RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

PROPOSED SUBDIVISION CONCEPT AT HUMPHRIES ROAD BONNYRIGG

DA Acoustic Report

11 November 2020

Premise

TL543-01F02 DA Acoustic Report (r2)

35 1982-2017 ACOUSTIC ENGINEERING EXCELLENCE

Sydney Melbourne Brisbane Gold Coast Kuwait Singapore
Renzo Tonin & Associates ABN 29 117 462 861
Level 1/418A Elizabeth St SURRY HILLS NSW 2010 | PO Box 877 STRAWBERRY HILLS NSW 2012
P (02) 8218 0500 F (02) 8218 0501 sydney@renzotonin.com.au www.renzotonin.com.au

aaac Association of Australian Acoustical Consultants

Document details

Detail	Reference
Doc reference:	TL543-01F02 DA Acoustic Report (r2)
Prepared for:	Premise
Address:	Suite 301, Level 3 Oran Park Podium, 351 Oran Park Drive Oran Park NSW 2570
Attention:	Paul Hume

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
06.11.2020	Report issued to client for review	0	1	B. Carlyle	-	D. Suwandi
11.11.2020	Updated Appendix D	-	2	B. Carlyle	-	B. Carlyle
R:\AssocSydProjects\TL501-TL550\TL543 ds Bonnyrigg Stages 8-11\1 Docs\TL543-01F02 DA Acoustic Report (r2).docx						

Contents

List of tables

List of figures

1 Introduction

Renzo Tonin & Associates was engaged to support the Development Application (DA) for the proposed Stages 1 & 2 residential subdivision at the intersection of Humphries Road and Cabramatta Road West, Bonnyrigg. The proposed development site is on the western side of Humphries Road and northern side of Cabramatta Road West, and within the Fairfield City Council's Local Government Area (LGA).

This report quantifies the noise impacts from road traffic around the proposed site. 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	State Environmental Planning Policy (Infrastructure) 2007 (ISEPP)	Section 4

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

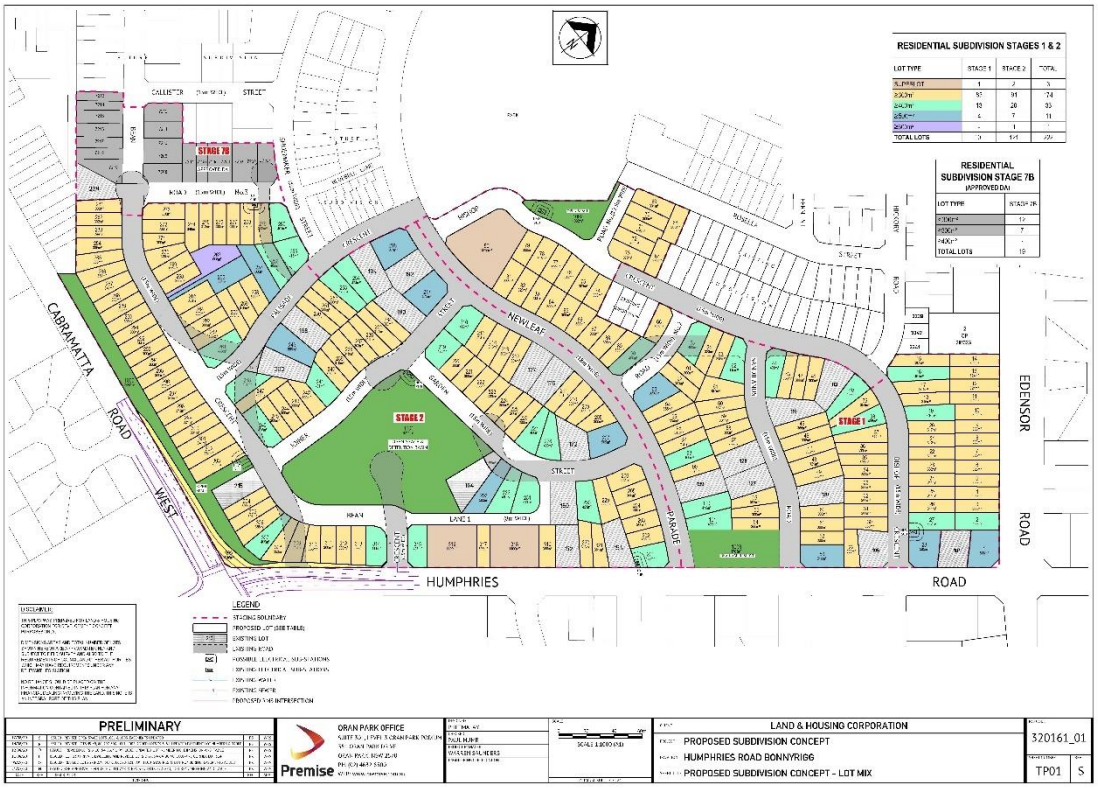
2.1 Site description and development overview

The site is bound by Edensor Road to the north, Humphries Road to the east, Cabramatta Road W to the south and existing residential dwellings to the west. Humphries Road and Cabramatta Road W are considered sub-arterial roads. The subdivision comprises Stages 1 and 2 which are separated by Newleaf Parade and collectively comprise 222 lots. The DA for Residential Subdivision Stage 7B is understood to have been approved; and therefore, does not form a part of this report.

Figure 1 shows the subject site and its surroundings and Figure 2 shows the subdivision concept.

Figure 1: Subject site

Figure 2: Subdivision concept



2.1.1 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;
- Using the results of the noise monitoring and predictive noise modelling to determine the extent of noise impact at residential lots;
- Where external noise levels are predicted to exceed the noise criteria, in-principle recommendations are provided for building envelope design in order to achieve internal noise criteria.

This report assumes all proposed dwellings are double storey and constructed in accordance with the below setback distances, provided by Premise:

- Rear boundary: 6 metres,
- Front boundary: 4.5 metres, and

- Side boundaries: 1.9 metres.

2.1.2 Reference material

The following documentation was referenced for this report:

- Subdivision concept prepared by Premise [ref: 320161_01S_TP01-TP02] dated 17/08/2020

3 Project description

Long-term noise monitoring was conducted at the subject site between Wednesday, 2 and Friday 11, September 2020 in order to determine existing road traffic noise levels. 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.

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	4 Laycock Place, Bonnyrigg	The noise monitor was located in the free field, near the southern boundary of the subdivision and approximately 16m from the closest lane of Cabramatta Road W. The noise monitor was located above the top of the existing boundary fence and had a clear line of sight to Cabramatta Road W. The noise environment was dominated by road traffic from Cabramatta Road W.
L2	16 Sandilands Road, Bonnyrigg	The noise monitor was located in the free field, near the eastern boundary of the subdivision and approximately 8m from the closest lane of Humphries Road. The noise monitor had a clear line of sight to Humphries Road. The noise environment was dominated by road traffic from Humphries Road.

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} traffic noise levels[3]	
	Day[1]	Evening[1]	Night[1]	Day[2]	Night[2]
L1 - 4 Laycock Place, Bonnyrigg	49	47	37	65	60
L2 - 16 Sandilands Road, Bonnyrigg	45	44	36	66	60

Notes:
1. Day: 07:00-18:00, Evening: 18:00-22:00, Night: 22:00-07:00
2. Day: 07:00-22:00; Night: 10:00-07:00
3. At-facade noise levels presented

4 Road traffic noise assessment

4.1 Fairfield City Council Development Control Plan 2013

Section 2.5.10 of the Fairfield City Council Development Control Plan (DCP) 2013 Amendment 22 contains specific noise controls for the site as follows:

> *2.5.10 Acoustic Reports - Rail, Road and Aircraft*
>
> *Development near a rail corridor or major road - Major roads and rail operations generate noise and vibration, and people living and working near major transport corridors can be adversely affected. In addition, major roads can impact on air quality due to the volume of traffic they carry.*
>
> *If the development is within or near a rail corridor or in the proximity of a major road, details shall be submitted to address the noise, vibration and air quality impacts of the railway or major road on the development. (Refer to State Environmental Planning Policy (Infrastructure) 2007 and the Department of Planning's 'Development near Rail Corridors - Interim Guidelines').*
>
> *As a guide, if your development is located on any of the following roads within Fairfield City, the requirement of State and Environmental Planning Policy (Infrastructure) 2007 may apply;*
>
> - *Cabramatta Road (between Liverpool Road/Hume Highway and Meadows Road)*
> - *Cowpasture Road*
> - *Cumberland Highway (Orange Grove Road, Joseph Street, Cambridge Street, New Cambridge Street, Palmerston Road and Smithfield Road)*
> - *Elizabeth Drive*
> - *Hume Highway (Liverpool Road)*
> - *The Horsley Drive*
> - *Wallgrove Road*
> - *Woodville Road*
> - *Liverpool to Parramatta Transitway*
> - *M7 Westlink Motorway*
> - *Hassall Street (between the Horsley Drive and Gipps Road)*
> - *Gipps Road*

4.2 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.*

4.2.1 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 also 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 on the basis of nominal 10dB(A) reduction through an open window to a free-field position. Windows open to 5% of floor area in accordance with the 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
Bedrooms*	Internal, windows closed	40	35
	Internal, windows open	50	45
	External free-field (allowing windows to remain open)^	60	55

Room	Location	$L_{Aeq,\ 15hr}$ Day 7am - 10pm	$L_{Aeq\ 9hr}$ Night 10pm - 7am

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

^ ISEPP Guideline states that where internal noise criteria are exceeded by more than 10dB(A) with windows open mechanical ventilation is required. External goals have been calculated on the basis of nominal 10dB(A) reduction through an open window to a free-field position. Windows open to 5% of floor area in accordance with the National Construction Code (NCC) 2019 requirements.

4.3 Noise sources

Road traffic noise sound power levels were determined from the noise monitoring results and historical noise data collected in the area. The following $L_{Aeq(15hrs)}$ and $L_{Aeq(9hrs)}$ sound power levels were used, which were validated to the logger locations and historical data, in the noise modelling.

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

Time period	Road	Overall, dB(A)
15-hour equivalent	Cabramatta Road W	65.9
	Humphries Road	63.0
	Edensor Road	66.7
9-hour equivalent	Cabramatta Road W	60.7
	Humphries Road	59.0
	Edensor Road	62.9

4.4 Road traffic noise predictions results

The noise propagation calculations were carried out in accordance with ISO9613 as implemented by CadnaA computer modelling program (version 2020). The software takes into account 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 first floor. Noise predictions were assessed to daytime and night-time criteria.

It was determined that predicted noise levels at the majority of facades on the boundary of the subdivision do not comply with the ISEPP noise limits.

Noise control treatments to mitigate road traffic noise are discussed in Section 5.

5 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-principle noise control recommendations to reduce noise intrusion for residential premises. The recommendations are based on a number of 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.

5.1 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).

5.2 Indicative building construction

On the basis of the noise modelling, and in accordance with internal noise criteria set out in Section 4.2, 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 6: Room parameters

Room	Item	Description
Bedroom	Dimensions (L x W x H)	4m x 4m x 2.7m
	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 D. The acoustic treatment corresponding to each category is specified in Table 7.

Table 7: 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	
		Roof/ceiling	Standard constructions	

Category	Room	Construction element	Indicative treatment	
		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 so as 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 considered to be 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.

5.3 Alternative ventilation

Where facades have been identified for acoustic treatment in Section 5.2, 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.

5.4 Scope of acoustic recommendations

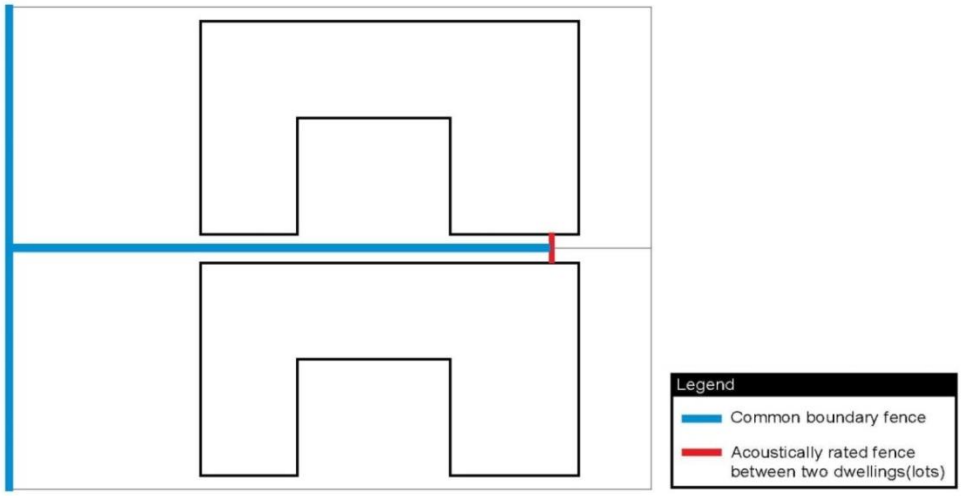
The recommended mitigation measures for road traffic noise cannot take into account the specific design of each dwelling as those details are not available at this stage of development. The recommendations have been developed in order for the approvals process and cost planning, and to provide the indicative 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.

5.5 Boundary fences

The required acoustic treatment categories are presented graphically in APPENDIX D are based on the installation of 1.8 metre high boundary fences located at the southern end of the subdivision. One boundary fence extends for 205 metres between Lots 286 and 303. The second boundary fence extents for 100 metres between 12 Palisade Crescent, Bonnyrigg and Lot 308. The location of the boundary fences are presented in APPENDIX D. Further in-principle boundary fence advise is provided below.

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 4.

Figure 4: 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 eg. 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.

6 Conclusion

Renzo Tonin & Associates has completed a road traffic noise assessment for the DA of the residential subdivision at the intersection of Humphries Road and Cabramatta Road West, Bonnyrigg. The report has quantified the noise impact from existing road traffic 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, eastern and northern portions of the subdivision.
- For facades that are exposed to noise levels above the ISEPP, acoustic constructions for treatment are required to achieve the internal noise level criteria.
- If 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.
- Noise mitigation measures are specified in Section 5 and APPENDIX D.

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 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(s)
RTA07 (NTi Audio XL2)	Type 1	1/1	L1 and L2

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 subsequent to the measurement period using a Brüel & Kjær Type 4231 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 EPA Noise Policy for Industry 2017 (NPfI). 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*'.

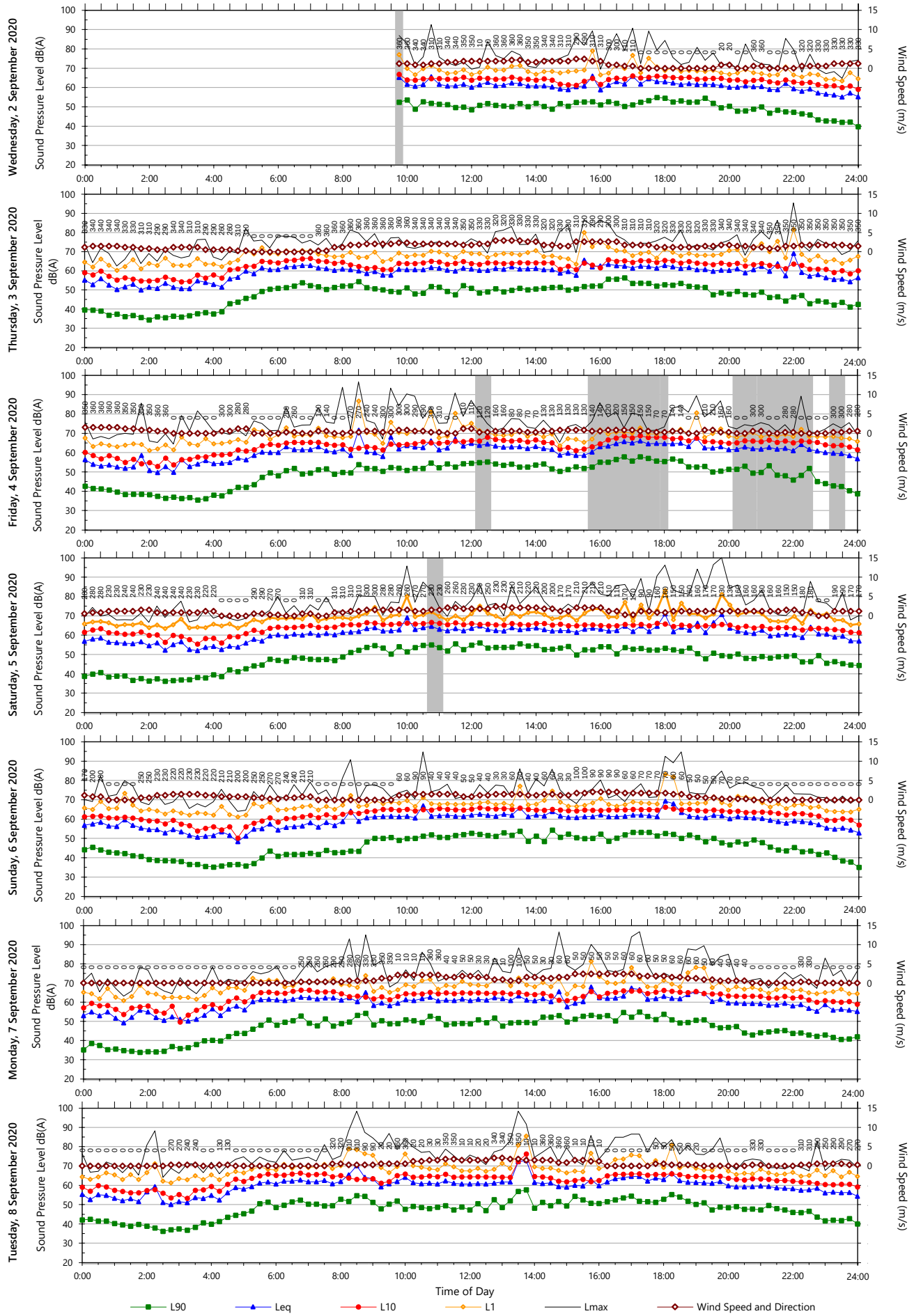
B.3 Noise vs time graphs

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

Unattended Monitoring Results

Location: 4 Laycock Place, Bonnyrigg

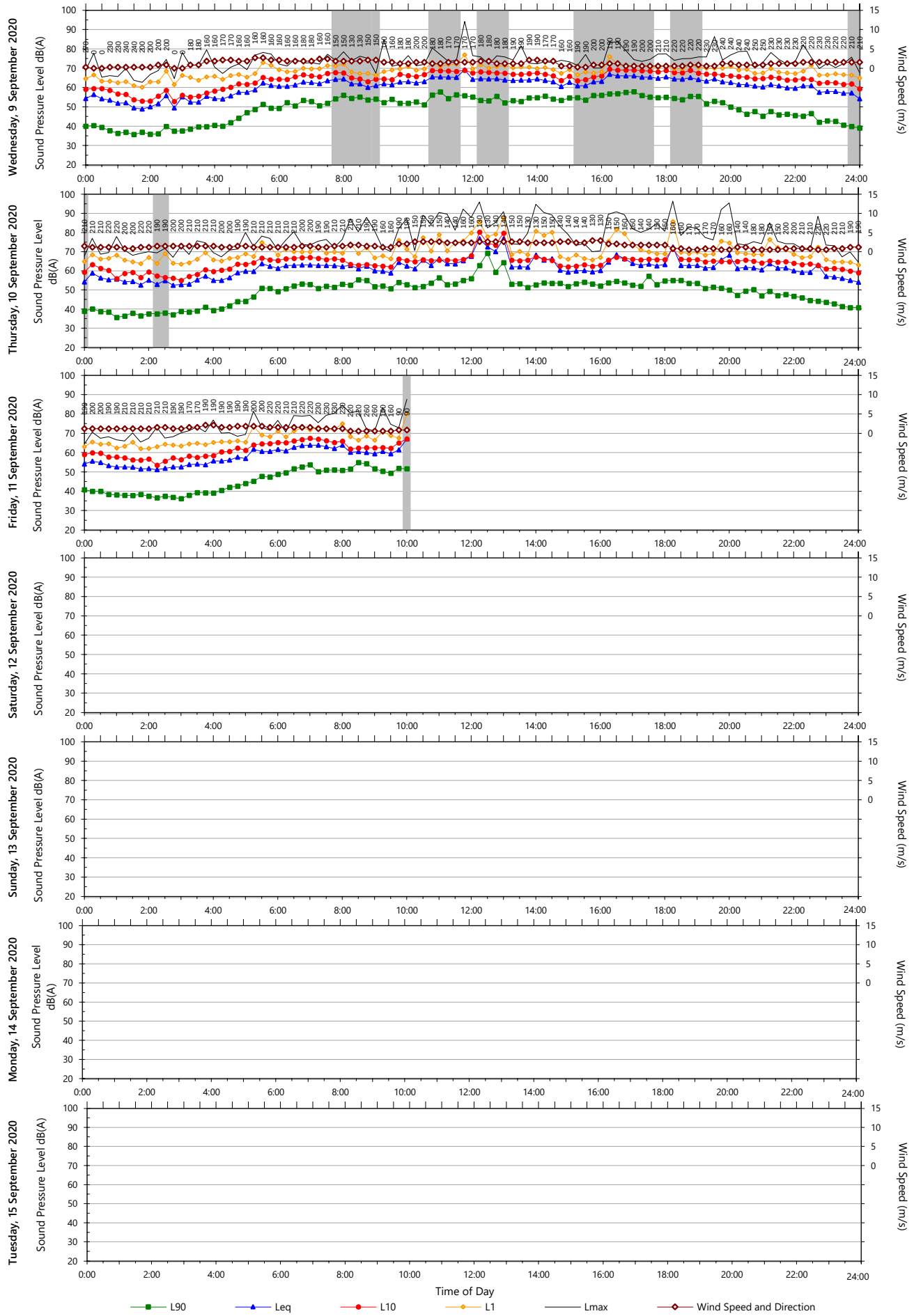


Data File: 2020-09-02_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r32)

Unattended Monitoring Results

Location: 4 Laycock Place, Bonnyrigg

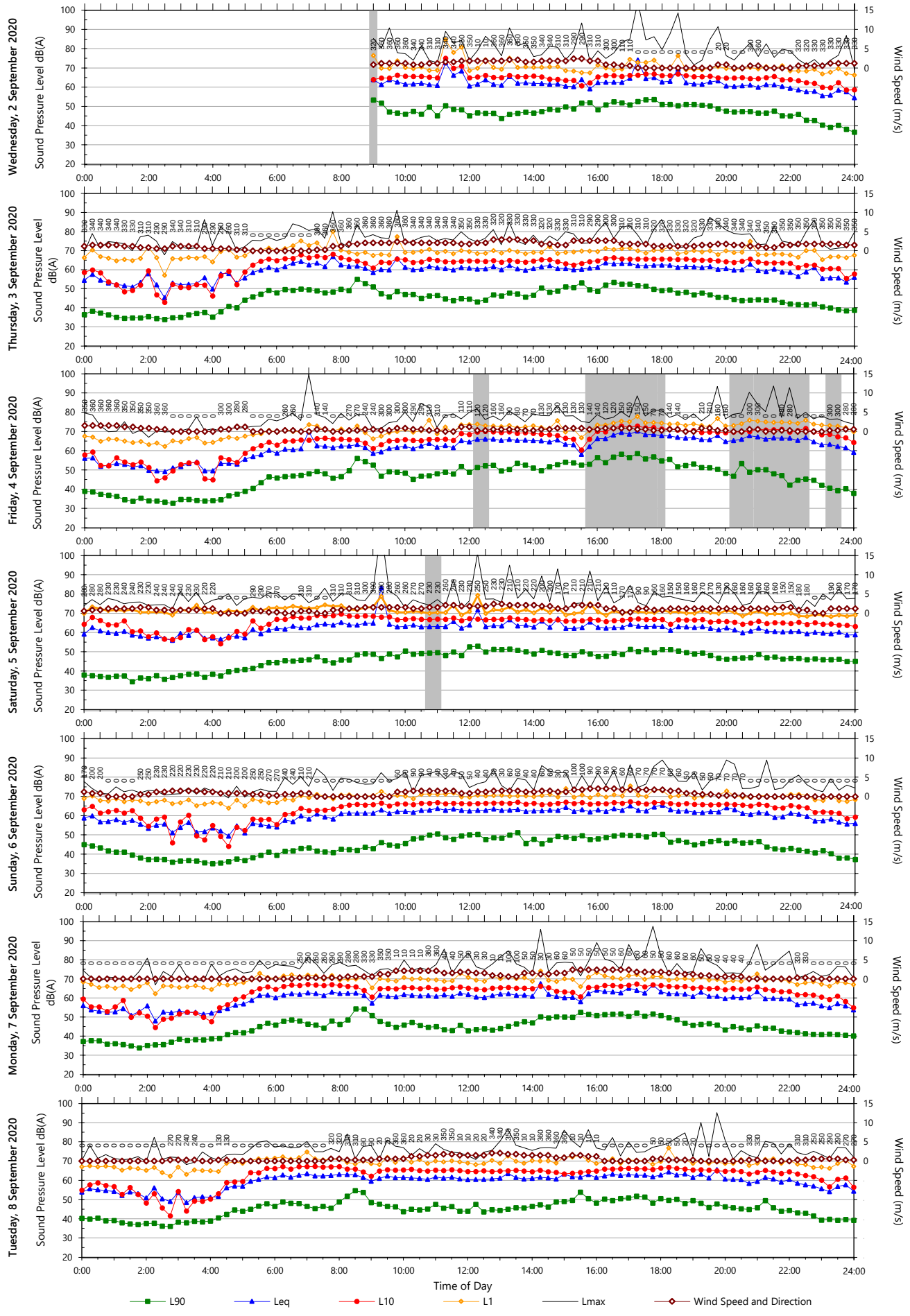


Data File: 2020-09-02_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r32)

Unattended Monitoring Results

Location: 16 Sandilands Road, Bonnyrigg

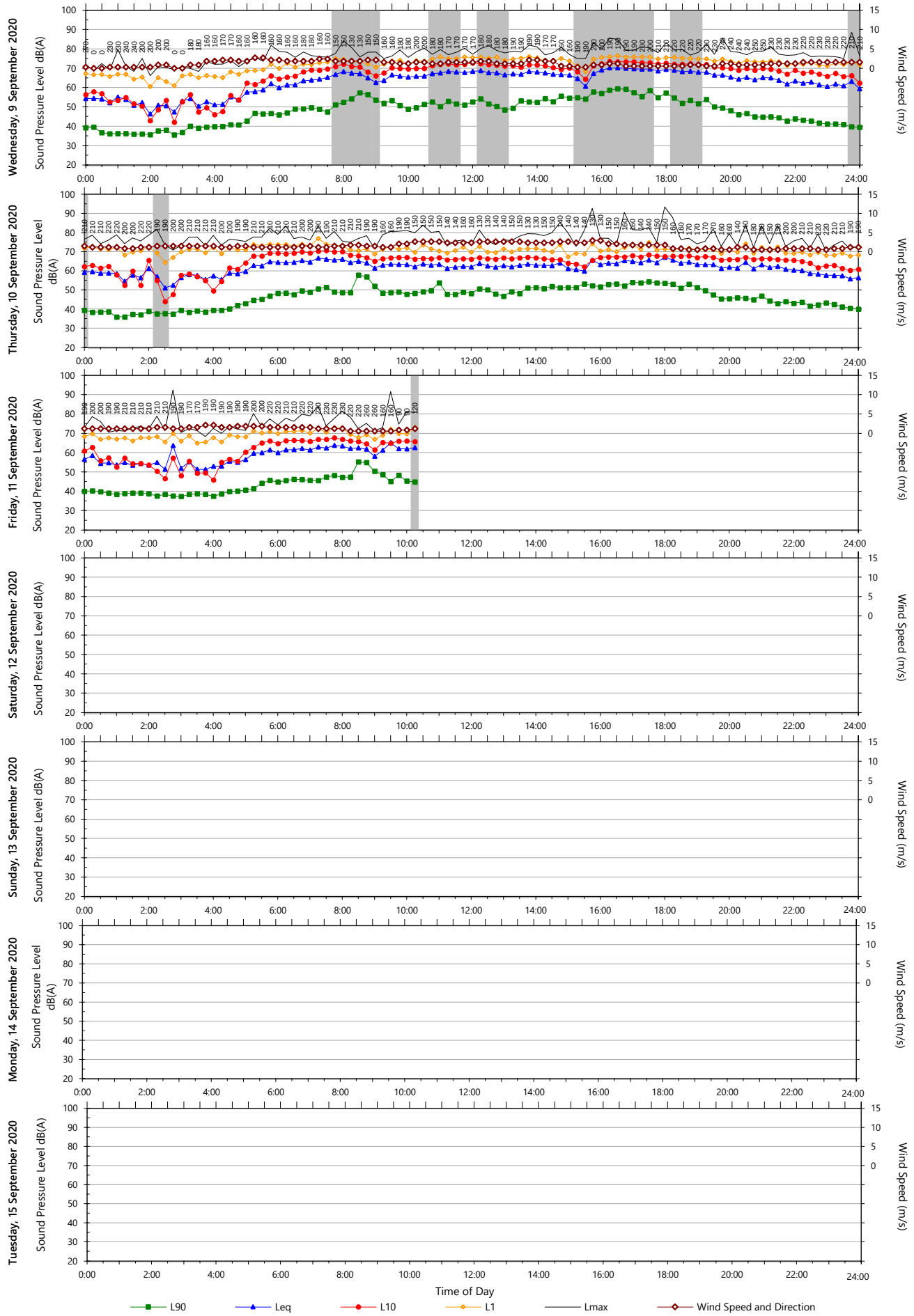


Data File: 2020-09-02_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r32)

Unattended Monitoring Results

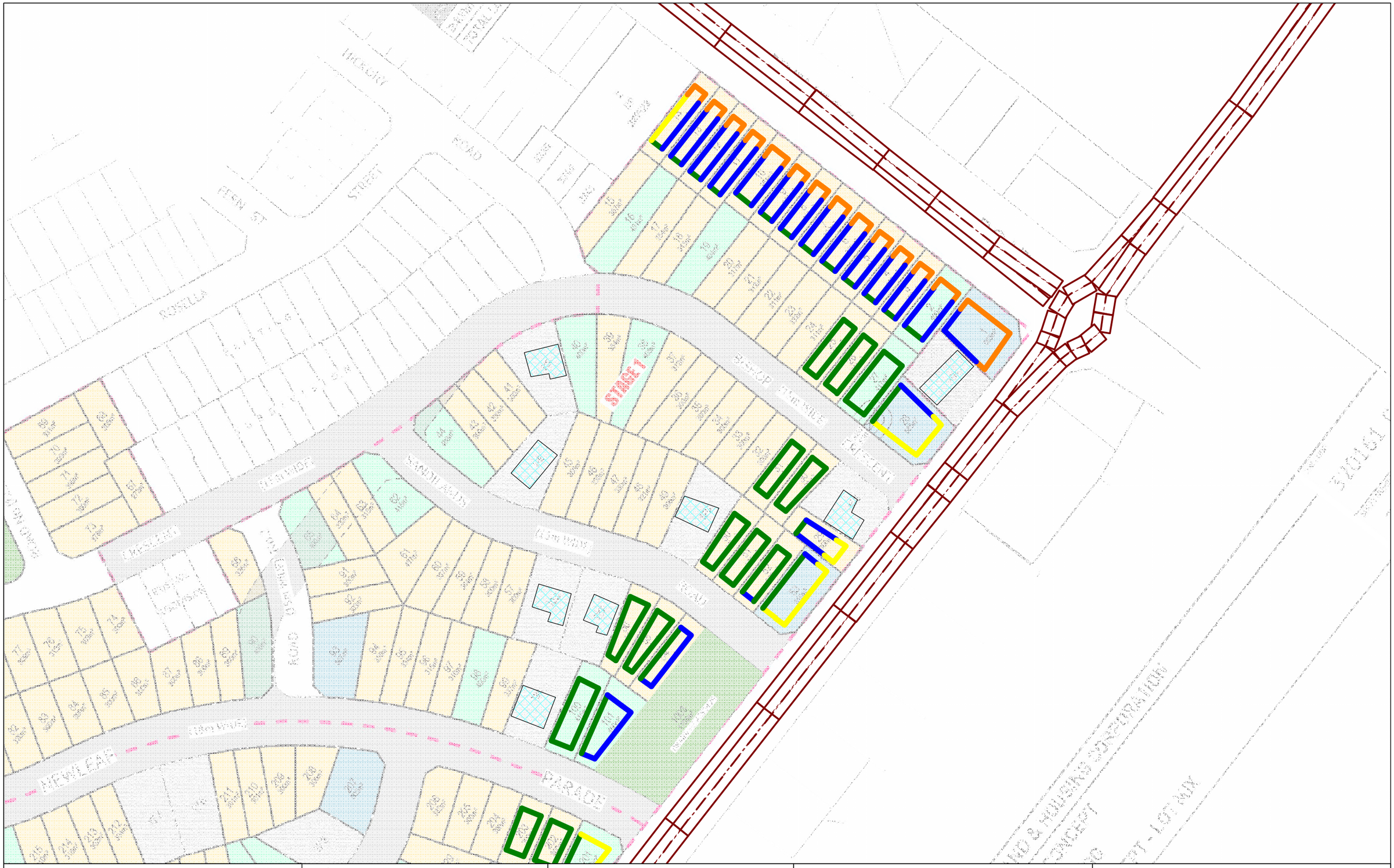
Location: 16 Sandilands Road, Bonnyrigg



Data File: 2020-09-02_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r32)

APPENDIX D Acoustic treatment categories



Legend:

- Line Source
- Road
- Building
- Barrier

Noise Level - dB(A)

- n/a
- Cat 1
- Cat 2
- Cat 3

Consultant:

RENZO TONIN & ASSOCIATES
inspired to achieve
Acoustics, Vibration & Structural Dynamics
Sydney Melbourne Brisbane Gold Coast Kuwait
1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

Client:

Premise

Project:

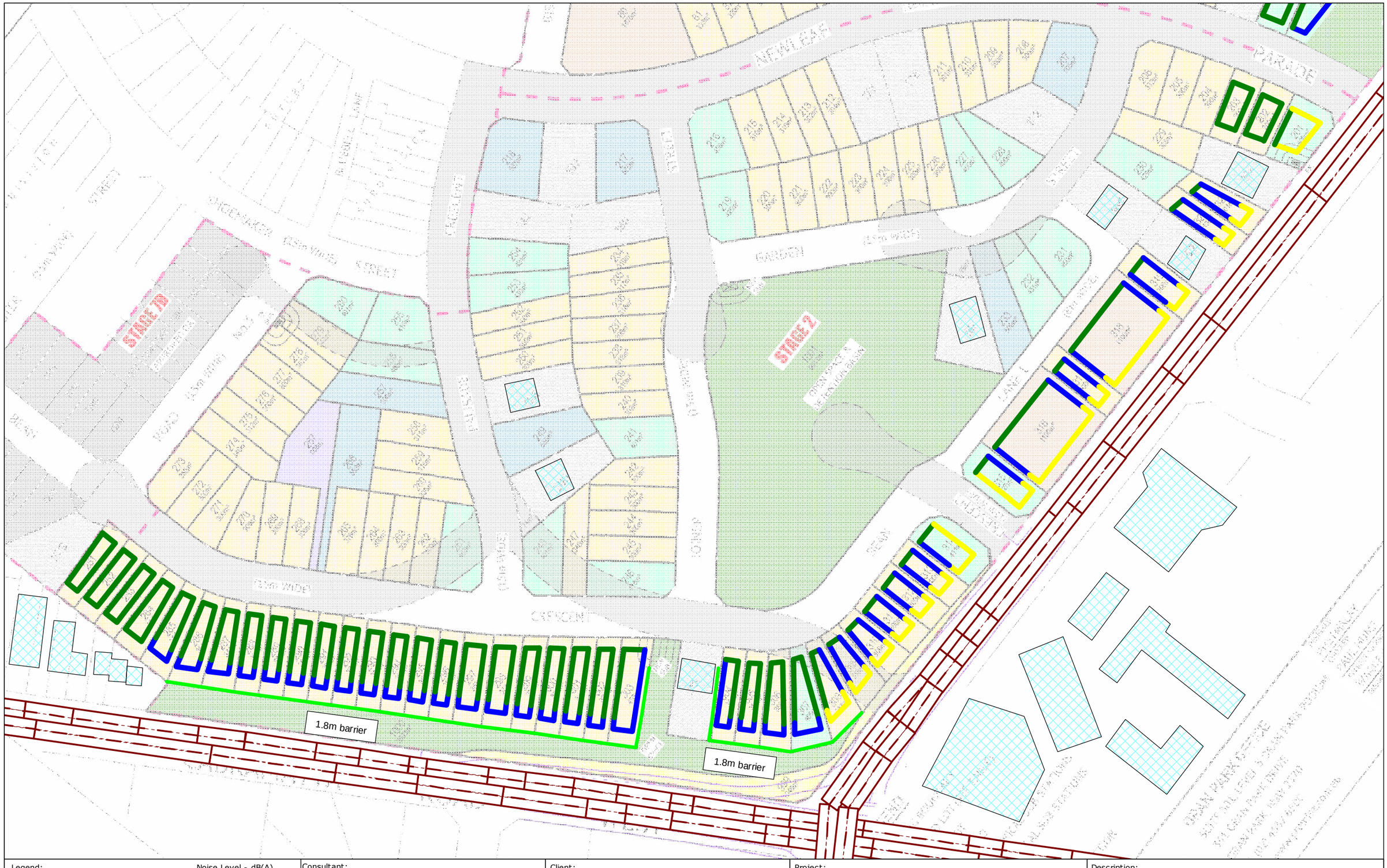
HUMPHRIES ROAD BONNYRIGG
RESIDENTIAL SUBDIVISION - CONCEPT

Description:

FACADE TREATMENT
CATEGORY RECOMMENDATIONS
GROUND FLOOR

Noise levels are approximate due to interpolation of contours and should b used for reference only.
For information only and not for construction.

Project No.:	TL543-01	Created by:	BC
Fig Ref:	TL543-01.5.1.1.5P01_1 (r0)	Grid:	
Date:	5.11.2020	Scale:	1: 1300 A3



Legend:

- Line Source
- Road
- Building
- Barrier

Noise Level - dB(A)

- n/a
- Cat 1
- Cat 2
- Cat 3

Consultant:

RENZO TONIN & ASSOCIATES
inspired to achieve
Acoustics, Vibration & Structural Dynamics
Sydney Melbourne Brisbane Gold Coast Kuwait
1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

Client:

Premise

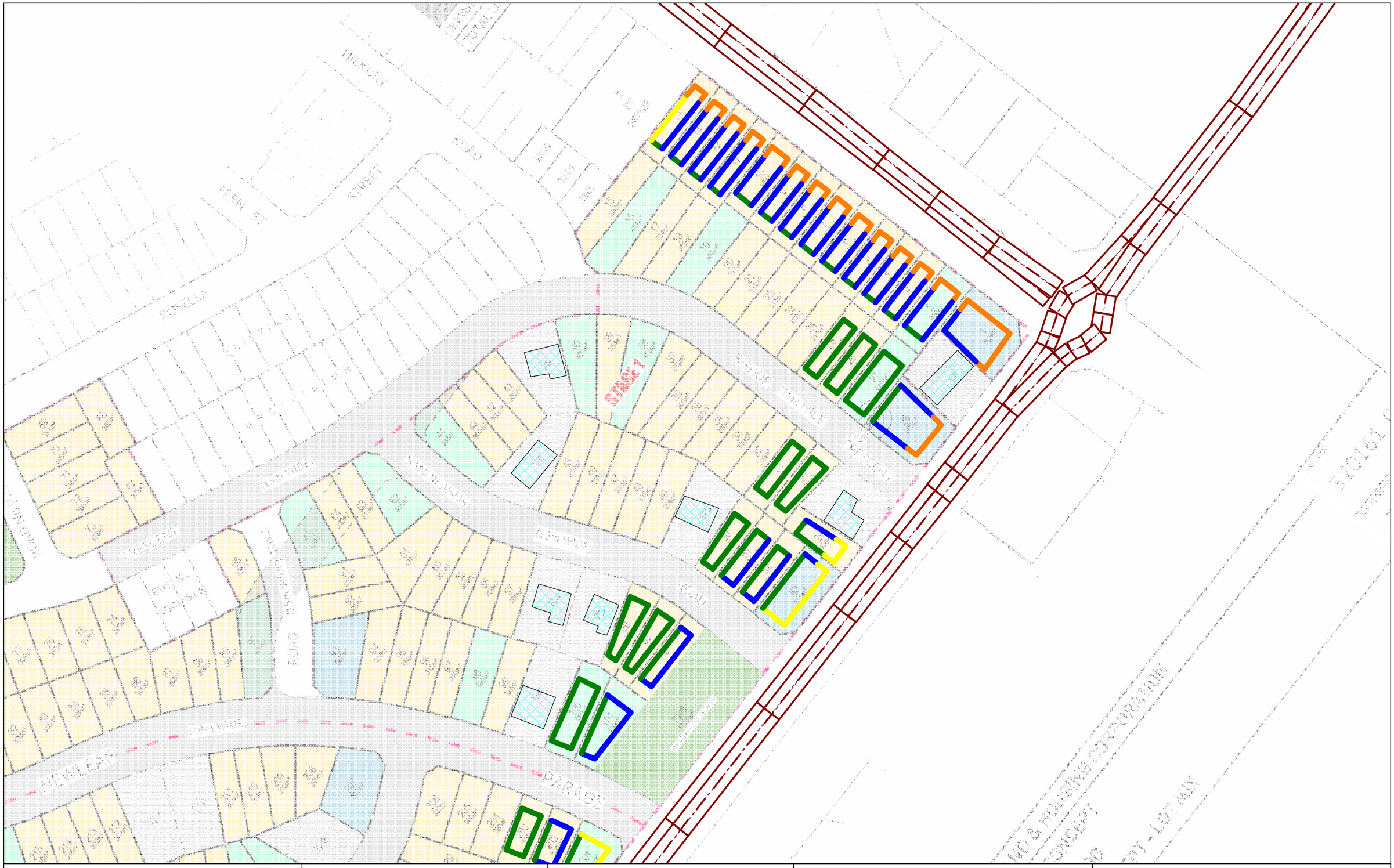
Project:

HUMPHRIES ROAD BONNYRIGG
RESIDENTIAL SUBDIVISION - CONCEPT

Description:

FACADE TREATMENT
CATEGORY RECOMMENDATIONS
GROUND FLOOR

Project No.:	TL543-01	Created by:	BC
Fig Ref:	TL543-01.5.1.1.5P01_2 (r1)	Grid:	
Date:	11.11.2020	Scale:	1: 1300 A3



Legend:

- Line Source
- Road
- Building
- Barrier

Noise Level - dB(A)

- n/a
- Cat 1
- Cat 2
- Cat 3

Consultant:

RENZO TONIN & ASSOCIATES
inspired to achieve
Acoustics, Vibration & Structural Dynamics
Sydney Melbourne Brisbane Gold Coast Kuwait
1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

Client:

Premise

Project:

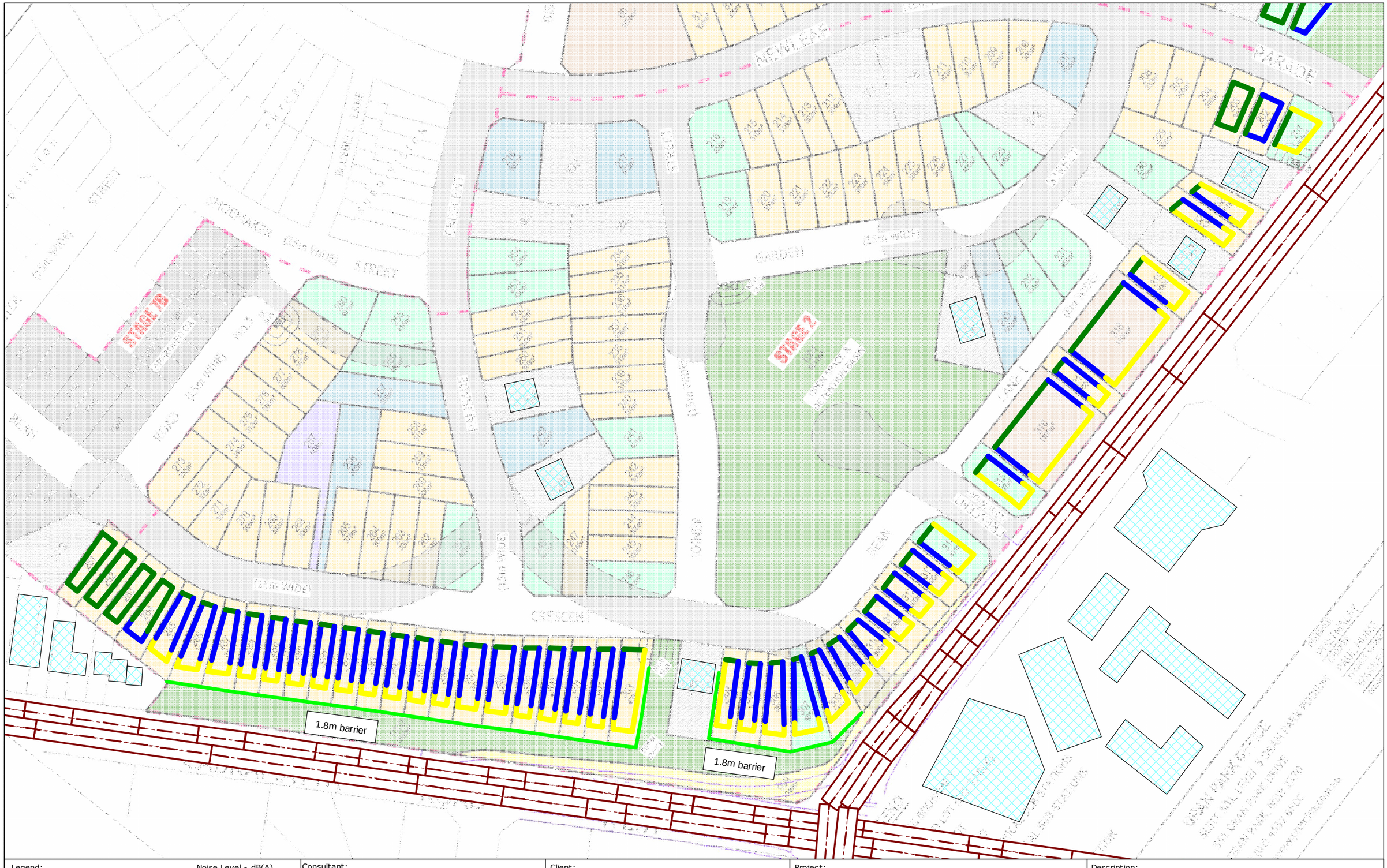
HUMPHRIES ROAD BONNYRIGG
RESIDENTIAL SUBDIVISION - CONCEPT

Description:

FACADE TREATMENT
CATEGORY RECOMMENDATIONS
FIRST FLOOR

Noise levels are approximate due to interpolation of contours and should b used for reference only.
For information only and not for construction.

Project No.:	TL543-01	Created by:	BC
Fig Ref:	TL543-01.5.1.1.5P02_1 (r0)	Grid:	
Date:	5.11.2020	Scale:	1: 1300 A3



Legend:

- Line Source
- Road
- Building
- Barrier

Noise Level - dB(A)

- n/a
- Cat 1
- Cat 2
- Cat 3

Consultant:

RENZO TONIN & ASSOCIATES
inspired to achieve
Acoustics, Vibration & Structural Dynamics
Sydney Melbourne Brisbane Gold Coast Kuwait
1/418A Elizabeth Street, SURRY HILLS NSW 2010
P: 02 8218 0500 F: 02 8218 0501

Client:

Premise

Project:

HUMPHRIES ROAD BONNYRIGG
RESIDENTIAL SUBDIVISION - CONCEPT

Description:

FACADE TREATMENT
CATEGORY RECOMMENDATIONS
FIRST FLOOR

Noise levels are approximate due to interpolation of contours and should b used for reference only.
For information only and not for construction.

Project No.:	TL543-01	Created by:	BC
Fig Ref:	TL543-01.5.1.1.5P02_2 (r1)	Grid:	
Date:	11.11.2020	Scale:	1: 1300 A3