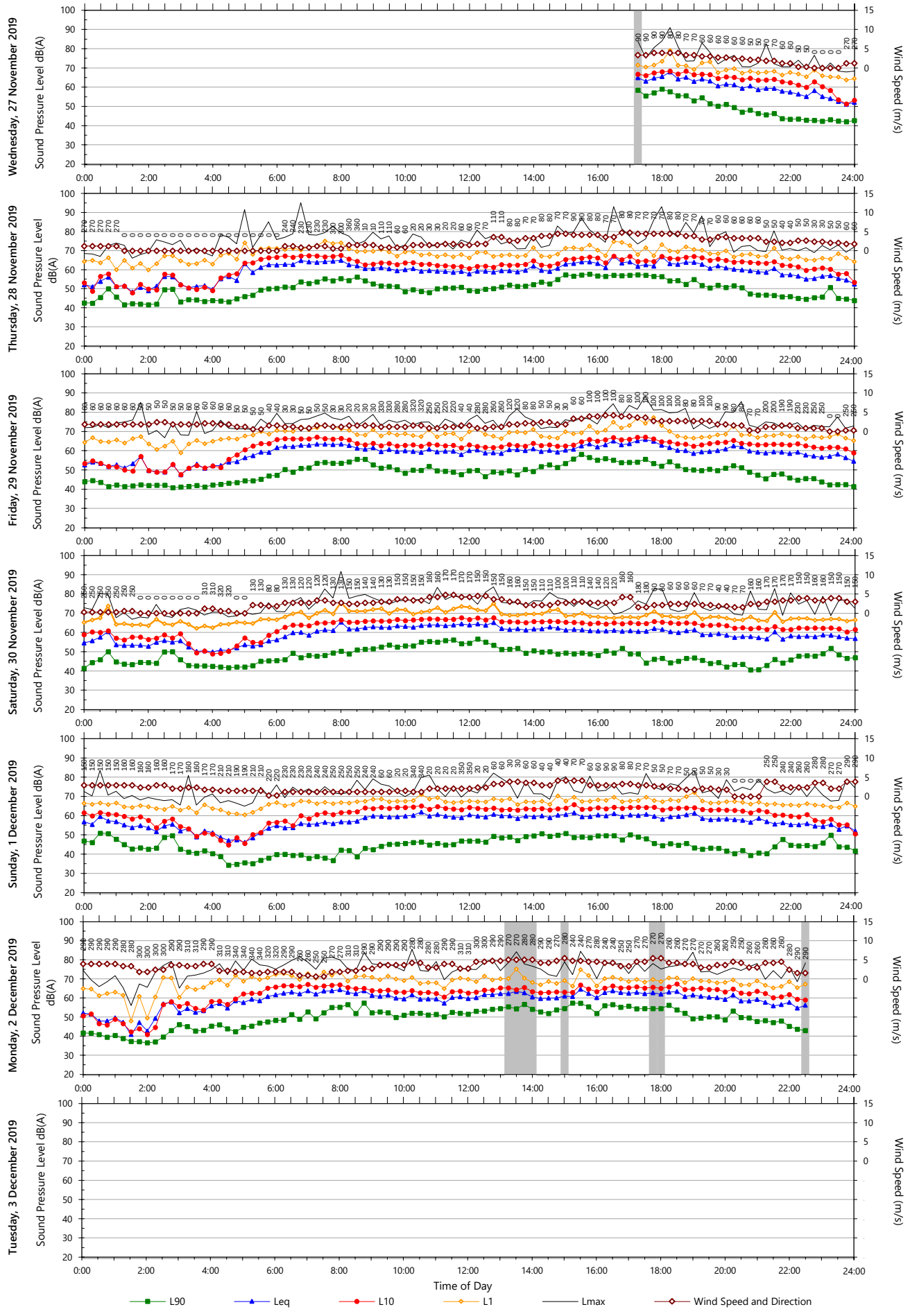
1. Day is 7:00am to 10:00pm 2. Night is 10:00pm to 7:00am 3. Median of daily L_{Aeq}

4. Upper 10th percentile $L_{Aeq\ 1hr}$ 5. Lower 10th percentile $L_{Aeq\ 1hr}$

6. Values are calculated at the facade. 2.5dB is added to results if logger is placed in the free field

Unattended Monitoring Results

Location: Horsley Road, Milperra



Data File: 2019-11-27_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r31)

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Background & Ambient Noise Monitoring Results - NSW 'Noise Policy for Industry', 2017

	L_{A90} Background Noise Levels[4]			L_{Aeq} Ambient Noise Levels		
Date	**Day[1]**	**Evening[2]**	**Night[3]**	**Day[1]**	**Evening[2]**	**Night[3]**
Wednesday-27-November-2019	-	47	40	-	66	63
Thursday-28-November-2019	53	48	39	68	67	63
Friday-29-November-2019	54	45	38	68	66	60
Saturday-30-November-2019	48	41	35	66	63	59
Sunday-01-December-2019	43	40	38	65	63	62
Monday-02-December-2019	54	50	40	68	65	63
Tuesday-03-December-2019	52	47	39	68	65	63
Wednesday-04-December-2019	-	-	-	-	-	-
Representative Weekday[5]	**53**	**47**	**39**	**68**	**66**	**62**
Representative Weekend[5]	**46**	**40**	**36**	**66**	**63**	**61**
Representative Week[5]	**53**	**47**	**39**	**67**	**65**	**62**

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 7. Number in brackets represents the measured (actual) RBL value, which is below the minimum policy value of 30 dB(A) during the evening or night period or 35 dB(A) during the day period.

Bullecourt Avenue, Milperra

Road / Rail Noise Monitoring Results (at one metre from façade)

	L_{Aeq} Noise Levels		$L_{Aeq\ 1hr}$ Noise Levels			
Date	**Day[1]**	**Night[2]**	**Day - Up[4]**	**Day - Low[5]**	**Night - Up[4]**	**Night - Low[5]**
Wednesday-27-November-2019	69	66	70	67	70	59
Thursday-28-November-2019	70	65	71	69	69	59
Friday-29-November-2019	70	63	71	69	65	60
Saturday-30-November-2019	68	61	70	65	64	58
Sunday-01-December-2019	67	65	68	64	69	56
Monday-02-December-2019	70	65	71	67	70	58
Tuesday-03-December-2019	70	66	71	67	70	59
Wednesday-04-December-2019	71	-	72	71	-	-
Representative Weekday[3]	**70**	**65**	**71**	**68**	**70**	**59**
Representative Weekend[3]	**67**	**63**	**69**	**65**	**66**	**57**
Representative Week[3]	**70**	**65**	**71**	**67**	**69**	**59**

Notes:

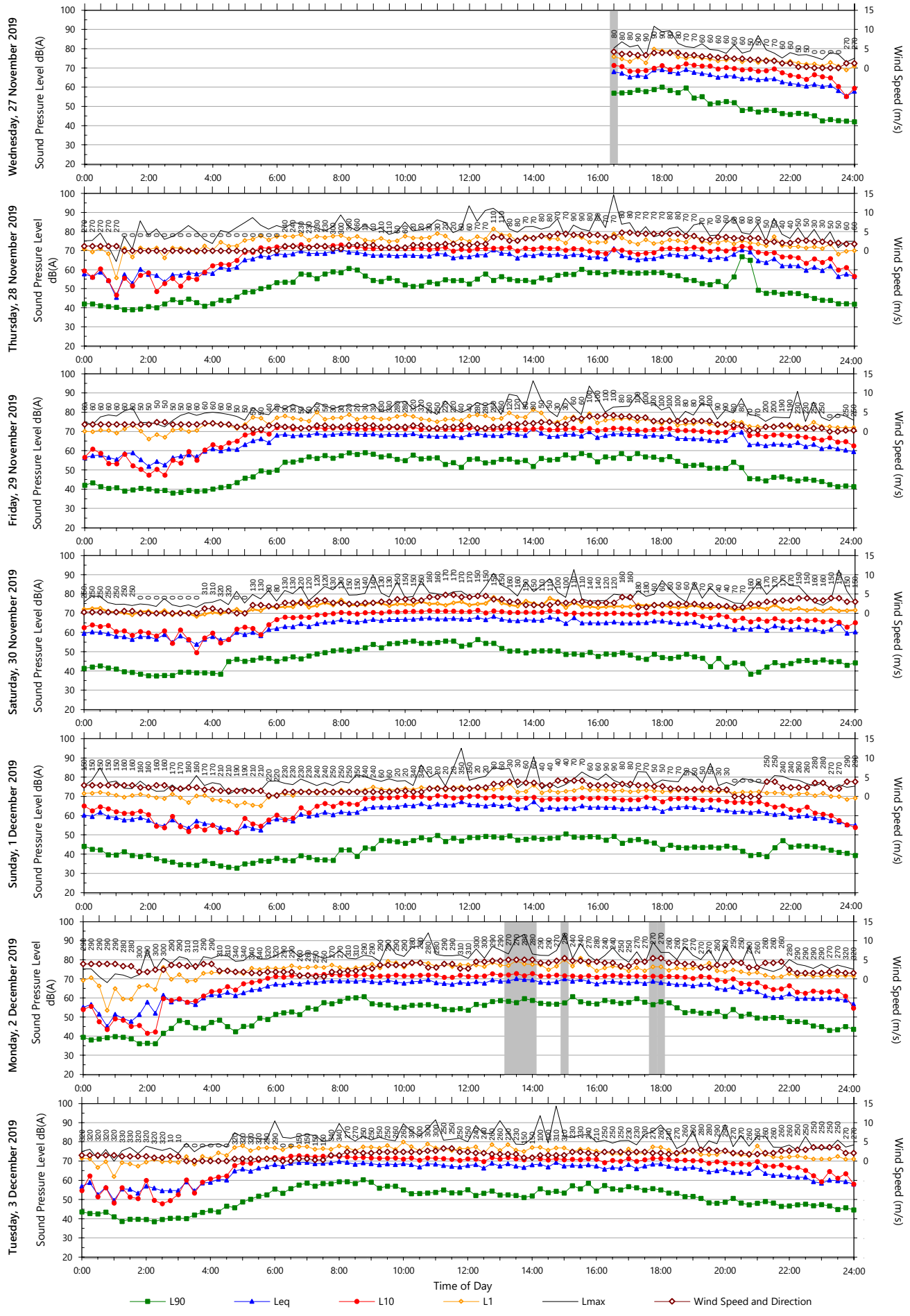
1. Day is 7:00am to 10:00pm 2. Night is 10:00pm to 7:00am 3. Median of daily L_{Aeq}

4. Upper 10th percentile $L_{Aeq\ 1hr}$ 5. Lower 10th percentile $L_{Aeq\ 1hr}$

6. Values are calculated at the facade. 2.5dB is added to results if logger is placed in the free field

Unattended Monitoring Results

Location: Bullecourt Avenue, Milperra

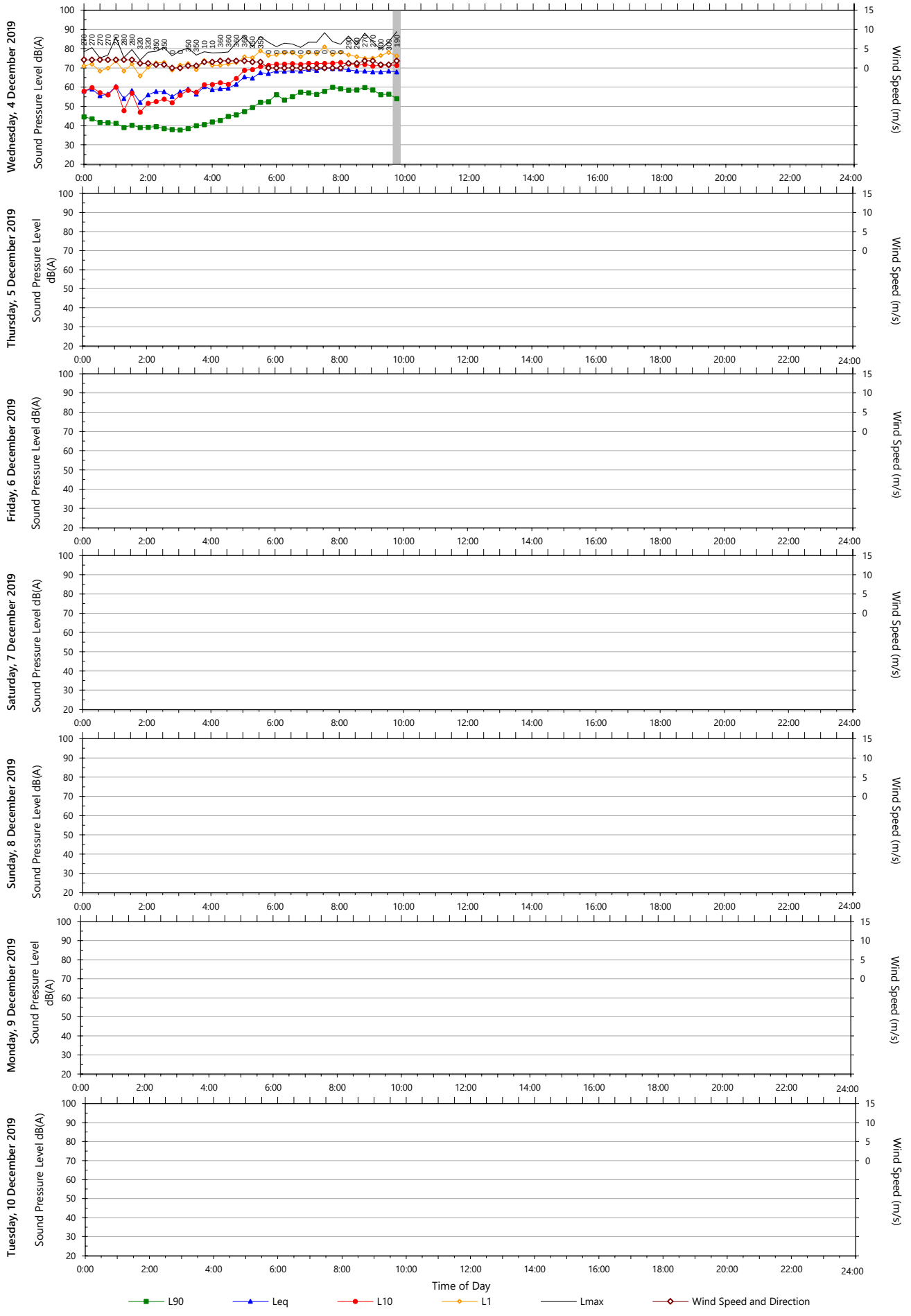


Data File: 2019-11-27_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r31)

Unattended Monitoring Results

Location: Bullecourt Avenue, Milperra



Data File: 2019-11-27_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r31)

RENZO TONIN & ASSOCIATES
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Acoustics
Vibration
Structural Dynamics

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www.renzotonin.com.au

Mount St Joseph Sports Field, Milperra

Background & Ambient Noise Monitoring Results - NSW 'Noise Policy for Industry', 2017

	L_{A90} Background Noise Levels[4]			L_{Aeq} Ambient Noise Levels		
Date	**Day[1]**	**Evening[2]**	**Night[3]**	**Day[1]**	**Evening[2]**	**Night[3]**
Friday-06-December-2019	-	-	39	-	-	47
Saturday-07-December-2019	43	45	38	54	51	47
Sunday-08-December-2019	44	43	39	52	51	47
Monday-09-December-2019	47	43	40	55	50	49
Tuesday-10-December-2019	-	47	40	-	53	48
Wednesday-11-December-2019	47	44	38	56	53	48
Thursday-12-December-2019	-	-	-	-	-	-
Representative Weekday[5]	**47**	**44**	**40**	**55**	**52**	**48**
Representative Weekend[5]	**43**	**44**	**39**	**53**	**51**	**47**
Representative Week[5]	**45**	**44**	**39**	**54**	**52**	**48**

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 7. Number in brackets represents the measured (actual) RBL value, which is below the minimum policy value of 30 dB(A) during the evening or night period or 35 dB(A) during the day period.

Mount St Joseph Sports Field, Milperra

Road / Rail Noise Monitoring Results (at one metre from façade)

	L_{Aeq} Noise Levels		$L_{Aeq\ 1hr}$ Noise Levels			
Date	**Day[1]**	**Night[2]**	**Day - Up[4]**	**Day - Low[5]**	**Night - Up[4]**	**Night - Low[5]**
Friday-06-December-2019	57	49	59	53	53	45
Saturday-07-December-2019	56	49	59	51	53	44
Sunday-08-December-2019	54	50	56	51	54	44
Monday-09-December-2019	57	51	59	53	56	45
Tuesday-10-December-2019	55	51	57	52	53	46
Wednesday-11-December-2019	58	50	59	54	53	44
Thursday-12-December-2019	61	-	63	56	-	-
Representative Weekday[3]	**57**	**50**	**59**	**53**	**53**	**45**
Representative Weekend[3]	**55**	**50**	**57**	**51**	**53**	**44**
Representative Week[3]	**57**	**50**	**59**	**53**	**53**	**45**

Notes:

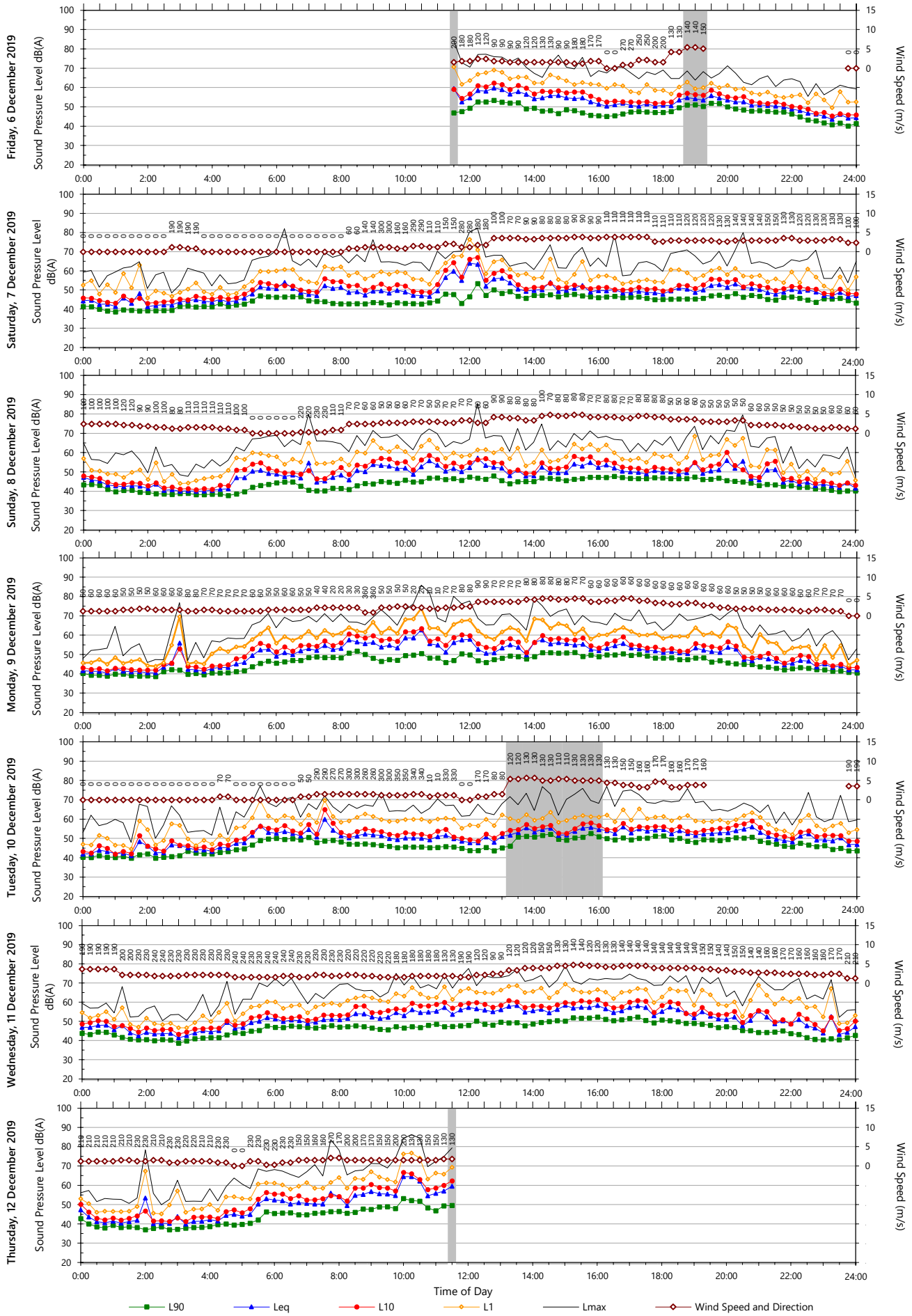
1. Day is 7:00am to 10:00pm 2. Night is 10:00pm to 7:00am 3. Median of daily L_{Aeq}

4. Upper 10th percentile $L_{Aeq\ 1hr}$ 5. Lower 10th percentile $L_{Aeq\ 1hr}$

6. Values are calculated at the facade. 2.5dB is added to results if logger is placed in the free field

Unattended Monitoring Results

Location: Mount St Joseph Sports Field, Milperra



Data File: 2019-12-06_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r31)

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Ashford Avenue, Milperra

Background & Ambient Noise Monitoring Results - NSW 'Noise Policy for Industry', 2017

	L_{A90} Background Noise Levels[4]			L_{Aeq} Ambient Noise Levels		
Date	**Day[1]**	**Evening[2]**	**Night[3]**	**Day[1]**	**Evening[2]**	**Night[3]**
Wednesday-27-November-2019	-	52	41	-	57	54
Thursday-28-November-2019	53	49	45	57	55	54
Friday-29-November-2019	52	49	44	56	55	55
Saturday-30-November-2019	54	50	40	58	56	52
Sunday-01-December-2019	52	50	43	56	55	51
Monday-02-December-2019	-	48	39	-	54	53
Tuesday-03-December-2019	52	53	46	56	63	56
Wednesday-04-December-2019	-	-	-	-	-	-
Representative Weekday[5]	**52**	**49**	**44**	**57**	**58**	**55**
Representative Weekend[5]	**53**	**50**	**41**	**57**	**56**	**52**
Representative Week[5]	**52**	**50**	**43**	**57**	**57**	**54**

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 7. Number in brackets represents the measured (actual) RBL value, which is below the minimum policy value of 30 dB(A) during the evening or night period or 35 dB(A) during the day period.

Ashford Avenue, Milperra

Road / Rail Noise Monitoring Results (at one metre from façade)

	L_{Aeq} Noise Levels		$L_{Aeq\ 1hr}$ Noise Levels			
Date	**Day[1]**	**Night[2]**	**Day - Up[4]**	**Day - Low[5]**	**Night - Up[4]**	**Night - Low[5]**
Wednesday-27-November-2019	59	57	60	58	60	52
Thursday-28-November-2019	59	57	60	57	60	53
Friday-29-November-2019	59	57	60	56	61	52
Saturday-30-November-2019	60	55	62	58	58	50
Sunday-01-December-2019	59	53	60	57	55	50
Monday-02-December-2019	58	56	58	56	60	50
Tuesday-03-December-2019	62	59	62	58	61	54
Wednesday-04-December-2019	61	-	61	60	-	-
Representative Weekday[3]	**59**	**57**	**60**	**57**	**60**	**52**
Representative Weekend[3]	**59**	**54**	**61**	**57**	**56**	**50**
Representative Week[3]	**59**	**57**	**60**	**57**	**60**	**52**

Notes:

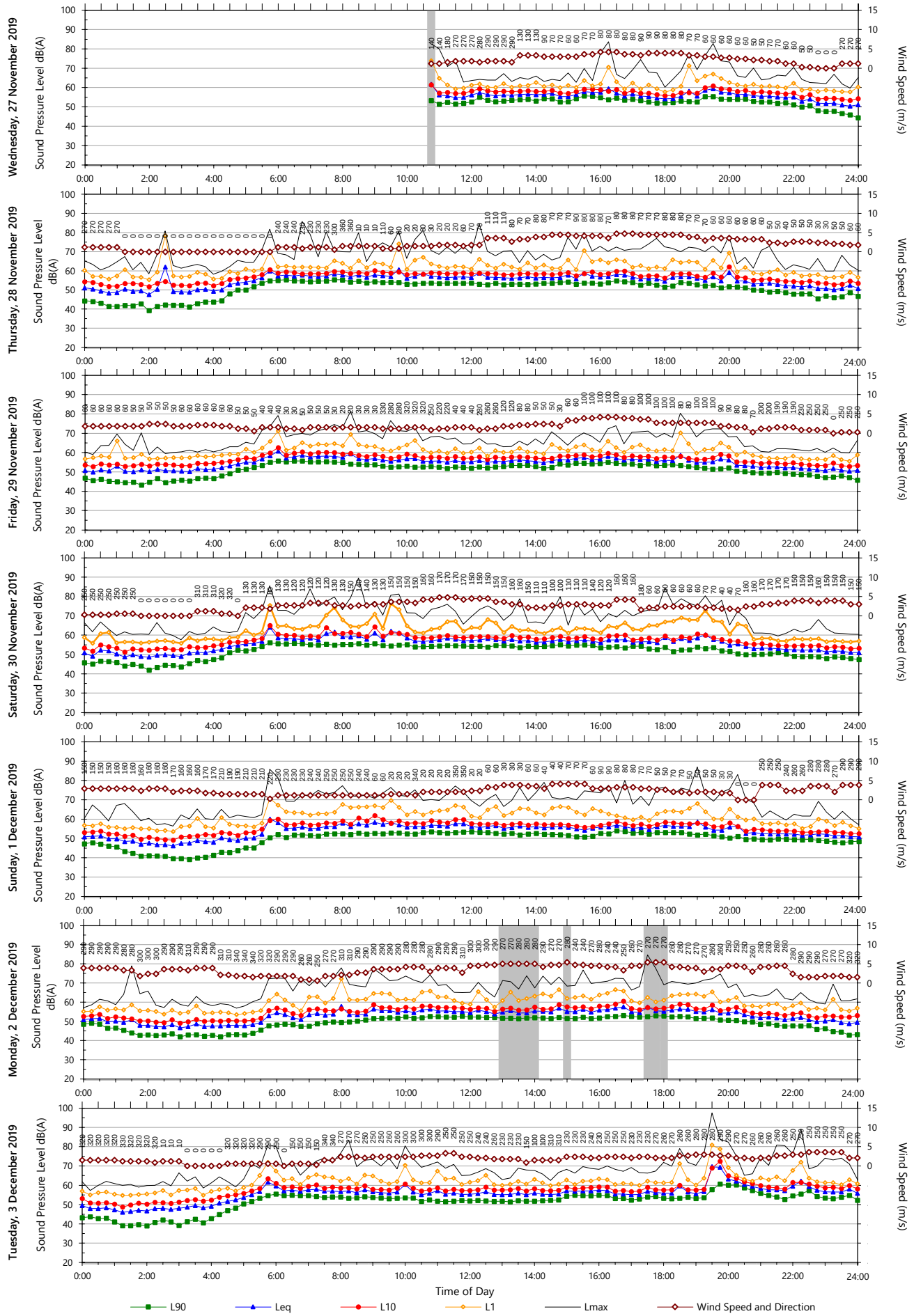
1. Day is 7:00am to 10:00pm 2. Night is 10:00pm to 7:00am 3. Median of daily L_{Aeq}

4. Upper 10th percentile $L_{Aeq\ 1hr}$ 5. Lower 10th percentile $L_{Aeq\ 1hr}$

6. Values are calculated at the facade. 2.5dB is added to results if logger is placed in the free field

Unattended Monitoring Results

Location: Ashford Avenue, Milperra

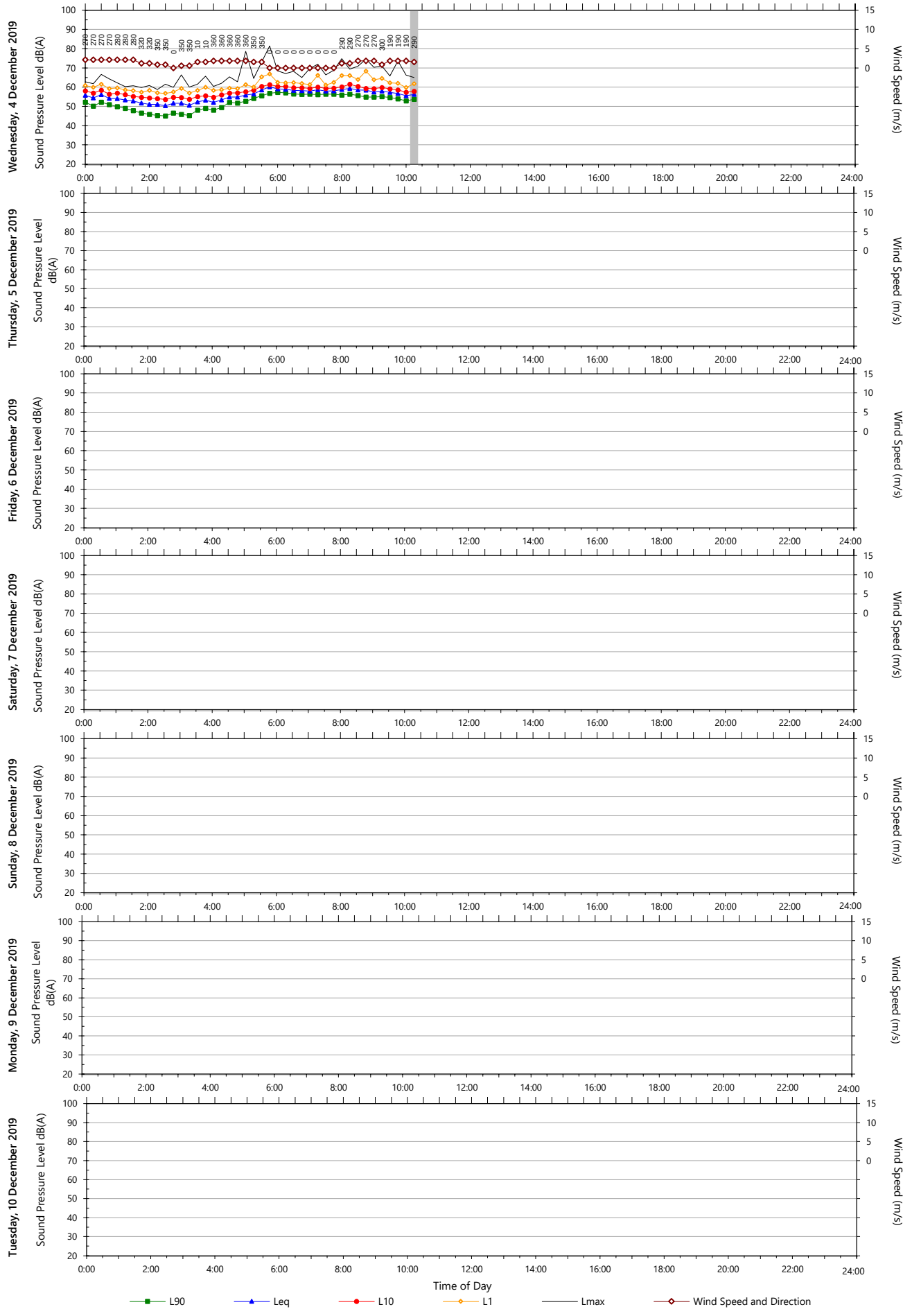


Data File: 2019-11-19_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r31)

Unattended Monitoring Results

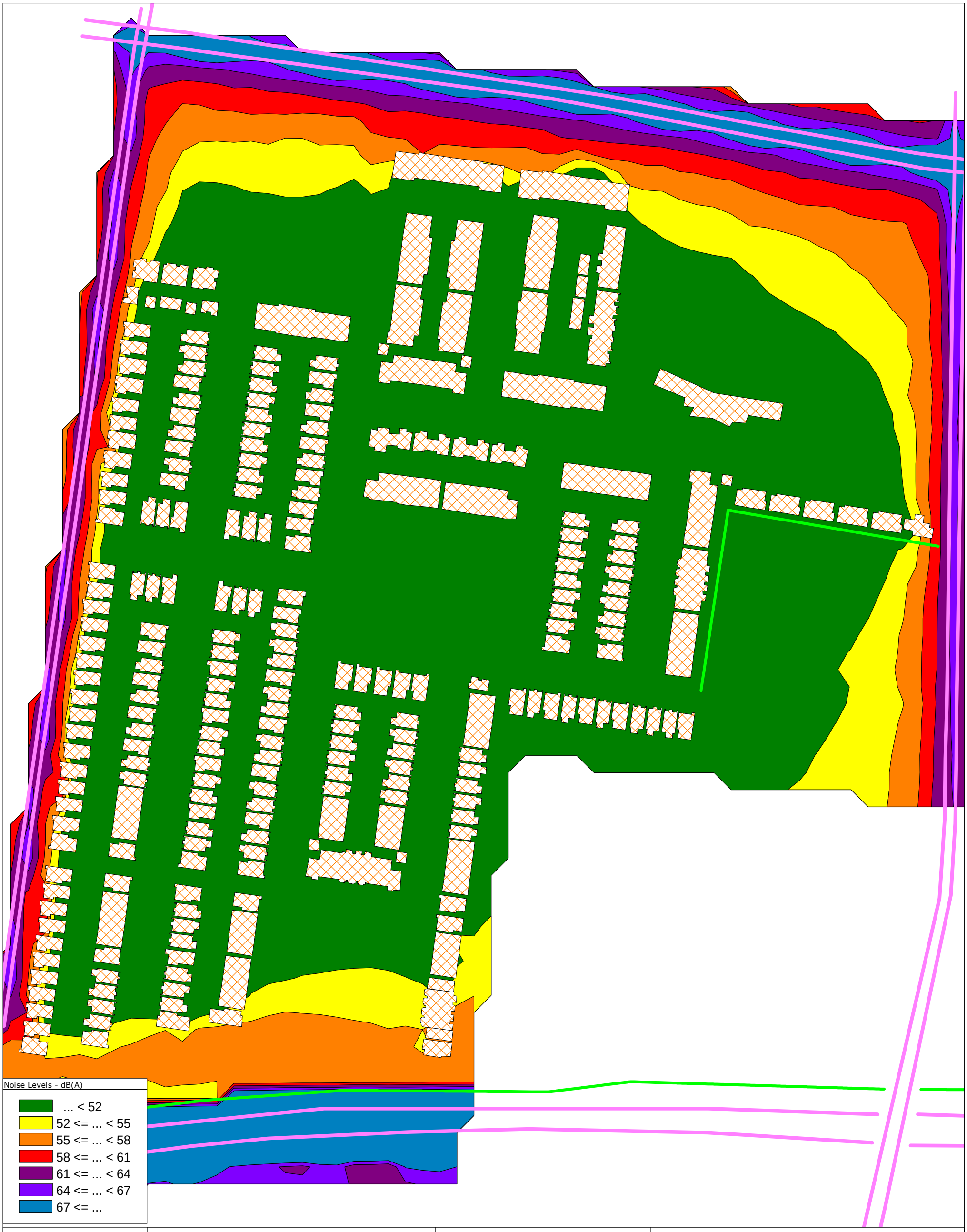
Location: Ashford Avenue, Milperra



Data File: 2019-11-19_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r31)

APPENDIX D Noise modelling results - Road Traffic Noise



legend:

- Building
- Existing Road
- Barrier

Client: mirvac

Consultant: RENZO TONIN & ASSOCIATES inspired to achieve

1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

Project:
WESTERN SYDNEY UNIVERSITY
MILPERRA SUBDIVISION

Description:
GROUND FLOOR FACADE TREATMENT

Noise levels are approximate due to interpolation of contours and should be used for reference only.

For information only and not for construction.

Project No.:	Produced by:
TL127-01	MSK
Figure Ref:	Grid:
TL127-02 (r0)	TL127-02 NC01
Date:	Scale:
13.09.2022	1: 2100 A3

Noise Levels - dB(A)

- ... < 52
- 52 <= ... < 55
- 55 <= ... < 58
- 58 <= ... < 61
- 61 <= ... < 64
- 64 <= ... < 67
- 67 <= ...

legend:

- Building
- Existing Road
- Barrier

Client: mirvac

Consultant:

RENZO TONIN & ASSOCIATES
inspired to achieve

1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

Project:
WESTERN SYDNEY UNIVERSITY
MILPERRA SUBDIVISION

Description:
FIRST FLOOR FACADE TREATMENT

Noise levels are approximate due to interpolation of contours and should be used for reference only.

For information only and not for construction.

Project No.:	Produced by:
TL127-01	MSK
Figure Ref:	Grid:
TL127-02 (r0)	TL127-01NC01
Date:	Scale:
13.09.2022	1: 2100 A3

APPENDIX E Noise modelling results - Playground and Sports Field Noise

Noise Levels - dB(A)

- ... < 52
- 52 <= ... < 55
- 55 <= ... < 58
- 58 <= ... < 61
- 61 <= ... < 64
- 64 <= ... < 67
- 67 <= ...

legend:

- Building
- Existing Road
- Barrier

Client: mirvac

Consultant:

RENZO TONIN & ASSOCIATES
inspired to achieve

1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

Project:
WESTERN SYDNEY UNIVERSITY
MILPERRA SUBDIVISION

Description:
GROUND FLOOR FACADE TREATMENT FOR PLAYGROUND N

Noise levels are approximate due to interpolation of contours and should be used for reference only.

For information only and not for construction.

Project No.:	Produced by:
TL127-01	MSK
Figure Ref:	Grid:
TL127-01P03 (r0)	TL127-01NC01
Date:	Scale:
13.09.2022	1: 2100 A3

Noise Levels - dB(A)

- ... < 52
- 52 <= ... < 55
- 55 <= ... < 58
- 58 <= ... < 61
- 61 <= ... < 64
- 64 <= ... < 67
- 67 <= ...

legend:

- Building
- Existing Road
- Barrier

Client:

mirvac

Consultant:

RENZO TONIN & ASSOCIATES
inspired to achieve

1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

Project:
WESTERN SYDNEY UNIVERSITY
MILPERRA SUBDIVISION

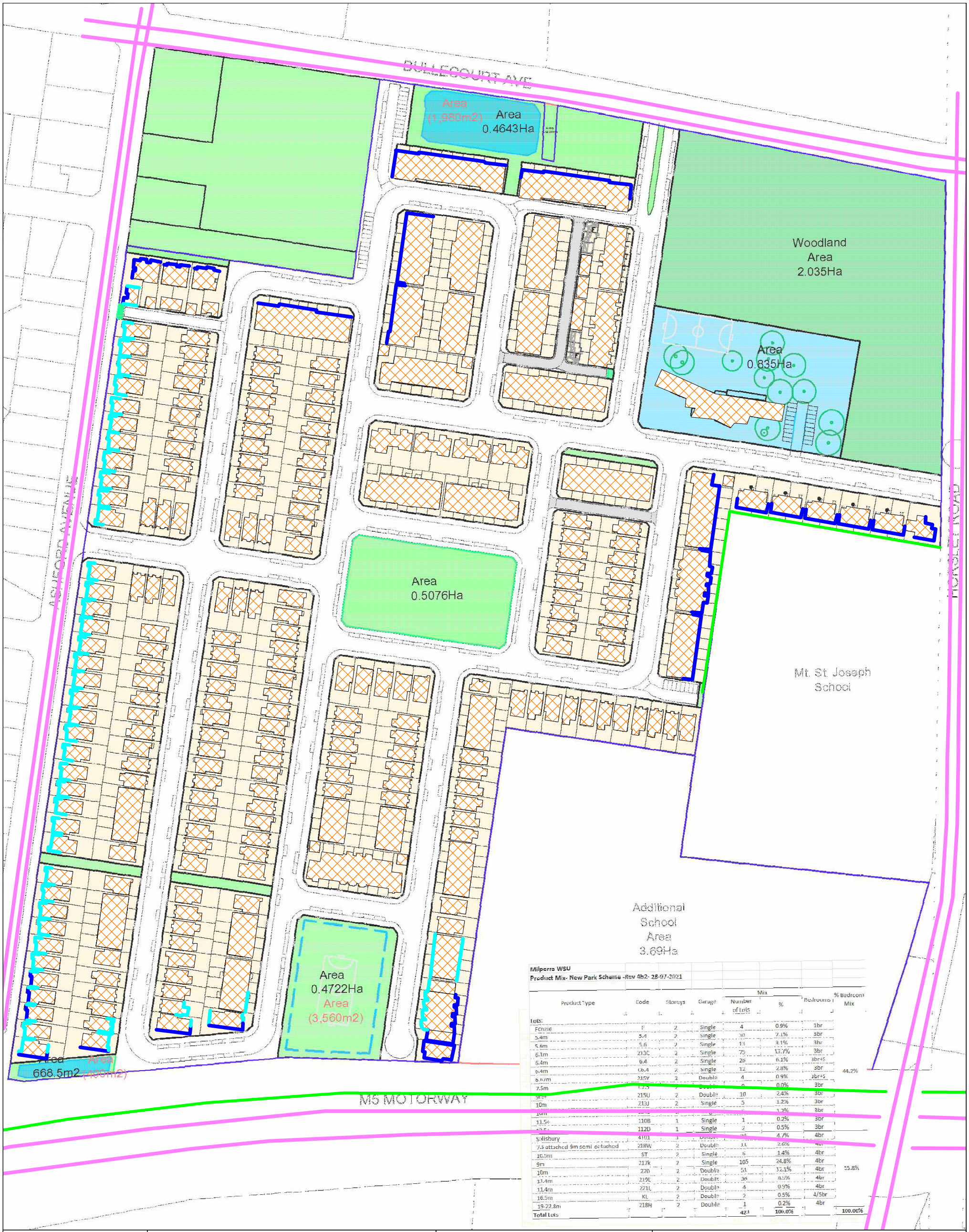
Description:
FIRST FLOOR FACADE TREATMENT FOR PLAYGROUND NOIS

Noise levels are approximate due to interpolation of contours and should be used for reference only.

For information only and not for construction.

Project No.:	Produced by:
TL127-01	MSK
Figure Ref:	Grid:
TL127-01P03 (r0)	TL127-01NC01
Date:	Scale:
13.09.2022	1: 2100 A3

APPENDIX F Acoustic treatment categories



Milperra WSU
Product Mix- New Park Scheme -Rev 4b2- 28-07-2021

Product Type	Code	Storeys	Garage	Mix: Number of Lots	Mix: %	Bedrooms	% Bedroom Mix
Lots:							
Fenzie	F	2	Single	4	0.9%	1br	
5.4m	5.4	2	Single	30	7.1%	3br	
5.6m	5.6	2	Single	11	2.1%	3br	
6.1m	215C	2	Single	75	17.7%	3br	
6.4m	6.4	2	Single	26	6.1%	3br+S	
6.4m	06.4	2	Single	12	2.8%	3br	44.2%
6.6m	215V	2	Double	4	0.9%	3br+S	
7.5m	17J	2	Double	0	0.0%	3br	
9m	215U	2	Double	10	2.4%	3br	
10m	213J	2	Single	5	1.2%	3br	
10m					1.2%	3br	
11.5m	110B	1	Single	1	0.2%	3br	
11.5m	112D	1	Single	2	0.5%	3br	
Salisbury	410J	1	Double	20	4.7%	4br	
7.5 attached 9m semi detached	218W	2	Double	11	2.6%	4br	
10.5m	ST	2	Single	6	1.4%	4br	
9m	217K	2	Single	105	24.8%	4br	
10m	220	2	Double	53	12.1%	4br	55.8%
11.4m	219L	2	Double	36	8.5%	4br	
11.4m	221L	2	Double	4	0.9%	4br	
16.5m	KL	2	Double	2	0.5%	4/5br	
19-22.8m	218H	2	Double	1	0.2%	4br	
Total Lots				421	100.0%		100.00%

legend:
- Building
- Existing Road
- Barrier

planners interior des

Client:

mirvac

Consultant:

RENZO TONIN & ASSOCIATES
inspired to achieve

1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

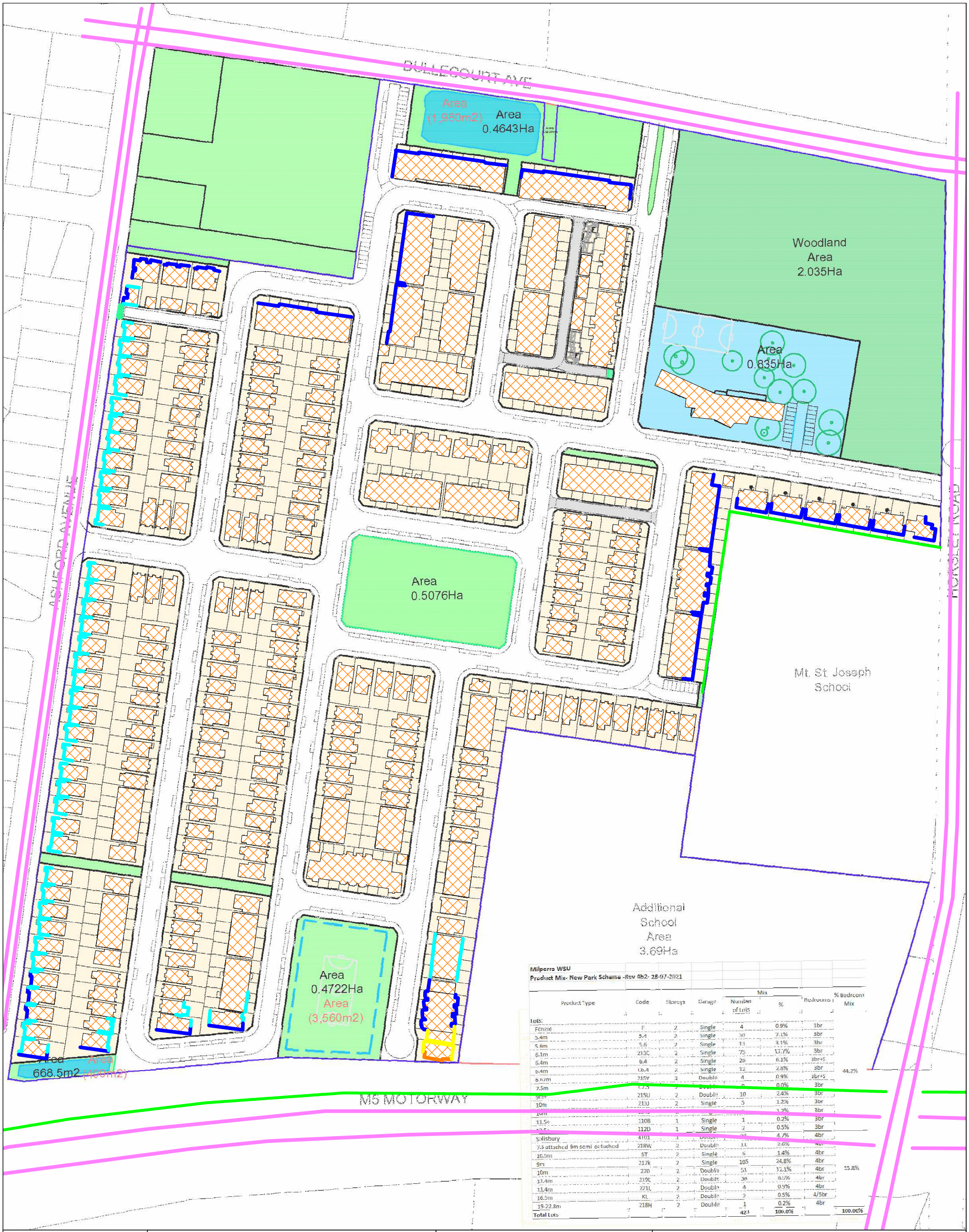
Project:
WESTERN SYDNEY UNIVERSITY
MILPERRA SUBDIVISION

Description:
GROUND FLOOR FACADE TREATMENT CATAGORIES

Noise levels are approximate due to interpolation of contours and should be used for reference only.

For information only and not for construction.

Project No.:	Produced by:
TL127-01	MSK
Figure Ref:	Grid:
TL127-01P03 (r0)	TL127-01NC01
Date:	Scale:
13.09.2022	1: 2100 A3



Milperra WSU
Product Mix- New Park Scheme -Rev 4b2- 28-07-2021

Product Type	Code	Storeys	Garage	Mix Number of Lots	Mix %	Bedrooms	% Bedroom Mix
Lots:							
Fenzie	F	2	Single	4	0.9%	1br	
5.4m	5.4	2	Single	30	7.1%	3br	
5.6m	5.6	2	Single	11	2.1%	3br	
6.1m	215C	2	Single	75	17.7%	3br	
6.4m	6.4	2	Single	26	6.1%	3br+S	
6.4m	06.4	2	Single	12	2.8%	3br	44.2%
6.6m	215Y	2	Double	4	0.9%	3br+S	
7.5m	17.5	2	Double	0	0.0%	3br	
9m	215U	2	Double	10	2.4%	3br	
10m	213J	2	Single	5	1.2%	3br	
10m					1.2%	3br	
11.5m	110B	1	Single	1	0.2%	3br	
11.5m	112D	1	Single	2	0.5%	3br	
Salisbury	410J	1	Double	20	4.7%	4br	
7.5 attached 9m semi detached	218W	2	Double	11	2.6%	4br	
10.5m	ST	2	Single	6	1.4%	4br	
9m	217K	2	Single	105	24.8%	4br	
10m	220	2	Double	53	12.1%	4br	55.8%
11.4m	219L	2	Double	36	8.5%	4br	
11.4m	221L	2	Double	4	0.9%	4br	
16.5m	KL	2	Double	2	0.5%	4/5br	
19-22.8m	218H	2	Double	1	0.2%	4br	
Total Lots				421	100.0%		100.00%

legend:
- Building
- Existing Road
- Barrier

Client: mirvac

Consultant:
RENZO TONIN & ASSOCIATES
inspired to achieve
1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

Project:
WESTERN SYDNEY UNIVERSITY
MILPERRA SUBDIVISION

Description:
FIRST FLOOR FACADE TREATMENT CATAGORIES

Noise levels are approximate due to interpolation of contours and should be used for reference only.

For information only and not for construction.

Project No.:	Produced by:
TL127-01	MSK
Figure Ref:	Grid:
TL127-01P03 (r0)	TL127-01NC01
Date:	Scale:
13.09.2022	1: 2100 A3