BHC Affordable Housing Development, Yeronga

Acoustic Report

Development Application

13 January 2023

Ref: 301050151

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Revision

Revision	Date	Comment	Prepared By	Approved By
001	28/11/2022	Issue for comments	MS	MLL
002	12/01/2023	Final	CE	MLL
003	13/01/2023	Minor amendments	CE	MLL

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1. Introduction

Stantec Australia Pty Ltd (Stantec) have been engaged by Brisbane Housing Company (BHC) to undertake a noise impact assessment for the development application stage (DA) of the BHC Affordable Housing Development, Yeronga project. The project site is located at 70 Park Road (Lot 3 on SP300888), Yeronga QLD 4104 and is within the Brisbane City Council (BCC).

The primary purpose of conducting acoustic assessment has been to determine noise impacts on the completed project from surrounding major transport corridors and, subsequently, determine appropriate treatments which endeavour to continuously protect the acoustic amenity of prospective occupants.

This acoustic services report:

- Defines understanding of the existing site and proposed uses of the buildings, as well as the acoustic quality standards for the project;
- Establishes criteria pertinent to the following acoustic parameters:
    - External noise intrusion / internal noise levels;
    - Environmental noise emissions;
- Responds to acoustic comments provided in pre-lodgement meeting minutes prepared by Economic Development Queensland.
- Provides design recommendations for the abovementioned parameters for various spaces based on the applicable design guidelines discussed in this report;

Each of the acoustical aspects identified have been addressed in this report and recommendations are made to provide a consistent acoustical outcome for the project.

A glossary of terms used in this report is provided in **Appendix A.**

The recommendations made in this report are specific to the building design at the date of issue of this report. The building design is subject to change during the following stages. Where this occurs, the assumptions made to inform the recommendations in the report may no longer be valid; therefore, further advice should be sought to ensure that the acoustic outcomes presented in this report are achieved.

The performance of products referred to in this report are made to meet the acoustic requirements only. It does not consider other aspects, including but not limited to thermal, wind, impact, structural, mechanical, national construction code, security and fire requirements. Relevant discipline reports, drawings and specifications should be referred to for conformance.

This report relates to this specific project and must not be applied to any other project without prior consultation with Stantec. Designs and conditions can vary between projects causing significant variations in acoustic performance and relevant subsequent advice to one project may not apply to another.

This report shall not be relied upon as providing any warranties or guarantees of construction quality regarding acoustics.

2. Referenced Documentation

2.1 Regulations, Policies, Standards and Guidelines

The following documents detailed in **Table 1** are relevant to the project and are referred to throughout this report.

Table 1: Applicable Regulations, Policies, Standards and Guidelines referenced in this report

Title	Abbreviation
Queensland Development Code Mandatory Part 4.4 – *Buildings in a Transport Noise Corridor* Version 1.1 (published 17 August 2015 from Department of Housing and Public Works)	QDC MP4.4
Australian Standard AS 1055.1-1997 *Acoustics – Description and measurement of environmental noise*	AS 1055
Australian and New Zealand Standard AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors	AS 2107
Australian and New Zealand Standard AS/NZS 60076.10:2009 *Power transformers – Part 10: Determination of sound levels (IEC 60076-10, Ed.1 (2001) MOD*)	AS 60076.10
International Standards Organization 9613-2:1996 *Attenuation of sound during propagation outdoors – Part 2: General method of calculation*	ISO 9613
Yeronga Priority Development Area - Development Scheme published by the Department of State Development, Manufacturing, Infrastructure and Planning August 2019	Yeronga PDA DS

2.2 Study Inputs

Acoustic assessment and the preparation of this report have been conducted based on the following received documentation detail in **Table 2**.

Table 2: Received documentation

Date Received	Details	Revision / Date Prepared	Prepared by	Format
22/12/2022	Architectural Drawings Package: • *221222 BHC Yeronga DA Rev A*	Rev A – DA Issue 22/12/2022	Ultralinea Architecture	PDF
09/11/2022	Pre-DA Meeting minutes: • PRE2022/608 - Part of 70 Park Road, Yeronga	10/11/2022	Economic Development Queensland	PDF
10/05/2022	Approval conditions: • S89(1)(a) *Approval* of PDA development application	DEV2021/1221 03/05/2022	Department of State Development, Infrastructure, Local Government and Planning	PDF

3. Project Details

3.1 Pre-lodgement Meeting Outcomes PRE2022/608

The pre-lodgement meeting minutes (PRE2022/608 - Part of 70 Park Road, Yeronga, dated 10 October 2022) provide the following guidance for the acoustic assessment requirements for the project:

Table 3: Pre-lodgement meeting outcome relating to acoustic (PRE2022/608)

Item	Description
4.	**Internal Interfaces, Setbacks, Landscaping, Privacy, Amenity** … e. Units in the south-eastern corner on the ground floor and potential level above appear to be impacted by a pad mount transformer. Appropriate noise mitigate should be included in the DA lodgement and discussed among other noise impacts, in the accompanying acoustic report.
6.	**Acoustic Report** The site is mapped in the Brisbane City Plan with Designated State Noise corridor - rail network: Category 0: Noise level <70 dB(A), to Designated State Noise corridor - rail network: Category 4: Noise Level > 85 dB(A). Further, the proposal plans include mechanical plant (i.e., pad mount transformer and potentially air conditioning) adjacent to a future sensitive use (townhouse). a) Provide an acoustic report prepared by a qualified person in accordance with relevant legislation and policies (i.e., Queensland Development Code 4.4). The report must address anticipated external and internal noise impacts and provide mitigation strategies to protect residents and adjoining sensitive uses. b) Balcony and outdoor recreation must be treated accordingly, and where necessary incorporate solid gap-free balustrade.

The project site has been identified as locating within the transport noise corridor, a mandatory design requirement stipulated within Queensland Development Code MP 4.4 – *Buildings in a Transport Noise Corridor* is applicable to the project.

3.2 Site Description

3.2.1 Project Location

The project site is located at 70 Park Road (Lot 3 on SP300888), Yeronga QLD 4104 and is within the Brisbane City Council (BCC). The site is exposed to noise emissions from passenger and freight rail transportation lines situated to the north of the site. The railway line is a primary passenger connection route between Gold Coast, Logan and Brisbane council regions.

The project site has been shown in context with the rail line existing surrounding developments and noise monitoring locations (conducted by Stantec and discussed in **Section 4**) in **Figure 1**.

Figure 1: Project site and noise monitoring location

Source: Nearmap (image dated 19/09/2022, accessed 22/11/2022) | annotated by Stantec

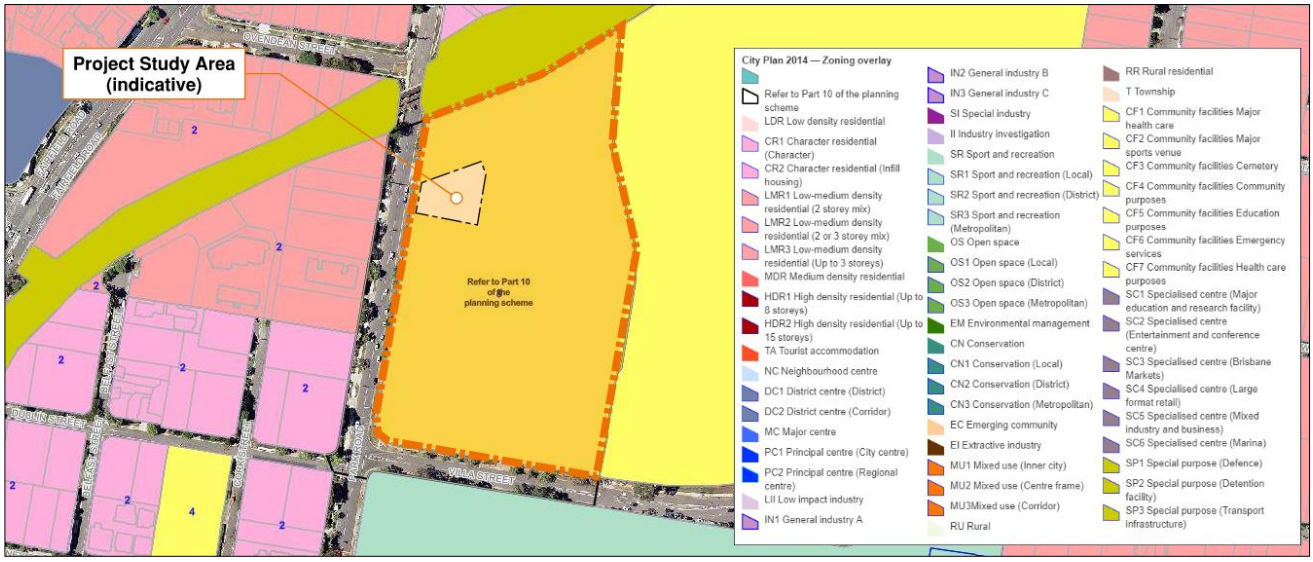
3.2.2 Surrounding Land Uses / Zoning

The Brisbane City Council City Plan 2014 Interactive Mapping (online) was accessed and reviewed on the 22nd November 2022 to determine site information, as well as existing and proposed land-uses of the areas surrounding the site (see **Figure 2**). The following was identified:

- The project site is:
  - Situated within Yeronga Priority Development Area (PDA) – Development Scheme and Dutton Park-Fairfield neighbourhood plan zone; and
  - Currently zoned CF5 Community facilities (Education purposes) by the BCC City Plan.
- Existing land uses surrounding the project site generally consist of the following zoning;
  - LMR2 Low-medium density residential (2 or 3 storey mix);
  - CR2 Character (Infill housing);
  - CF5 Community facilities (Education purposes);
  - SP3 Special purpose (Transport infrastructure)
  - SR1 Sport and recreation (Local); and
  - SR2 Sport and recreation (District).
- The nearest noise sensitive receivers to the project site (outside of the Yeronga PDA) are located at:
  - 25 Oakwood St, Yeronga 4104;
  - 25 – 51 Park Rd, Yeronga 4104; and
  - 31 Dublin St, Yeronga 4104.
- The project site is located within;
  - State designated noise corridor - rail network up to Category 4: > 85 dB(A) L_{max} (see **Figure 3**).3

- The project site is not located within;
  - Aircraft Noise Exposure Forecast (ANEF) contours; and
  - State designated noise corridor – state-controlled road.

Figure 2: Land use / zoning surrounding the project site



Source: Brisbane City Council City Plan 2014 Interactive Mapping (online – City Plan Zone 2014 Zone overlay, accessed 22/11/2022)

Figure 3: Transport noise corridor overlay

Source: Brisbane City Council City Plan 2014 Interactive Mapping (State designated noise corridor - rail network overlay, accessed 22/11/2022) | Annotated by Stantec

In addition, the development will be located at ≈ 40 m from the nearest railway track. This is greater than the 25 m distance required in SDAP State Code 2 for the assessment of rail induced vibration; therefore, this acoustic element is not considered further.

Figure 4: Areas within 25 m of State transport corridor

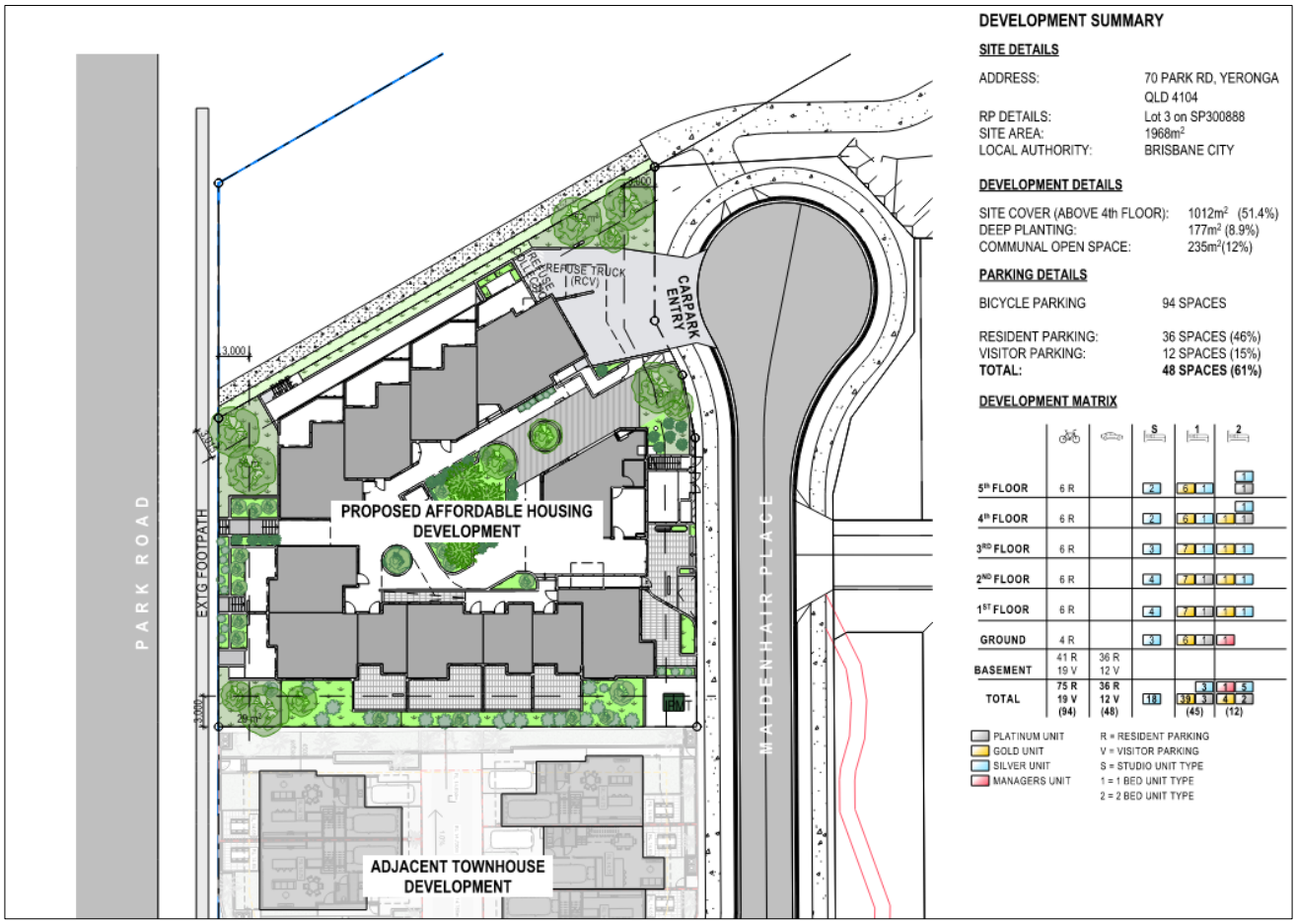
Source: QLD Government - Development Assessment Mapping System, (Area within 25 m of a railway corridor overlay, accessed 22/11/2022 | Annotated by Stantec

3.3 Project Description

Based on the architectural documentation received (refer to **Table 2**) the project will comprise a 6-storey residential tower with 75 single residential dwellings and basement parking (up to 48 spaces). Outdoor communal areas will also be provided at the centre of the building at ground level.

The layout of the proposed residential dwelling precincts is presented in **Figure 5**.

Figure 5: Precinct site plan



Source: Project Site Plan (SK201[A], dated 22/12/2022) prepared by UltraLinea Architecture

3.4 Acoustic Issues and Future Design Considerations

The following items are to be considered for the project:

- The proposed development will be in close proximity to the railway line connecting the Gold Coast and Brisbane regions, as well as road traffic noise. Noise impacts are to be assessed in accordance with Queensland Development Code Mandatory Part 4.4 Consideration shall be given towards construction of the building envelope during the design stages of the project, such that resultant indoor noise levels are sufficiently designed for, and which maintain a high degree of occupant amenity.
- The nearest external noise sensitive receivers in proximity of the proposed development are located at:
    - Residential: 25 – 51 Park Road and 31 Dublin Street, Yeronga 4104; and
    - Future residential uses within the masterplan area.

  Noise emissions from any mechanical plant or operational activities proposed for the project will need to comply with the criteria outlined by the Yeronga PDA, BCC City Plan (where applicable), EPA 1994 and EPP 2019.

4. Site Noise Surveys

4.1 Unattended Noise Measurement Method

To quantify the existing noise environment on site and degree of exposure to noise associated with rail transport, unattended noise monitoring (noise logging) was conducted from Friday 23rd April 2021 to Friday 30th April 2021 (inclusive). The location of the noise monitoring location has been shown in **Figure 1** with approximate setback from the centre of the nearest track of 21 m.

Noise measurements were conducted following guidance from Australian Standard AS 1055:2018 – *Acoustics – Description and measurement of environmental noise*, and the instruments were configured as follows:

- A-weighting frequency response;
- FAST time response; and
- 15-minute, 1 minute and 1 second intervals.

The sound level meter was calibrated before and after the measurement period. The instrument showed a drift less than ±1 dB during the course of monitoring; therefore, measurements are considered valid according to AS 1055:2018. Complete details regarding noise logging measurements and results are presented in **Appendix B**.

4.2 Site Averaged Noise Levels

A summary of relevant of the average unattended noise levels recorded at each measurement location from Friday 23rd April 2021 to Friday 30th April 2021 (inclusive) presented in **Table 4**. For further details and full measured results, refer to **Appendix B**.

Table 4: Summary of relevant noise descriptors used to determine noise limits and inform acoustic assessment

Equivalent Continuous Noise Level, L_{eq} dB(A)			Rating Background Level, RBL dB(A)			Background Noise Level, $L_{90,T}$ dB(A)			$L_{10,18hr}$ dB(A)
Day [1)]	**Evening** [1)]	**Night** [1)]	**Day**	**Evening**	**Night**	**Day**	**Evening**	**Night**	
62	61	58	45	45	35	45	49	38	61
NOTES: 1) Day – 7am-6pm | Evening – 6pm-10am | Night – 10pm-7am									

4.3 Railway Noise Levels

In addition to establishing the general acoustic profile at the project site, the purpose of unattended noise monitoring was to quantify noise levels associated with rail transport service. According to the Queensland Rail Code of Practice – Railway Noise Management;

> *"The Single Event Maximum Level provides a way to account for the potential disturbance based on peak maximum levels. Typically, on rail lines through urban areas, the Single Event Maximum Level is determined from highest 15 peak maximum levels over a 24-hour period."*

The measured data and captured audio files (described by **Appendix B**) was processed and analysed for each 24-hour period. A summary of the worst-case 15 peak maximum levels over a 24-hour period, which were measured on the Saturday 24th April 2021, as well as the calculated single event maximum noise level have been provided in **Table 5**.

Table 5: Calculation of single event maximum noise level (SEM) 24-hour period (measured Saturday 24th April 2021)

Time	Train Type	Measurement Distance (m)	Measured Level L_{max} dB(A)
12:03:58	Passenger Train 1	24	85
18:35:13	Passenger Train 2		84.8
20:51:10	Passenger Train 3		83.9
11:51:43	Passenger Train 4		83.8
16:21:32	Passenger Train 5		83.2
21:04:10	Passenger Train 6		83.1
9:43:50	Passenger Train 7		82
9:44:45	Freight Train 1		81.9
14:21:03	Passenger Train 8		81.9
18:45:36	Passenger Train 9		81.8
16:35:05	Passenger Train 10		81.7
15:41:40	Passenger Train 11		81.3
14:21:04	Passenger Train 8		81.1
18:39:23	Freight Train 2		80.2
21:09:02	Freight Train 3		80
Single event maximum noise level (SEM)			**82.4**
$L_{eq,24hour}$ dB(A)			**59.8**

5. Acoustic Criteria

5.1 Yeronga PDA – Development Scheme

Acoustic Requirements

The Yeronga Priority Development Area – Development Scheme (Yeronga PDA DS) prepared by the Economic Development Queensland (EDQ) outlines a single requirement regarding noise intrusion on the site within ***Section 2.5.6 Community safety and development constraints***:

> *The siting, design, construction and operation of development supports community safety and gives appropriate consideration to development constraints by:*
>
> *3. avoiding, to the greatest extent practicable, then managing or mitigating significant adverse impacts:*
>
> *b. from noise emissions on sensitive uses [41], including those from transport noise corridors (in this section, note 41 of the scheme states "**for guidance on acoustic amenity, refer to the Brisbane City Plan Centre or mixed-use code**"), and*
> *c. on the environment.*

Relationship with Brisbane City Plan 2014

Schedule 6 of the Planning Regulation 2017 (Planning Regulation) prohibits Brisbane City Plan 2014 from making PDA-related development assessable under the Planning Act. However, schedule 2 adopts definitions from Brisbane City Plan 2014 and the development scheme calls up various other parts of the Brisbane City Plan 2014 as guidance.

Under section 71 of the ED Act, if there is a conflict between the development scheme and a planning instrument, or assessment benchmarks prescribed by regulation under the Planning Act or another Act for the Planning Act, the development scheme prevails to the extent of any inconsistency.

5.2 Environmental Noise Emissions

5.2.1 Brisbane City Council – City Plan 2014

The Brisbane City Council – City Plan 2014 (version 21, effective as of 28th May 2021) requires developments to be designed to maintain the expected level of amenity for the area where they are constructed.

In accordance with Section 3b of the Yeronga PDA DS, guidance on acoustic amenity shall be sought from the Brisbane City Plan when assessing noise emissions from the project site to external sensitive uses, specifically, the centre or mixed-use code. A summary of the acoustic-related performance and acceptable outcomes defined under the 9.3.3 Centre or mixed-use code have been provided in **Table 6**.

Table 6: Performance outcomes and acceptable outcomes (BCC City Plan, Table 9.3.3.3.A)

Performance outcomes	Acceptable outcomes
PO1 Development: a. has hours of operation which are controlled so that the use does not detrimentally impact on the amenity of adjoining residents; b. does not result in noise emissions that exceed the noise (planning) criteria in Table 9.3.3.3.F, low frequency noise criteria in Table 9.3.3.3.G and night-time noise criteria in Table 9.3.3.3.H in a sensitive zone or a nearby sensitive use, except music noise where located in a Special entertainment precinct identified in a neighbourhood plan. Note—A noise impact assessment report prepared in accordance with the Noise impact assessment planning scheme policy can assist in demonstrating achievement of this performance outcome.	**AO1.1** Development: a. for accommodation activities, dwelling unit or emergency services has unlimited hours of operation; b. for a club, if licensed, bar, function facility, hotel or nightclub entertainment facility does not generate noise which is clearly audible and detectable, or impacts on the amenity of a resident, in a dwelling or other sensitive use; Note—Development for a club, if licensed, bar, function facility, hotel or nightclub entertainment facility is not expected to achieve this outcome. c. for any other use: i. where in the Principal centre zone or Major centre zone has unlimited hours of operation;

Performance outcomes	Acceptable outcomes
	ii. where in the District centre zone, Neighbourhood centre zone or Mixed use zone: A. has hours of operation, including for deliveries, which are limited to 6am to 10pm; or B. does not generate noise which is clearly audible and disturbing in a dwelling or other sensitive use; iii. where in any other zone: A. has hours of operation, including for deliveries, which are limited to 6am to 8pm; or B. does not generate noise which is clearly audible and disturbing in a dwelling or other sensitive use.
	AO1.2 Development ensures mechanical plant or equipment is acoustically screened from an adjoining sensitive use. Note—Mechanical plant includes generators, motors, compressors and pumps e.g. air-conditioning, refrigeration or cold room motors

Noise (planning) criteria

The applicable noise planning criteria from the *centre or mixed-use zone code* (Table 9.3.3.3.F) has been reproduced in **Table 7**.

Table 7: Noise (planning) criteria (Table 9.3.3.3.F, City Plan 2014)

Criteria Location	Intrusive Noise Criteria	Acoustic Amenity Criteria		
	Day, evening and night $L_{Aeq,adj,T}$ are not greater than the RBL plus the value in this column for the relevant criteria location, where T equals: • day – 11hr • evening – 4hr • night – 9hr	Day, evening and night $L_{Aeq,adj,T}$ are not greater than the values in the columns below for the relevant criteria location, where T equals: • day – 11hr • evening – 4hr • night – 9hr		
		Day	**Evening**	**Night**
Low–medium density residential zone boundary	3 dB(A)	55 dB(A)	45 dB(A)	40 dB(A)
Character residential zone boundary	3 dB(A)	55 dB(A)	45 dB(A)	40 dB(A)
At a sensitive use in the mixed-use zone	5 dB(A)	60 dB(A)	55 dB(A)	50 dB(A)

NOTES:

- $L_{Aeq,adj,T}$: The adjusted A-weighted equivalent continuous sound pressure level of the development during the time period T, where T is an 11-hour day (7am–6pm), 4-hour evening (6pm–10pm) and 9-hour night (10pm–7am), determined in accordance with the methodology in the Noise impact assessment planning scheme policy.
- RBL: Rating background level determined in accordance with the methodology in the Noise impact assessment planning scheme policy.
- dB(A): A-weighted decibels

Low frequency noise criteria

Low frequency noise emissions from the proposed development shall comply with the acoustic performance criteria outlined in **Table 8**.

Table 8: Low frequency noise criteria (Table 9.3.3.3.G, City Plan 2014)

Criteria location	Day (7am-6pm) $L_{Ceq,adj,11hr}$ is not greater than the following values at the relevant criteria location	Evening (6pm-10pm) $L_{Ceq,adj,4hr}$ is not greater than the following values at the relevant criteria location	Night (10pm-7am) $L_{Ceq,adj,9hr}$ is not greater than the following values at the relevant criteria location
Low-medium density residential zone boundary Character residential zone boundary	65 dB(C)	65 dB(C)	60 dB(C)
At a sensitive use in the mixed-use zone	75 dB(C)	75 dB(C)	70 dB(C)

NOTES:

- $L_{Ceq,adj,T}$: The adjusted C-weighted equivalent continuous sound pressure level of the development during the time period T, where T is an 11-hour day (7am–6pm), 4-hour evening (6pm–10pm) and 9-hour night (10pm–7am), determined in accordance with the methodology in the Noise impact assessment planning scheme policy.
- dB(C): C-weighted decibels

Night-time noise criteria

The relevant night-time noise criteria outlined by *Table 9.3.3.3.H* of the City Plan 2014 has been reproduced in **Table 9**.

Table 9: Night-time noise criteria (Table 9.3.3.3.H, City Plan 2014)

Criteria location	Where the existing $L_{Aeq,9hr\ night}$ at the criteria location is:	Average of the highest 15 single L_{Amax} events over a given night (10pm–7am) period is not greater than the following values at the relevant criteria location	The absolute highest single L_{Amax} event over a given night (10pm–7am) period is not greater than the following values at the relevant criteria location
Low-medium density residential zone boundary Character residential zone boundary	< 45 dB(A)	50 dB(A)	55 dB(A)
	45 to 60 dB(A)	$L_{Aeq,9hr\ night}$ + 5 dB(A)	$L_{Aeq,9hr\ night}$ + 10 dB(A)
	> 60 dB(A)	65 dB(A)	70 dB(A)
Mixed use zone	Not applicable	65 dB(A)	70 dB(A)

NOTES:

- L_{Amax}: The A-weighted maximum sound pressure level determined in accordance with the methodology in the Noise impact assessment planning scheme policy.
- $L_{Aeq,9hr}$: The A-weighted equivalent continuous sound pressure level of the development during the night- time period 10pm to 7am, determined in accordance with the methodology in the Noise impact assessment planning scheme policy.
- Night: 10pm to 7am
- dB(A): A-weighted decibels

5.2.2 Queensland Environmental Protection Act 1994

The objective of the Queensland Environmental Protection Act 1994 (EPA 1994) is *"to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends."*

To uphold this intent, and of relevance to acoustic assessment for the project, the EPA 1994 defines a series of noise-related standards in Chapter 8, Part 3B Offences relating to noise standards. The following sections are considered applicable:

Section 440R Building work

(1) A person must not carry out building work in a way that makes an audible noise—
(a) on a business day or Saturday, before 6.30a.m. or after 6.30p.m; or
(b) on any other day, at any time.
(2) The reference in subsection (1) to a person carrying out building work—
(a) includes a person carrying out building work under an owner-builder permit; and

(b) otherwise does not include a person carrying out building work at premises used by the person only for residential purposes.

Section 440U Air-conditioning equipment

(1) This section applies to premises at or for which there is air-conditioning equipment.
(2) An occupier of the premises must not use, or permit the use of, the equipment on any day:
(a) before 7am, if it makes a noise of more than 3dB(A) above the background level [1]; or
(b) from 7am to 10pm, if it makes a noise of more than 5dB(A) above the background level; or
(c) after 10pm, if it makes a noise of more than 3dB(A) above the background level.

5.2.3 Environmental Protection (Noise) Policy 2019

The Queensland Environmental Protection (Noise) Policy 2019 (EPP 2019) identifies environmental values to be enhanced or protected, states acoustic quality objectives, and provides a framework for making decisions about the acoustic environment.

Schedule 1 Acoustic Quality Objectives

The acoustic quality objectives are stated in Section 7 of Schedule 1 of the EPP 2019. In accordance with EPP 2019, the acoustic quality objectives are stated for a defined type of noise sensitive use and specified period of the day (reproduced in **Table 10**). The environmental values which EPP 2019 aims to enhance or protect are also stated. It is intended that the acoustic quality objectives be progressively achieved as part of achieving the purpose of EPP 2019 over the long term.

Table 10: Acoustic quality objectives as defined in Schedule 1 of the EPP 2019

Sensitive Receiver	Time of Day	Acoustic Quality Objectives [1)] (measured at the receiver) dB(A)			Environmental Value
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,1hr}$	$L_{A1,adj,1hr}$	
residence (for outdoors)	daytime and evening	50	55	65	health and wellbeing
residence (for indoors)	daytime and evening	35	40	45	health and wellbeing
	night-time	30	35	40	health and wellbeing, in relation to the ability to sleep
library and educational institution (including a school, college and university) (for indoors)	when open for business or when classes are being offered	35	—	—	health and wellbeing
school or playground (for outdoors)	when the children usually play outside	55	—	—	health and wellbeing, and community amenity

NOTES:

1) The $L_{Aeq,Adj,T}$ noise limits apply to all noise sources, whilst the $L_{A10,Adj,1hr}$ and $L_{A1,Adj,1hr}$ only apply to intermittent noise sources (i.e. excludes air conditioning).

5.3 External Noise Intrusion

5.3.1 Queensland Development Code Mandatory Part 4.4

The Queensland Development Code Part MP 4.4 - *'Buildings in a Transport Noise Corridor'* (QDC MP4.4, August 2015) specifies noise categories to ensure that habitable rooms of residential buildings are adequately protected from transport noise with an allowance for 10 year growth.

[1] *NOTE: According to the EPA 1994:*
- *Background level means the background A-weighted sound pressure level under the prescribed standard measured as $L_{A90,T}$.*
- *$L_{A90,T}$ means the A-weighted sound pressure level obtained using time weighting 'F' that is exceeded for 90% of the measuring period (T).*

The purpose of the QDC MP4.4 is to ensure any habitable rooms of Class 1, 2, 3 and 4 buildings located in a transport noise corridor are designed and constructed to reduce transport noise and protect the occupants inside dwellings. QDC MP4.4 requires that each external facade of a habitable room be assigned a noise category, which is dependent upon the future noise exposure at the façade.

QDC MP4.4 applies at the time of Building Approval for buildings on the subject site. It is responsibility of the building certifier to assess the building design against the provisions of the QDC MP4.4 or an assessment undertake by a noise assessment which is specific to the building and its noise with surrounding buildings and screening. It must be prepared by a suitably qualified person.

The objective of the noise assessment is to clearly demonstrate that the noise category that is applicable to a particular part of or entire building, or site. The applicable criteria for determining the relevant noise category are reproduced in **Table 11** below.

Table 11: QDC MP 4.4 noise category levels

Noise Category	Single event maximum noise (L_{Amax}) for railway land [1)]
Category 4	≥ 85 dB(A)
Category 3	80 – 84 dB(A)
Category 2	75 – 79 dB(A)
Category 1	70 - 74 dB(A)
Category 0	≤ 69 dB(A)

NOTES:
1) measured at 1 m from the façade of the proposed building.

Acceptable solutions for the external envelope of each habitable room in a relevant residential building must comply with the nominated minimum acoustic rating for each building component specified in Schedule 1 of the QDC MP4.4 to achieve a minimum transport noise reduction level for the relevant noise category by either using:

a) using materials specified in Schedule 2 of the QDC MP4.4; or
b) using materials with manufacturer's specifications that, in combination, achieve the minimum R_w value for the relevant building component and applicable noise category.

6. Noise Impact Assessments

6.1 Rail Noise Impacts

6.1.1 Assessment Overview

This section presents details of calculations conducted to determine the potential rail transportation noise impacts onto the project.

To predict noise impacts, calculations were made using the recognised Nordic Rail Prediction Method (Kilde Rep.130) for passenger and freight rail noise, which is also recommended by TMR document *Attachment A - Railway Noise Assessment Report Structure and Specific Issues*. Calculations were assisted by a three-dimensional computer model (acoustic simulation model) of the site and proposed developments created within SoundPLAN 8.2 acoustic software.

The acoustic simulation model was created as a representation of the existing and future site, which incorporated the following inputs:

- Calculation algorithms – SoundPLAN implementation of accepted noise prediction standards;
- Terrain elevation – A 3D representation of the existing terrain and at completion of construction;
- Ground surface corrections – Areas of soft (absorptive) and hard (reflective) ground;
- Roads sources – The placement of each road source as a source line and the input of traffic flow parameter;
- Buildings – Detailed implementation of the proposed building from drawings (i.e., layout, height, floors),
- Surrounding buildings – relevant building footprints and heights of the adjacent buildings to the proposed site that may provide shielding; and
- Sensitive receivers – Locations where the noise limits are to be assessed.

Refer to **Appendix C** for further details regarding the acoustic simulation model.

NOTE: Only the existing and approved surrounding buildings outside of the project site have been considered for the noise model. As a conservative approach, future buildings proposed as part of the Masterplan which have yet to be approved have not been included in the assessment. Based on the location of the other proposed buildings within the masterplan, once completed, may provide additional shielding benefit to the project site.

Once the remaining buildings within the Masterplan have been approved and design confirmed, a reassessment of the rail noise impact to the proposed dwellings may be conducted to potentially minimise the acoustic requirements of the building envelope to individual dwellings.

6.1.2 Model Verification of Accuracy

The acoustic simulation model is to be considered verified when the difference between the measured and predicted noise levels at the monitoring location is less than ± 2 dB. The SEM is calculated using the TMR guideline, the values in **Table 12** result.

Table 12: Rail traffic noise model verification

Location	Noise descriptor	Monitor location predicted noise level	Measured noise level	Difference
Monitoring Location	SEM	**82.5**	**82.4**	-0.1
	$L_{Aeq,24hr}$	**59.6**	**59.8**	+0.2

The acoustic simulation model has therefore been validated and any noise predictions have been made without corrections, other than those stated in this report, applied to the results.

6.1.3 Predicted Noise Levels – Maximum Noise Level Event (L_{Max})

The acoustic simulation model was used to predict the L_{Amax} noise levels from rail sources at 1 m from the façade of each sensitive use associated with a sole-occupancy dwelling. Based on the predicted levels, façade noise categories have been determined in accordance with QDC MP4.4 and provided as markups in **Appendix E**.

6.1.4 Predicted Noise Levels - $L_{Aeq\ (24hr)}$

The predicted $L_{Aeq\ (24\ hour)}$ rail noise level at the measurement location which is closer to the rail line and more affected than any other point on the site is less than 59.8 dB(A) (free-field) based on current number of trains per day. This complies with the SDAP criteria for both external façade and private open space with allowance for future rail traffic growth.

As compliance is achieved at the most affected point on the site to the rail line and all other receptors are further removed than this point, compliance is will be achieved across the site. No further assessment is warranted.

6.1.5 MP4.4 Construction Requirements – Building Envelope

Noise modelling predictions showed that railway transportations noise levels will be between Category 0 and Category 3 of QDC MP4.4. We refer to the noise predictions and applicable categories in **Appendix E** and Schedule 1 of QDC MP4.4 for the minimum required R_w of building components (reproduced in **Table 13**).

Where a R_w rating applies to a window, this applies to the glass, frame and window seal system. An acoustic test certificate will be required from the window supplier for Category 2 glazing and higher. It is noted that in order to achieve the internal design sound levels, windows must remain closed.

Table 13: Minimum R_w required for the building component (reproduced from QDC MP4.4)

Noise Category	Minimum transport noise reduction required for habitable rooms, dB(A)	Component of building's external envelope	Minimum R_w required for each component
4	40	Glazing	43
		External walls	52
		Roof	45
		Floors	51
		Entry doors	35
3	35	Glazing	38 (total area of glazing for a *habitable* room is greater than 1.8m^2)
			35 (total area of glazing for a *habitable* room is less than or equal to 1.8 m^2)
		External walls	47
		Roof	41
		Floors	45
		Entry doors	33
2	30	Glazing	35 (total area of glazing for a *habitable* room is greater than 1.8m2)
			32 (total area of glazing for a *habitable* room is less than or equal to 1.8 m^2)
		External walls	41
		Roof	38
		Floors	45
		Entry doors	33

Noise Category	Minimum transport noise reduction required for habitable rooms, dB(A)	Component of building's external envelope	Minimum R_w required for each component
1	25	Glazing	27 (total area of glazing for a *habitable* room is greater than 1.8 m^2)
			24 (total area of glazing for a *habitable* room is less than or equal to 1.8 m^2)
		External walls	35
		Roof	35
		Entry doors	28
0	No additional acoustic treatment required – standard building assessment provisions apply.		

6.1.6 Site-specific Construction Recommendations

Recommended construction of façade elements as specified in Schedule 2 of QDC MP4.4 are provided in **Appendix D.**

Based on the proposed construction of external building material, the following site-specific building envelope construction recommendations are provided in **Table 14**.

Other forms of construction may be applied, provided these meet the minimum R_w values required.

Table 14: Site specific construction recommendation

Building element	Noise Category	Minimum R_w per component	Example Construction Description	Source
Weatherboard	**1**	**35**	• Weatherboards or plank cladding externally; with – minimum 90 mm deep timber stud or 92 mm metal stud; and – standard plasterboard at least 13 mm thick internally.	QDC [1)]
	2	**41**	• Cemintel sheet or weatherboard cladding; with – 19 to 35 mm depth battens; – 1 x 13 mm Gyprock Fyrchek MR Plasterboard; – 90 mm steel studs at 600 mm maximum centres + 75 Gold Batts R1.5; and – 1 x 10 mm Gyprock Plus Plasterboard. OR • Cemintel sheet or weatherboard cladding; with – 1 x 16 mm Gyprock Fyrchek MR Plasterboard; – 90 mm timber studs at 600 mm maximum centres + 75 Gold Batts R1.5; and – 1 x 10 mm Gyprock Plus Plasterboard.	CSR 5152 System OR CSR 5510 System [2)]
	3	**47**	• Cemintel sheet or weatherboard cladding; with – 19 to 35 mm depth battens; – 1 x 16 mm Gyprock Fyrchek MR Plasterboard; – 90 mm steel studs at 600 mm maximum centres + 75 Gold Batts R1.5; and – 1 x 16 mm Gyprock Fyrchek MR Plasterboard. OR • Cemintel sheet or weatherboard cladding; with – 1 x 16 mm Gyprock Fyrchek MR Plasterboard; – 90 mm timber studs at 600 mm maximum centres + 75 Gold Batts R1.5; and – 2 x 16 mm Gyprock Fyrchek MR Plasterboard.	CSR 5168 System OR CSR 5623 System [2)]

Building element	Noise Category	Minimum R_w per component	Example Construction Description	Source
	4	52	• Cemintel sheet or weatherboard cladding; with – 2 x 16 mm Gyprock Fyrchek MR Plasterboard; – 90 mm timber studs at 600 mm maximum centres + 75 Gold Batts R1.5; and – 2 x 16 mm Gyprock Fyrchek MR Plasterboard.	CSR 5174 system [2]
Blockwork	1	35	• Concrete brickwork at least 110 mm thick	QDC [1]
	2	41	• Concrete brickwork at least 110 mm thick	QDC [1]
	3	47	• Single leaf of minimum 150 mm thick masonry of hollow, dense concrete blocks, with mortar joints laid to prevent moisture bridging.	QDC [1]
	4	52	• Two leaves of clay brick masonry, at least 270 mm in total, with subfloor vents fitted with noise attenuators	QDC [1]
Fibre Cement	1	35	• Minimum 6 mm thick fibre cement sheeting; with – minimum 90 mm deep timber stud or 92 mm metal stud; and – standard plasterboard at least 13 mm thick internally.	QDC [1]
	2	41	• Minimum 6 mm thick fibre cement sheeting; with – minimum 90 mm deep timber stud or 92 mm metal stud with fibreglass insulation (minimum density 11 kg/m^3); and – standard plasterboard at least 13 mm thick internally.	Insul [3]
	3	47	• Minimum 6 mm thick fibre cement sheeting; with – Minimum 90 mm deep timber stud or 92 mm metal stud with 50 mm thick acoustic insulation (minimum density 11 kg/m^3); and – 2 x standard plasterboard at least 13 mm thick internally.	Insul [3]
	4	52	• 2 x 6 mm thick fibre cement sheeting; with – Minimum 90 mm deep timber stud or 92 mm metal stud with 50 mm thick acoustic insulation (minimum density 11 kg/m^3); and – 2 x fire-rated plasterboard at least 13 mm thick internally.	Insul [3]
Roof	1	35	• Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10 mm thick fixed to ceiling cavity.	QDC [1]
	2	38	• Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10 mm thick fixed to ceiling cavity, mineral insulation or glass wool insulation at least 50 mm thick with a density of at least 11 kg/m^3.	QDC [1]
	3	41	• Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10 mm thick fixed to ceiling joists, glass wool insulation at least 50 mm thick with a density of at least 11 kg/m^3 or polyester insulation at least 50 mm thick with a density of at least 20 kg/m^3 in the cavity. OR • Concrete suspended slab at least 100 mm thick.	QDC [1]

Building element	Noise Category	Minimum R_w per component	Example Construction Description	Source
	4	45	• Concrete or terracotta tile or sheet metal roof with sarking, acoustically rated plasterboard ceiling at least 13 mm thick fixed to ceiling joists, cellulose fibre insulation at least 100 mm thick with a density of at least 45 kg/m^3 in the cavity. OR • Concrete or terracotta tile or sheet metal roof with sarking, 2 layers of acoustically rated plasterboard at least 16 mm thick fixed to ceiling joists, glass wool insulation at least 50 mm thick with a density of at least 11 kg/m^3 or polyester insulation at least 50 mm thick with a density of at least 20 kg/m^3 in the cavity.	QDC [1)]
Glazing	1	24 / 27	Procured to a performance requirement with supporting laboratory test certificate.	-
	2	32 / 35		
	3	35 / 38		
	4	43		

NOTES:
1) Construction description obtained from QDC MP4.4
2) Performance data obtained from CSR Gyprock The Red Book, Fire, Acoustic & Thermal Design Guide, May 2020
3) Calculated construction element based on predicted sound insulation performance using INSUL v9.0.8

6.1.7 Wintergarden Acoustic Performance

As indicated in **Appendix E**, apartments located on ground floor to Level 2 are exposed to rail noise levels that exceed L_{max} 85 dB(A) and, consequently, requires construction that satisfies QDC MP4.4 Noise Category 4.

Through discussions with BHC, a wintergarden arrangement to the affected apartments has been agreed upon. To achieve a satisfactory internal noise levels using this type of system, the following configuration is advised and is considered comparable in performance to the accepted glazing system advised under QDC MP4.4 for Noise Category 4 scenarios:

Outer (to exterior)

- Operable glazed systems to be rated $R_w \geq 28$.

Inner (to apartment)

- Fixed and sliding door and window elements (including frames) to be rated $R_w \geq 30$.

All systems defined above shall be procured to the performance stated with supporting acoustic test laboratory certification.

6.1.8 Outdoor Communal Area

Two outdoor communal areas are proposed for the project:

- Ground floor Central Oasis; and
- Level 5 to north-east of building.

The predicted noise levels at the above locations complies with the noise criteria of L_{max} 84 dB(A).

No further mitigation control is required.

6.2 Pad-mounted Transformer (PMT)

As noted by Item 4(e) of the pre-lodgement meeting minutes (see **Table 3**), units in the south-eastern corner on the ground floor and potential level above appear to be impacted by a pad mount transformer (PMT).

It is expected that the pad-mounted transformer (PMT) will have a 500 kVA rating. With reference to Appendix ZA of AS 60076.10, sound power levels of a PMT to the rating stated are estimated to be $L_w \approx 62$ dB(A).

A noise intrusion assessment was conducted to the nearest affected habitable rooms located on ground and first floors with consideration of the following:

- Relative distance between PMT and nearest affected habitable rooms located on ground and first floors;
- Extent of screening surrounding the PMT as indicated by the architectural drawings package referred to in **Table 2**;
- An internal noise target of 35 dB(A) based on recommendations outlined in AS 2107 (RESIDENTIAL BUILDINGS – Houses and apartments in suburban areas or near minor roads – Sleeping areas (night time));
- + 5 dB penalty for tonality applied to the transformer noise emissions – it is common for this type of plant to produce tonal attributes at 100 Hz and higher order harmonics;
- A maximum outdoor-to-indoor correction at each nearest noise sensitive receptor of -5 dB applied due to typical attenuation through an open window.

Based on the above assessment inputs and assumptions, no additional acoustic treatments are considered mandatory for compliance with internal noise targets at the nearest affected habitable rooms with windows open.

6.3 Refuse Bay

The proposed refuse bay is located at the northeast boundary of the project site at the roundabout.

Whilst noise impacts from site waste collection may contribute to the acoustic environment at adjacent noise sensitive receptors (predominately those situated within the Yeronga PDA DS area), typical use occurring over a brief duration is anticipated and is considered unlikely to result in significant disturbance.

Hence, noise mitigation measures to control noise impacts from the refuse bay area are not proposed.

6.4 Car Parking

The proposed carpark is located in the basement level of the development and noise from the movement within the carpark is likely to be insignificant.

Notwithstanding, the proposed driveway accessing the basement carpark is within direct line of sight to the adjacent future residential receivers to the east. The noise from vehicle movement accessing the driveway is likely to be audible by these residents.

The following controls is recommended to minimise potential noise from vehicle using the driveway:

- The driveway floor to be constructed completely flat, with no speed bumps
- Surface finishes such as concrete brush finish or trowelled finish are recommended to minimise tyre squeal
- Ensure that the gutter drain cover is sufficiently recessed to grade of the driveway and well fabricated to not generate additional noise when the vehicle drives over.

6.5 Mechanical Plant Noise Emissions

6.5.1 Noise Source Locations

It is anticipated that mechanical services plant may be required for the individual dwelling. The outdoor units are assumed to be located at the building the units are servicing.

6.5.2 Assessment Inputs and Assumptions

Noise emissions from proposed or repurposed / relocated equipment selections are required to comply with the environmental noise limits outlined in **Section 5.2**, the most stringent of which is set by the EPP 2019 (i.e., $L_{eq,adj,1hr}$ 30 dB(A) indoors at a residential premises during the night-time).

Given the current stage of the project, location and type of mechanical services plant have not been proposed and, therefore, detailed calculations are to be conducted in a later stage of the project. In general, the noise emission of mechanical plant associated with the development should be controlled so that the operation of such plant does not adversely impact nearby sensitive receivers.

It is envisaged that the mechanical plant noise sources will be controllable by common engineering methods that may consist of:

- Quiet equipment selections of selections
- Judicious location of plant
- Barriers
- Silencers

The selected mechanical equipment should be reviewed and assessed for conformance with the established criteria at the subsequent design stage of the project when specific plant selection is known and appropriate noise control measures can be determined, noting that the cumulative noise emissions from all site noise sources should be considered when determining appropriate mitigation options.

7. Conclusion

Stantec Australia Pty Ltd have been engaged by Brisbane Housing Company to undertake a noise impact assessment for the development application stage of the BHC Affordable Housing Development, Yeronga project located at 70 Park Road (Lot 3 on SP300888), Yeronga QLD 4104.

This acoustic services report has:

- Established relevant design criteria in accordance with current Australian Standards, Design Guidelines, Regulations and Policies;
- Identified potential acoustic-related issues to be addressed during the design stages of the project; and
- Responded to acoustic comments provided in pre-lodgement meeting minutes prepared by Economic Development Queensland; and
- Provided detailed design recommendations and advice pertinent to the project.

We trust that this report to be sufficient for your current requirements; however, should you have any queries, please do not hesitate to contact the undersigned on (07) 3811 4500.

Yours sincerely,

Stantec Australia Pty Ltd

Carl Edser (Author)
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Appendix A Glossary of Acoustic Terms

TERM	DEFINITION
Adverse Weather	Weather conditions that affect noise (wind and temperature inversions) that occur at a particular site for a significant period of time. The previous conditions are for wind occurring more than 30% of the time in any assessment period in any season and/or for temperature inversions occurring more than 30% of the nights in winter).
Assessment Location	The position at which noise measurements are undertaken or estimated.
Assessment Period	The period in a day over which assessments are made.
Attenuation	A reduction in the magnitude of sound.
A-weighting	A frequency dependent filter applied to an instrument-measured noise. In its simplest form, the filter is designed to replicate the relative sensitivity to loudness perceived by the human ear.
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. 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 L_{A90} noise level.
Barrier	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc. used to reduce noise.
C_{tr}	A standard weighting curve which replicates low frequency noise, such as that from traffic. Often added to $D_{nT,w}$ or R_w to characterise airborne sound insulation performance.
dB	The abbreviation for decibel.
dB(A)	A-weighted sound level in decibels.
Decibels	The relative unit of measure for noise, which is a logarithmic ratio between the measured level and reference (threshold) level of 0 dB.
Dw	A single number value that represents a field measurement of the weighted level difference between two adjacent spaces separated by a partition. $D_w = L1 – L2$ where, L1 is the average sound pressure level in the source room; and L2 is the average sound pressure level in the receiver room.
Frequency	Frequency is synonymous to pitch. Frequency or pitch can be measured on a scale in units of Hertz (Hz). Most noise sources typically comprise of a vast, and often complex, range of frequencies.
Frequency Response	This is a characteristic of a system which has a measured response resulting from a known applied input. In a mechanical structure, the frequency response function (FRF) is the spectrum of the vibration of a structure divided by the spectrum of the input force to the system. To measure the frequency response of a mechanical system, one must measure the spectra of both the input force to the system and the vibration response.
Intermittent Noise	Level that drops to the background noise level several times during the period of observation.
L_{A1}	The A-weighted sound pressure level exceeded for 1 % of the measurement time period.
L_{A10}	The A-weighted sound pressure level exceeded for 10 % of the measurement time period.
L_{A90}	The A-weighted sound pressure level exceeded for 90 % of the measurement time period. Typically represents the background noise level of an environment.
L_{Aeq}	The equivalent continuous sound pressure level in dB(A). It is often accompanied by an additional suffix “T”, which is indicative of the measurement time period. (e.g. $L_{Aeq,15min}$, symbolising the measurement is evaluated over 15-minutes).
L_{Amax}	The maximum A-weighted sound pressure level recorded over the measurement period.
Reflection	Sound wave changed in direction of propagation due to a solid object met on its path.
Reverberation	The persistence of a sound within a space, which will naturally decay over time. Most apparent once the source signal has ceased emitting. Reverberation may have effects on speech intelligibility if not adequately controlled. Reverberation time, represented in seconds, can vary depending on the volume and surface finishes of the space.

TERM	DEFINITION
R_w	Weighted sound reduction index. A single number value which represents the airborne sound insulation performance of a partition or building element that has been determined under laboratory testing conditions.
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 Power Level	The total sound energy radiated by a source, expressed in Watts. The sound power level is ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Sound Pressure Level	The measured acoustic wave strength in a given environment and at a particular point of interest where the total sound level expressed is relative to a reference pressure, i.e. the threshold of human hearing. Sound pressure level is typically measured using a standard sound level meter with a microphone, expressed in decibels (dB).
Spectrum	The spectrum is the result of transforming a time domain signal to the frequency domain. Spectrum analysis is the procedure of doing the transformation, and it is most commonly done with an FFT analyser.

Appendix B Noise Monitoring Details

Unattended noise logging was conducted from Friday 23rd April 2021 to 30th April 2021 (inclusive) at the location shown in **Figure 1** (coordinates in **Table 15**). This location was selected due to a high degree of exposure to the railway line.

Table 15: Noise monitoring coordinates

Monitor	Latitude	Longitude
001	-27.515506	153.020467

The following instrumentation was used:

- An NTi XL2 Class 1 sound level meter (S/N A2A-12892-E0), and Pulsar 105 Class 1 acoustic calibrator (S/N 72913). The instrument had a current calibration certificate by a certified National Association of Testing Authorities (NATA) acoustics laboratory at the time of measurements.

Noise measurements were conducted in accordance with Australian Standard AS 1055.1-1997 – *Acoustics – Description and measurement of environmental noise*, and the instruments were configured as follows:

- A-weighting frequency response;
- FAST time response;
- 15-minute, 1 minute and 1 second intervals.

The sound level meter was calibrated before and checked at the end of the measurement period. The instrument showed a drift less than ±1 dB during the course of monitoring; therefore, measurements are considered valid according to AS1055.1-1997.

Audio was recorded during the measurements period and used for the purpose of identifying contributing noise sources.

Noise monitoring results

The raw sound level meter files were post-processed to determine relevant long-tern noise descriptors, some of which were used to determine the applicable noise limits.

Results and time trace plots of relevant noise descriptors are provided below (see **Table 16** and **Figure 6**). Where data was not measured for a full period (i.e. at the start and end of measurement), the cells are shown dashed in the table. In addition, the noise descriptor averages are presented.

A summary of weather observations by the Bureau of Meteorology (BoM) during the monitoring period is presented in **Table 17**. Where adverse weather (e.g. rain, excessive wind) occurred within the monitoring period, the measured data has been excluded.

Table 16: Summary of measured noise levels (rounded)

Noise descriptor	Average	23-Apr-21	24-Apr-21	25-Apr-21	26-Apr-21	27-Apr-21	28-Apr-21	29-Apr-21
$L_{A10(18hr),6am-12am}$	61	—	61	60	60	62	62	62
$L_{Aeq,7am-6pm}$	62	—	61	60	60	63	64	63
$L_{Aeq,6pm-10pm}$	61	61	60	60	60	60	62	61
$L_{Aeq,10pm-7am}$	58	58	58	57	59	59	59	—
$RBL_{,7am-6pm}$	45	—	41	38	40	44	45	46
$RBL_{,6pm-10pm}$	45	43	43	42	47	43	44	43
$RBL_{,10pm-7am}$	35	33	33	32	35	35	34	—
$L_{A90,7am-6pm}$	45	—	43	41	43	47	48	49
$L_{A90,6pm-10pm}$	49	45	46	47	48	47	47	47
$L_{A90,10pm-7am}$	38	38	37	36	39	39	38	—

Figure 6: Time trace of relevant noise descriptors

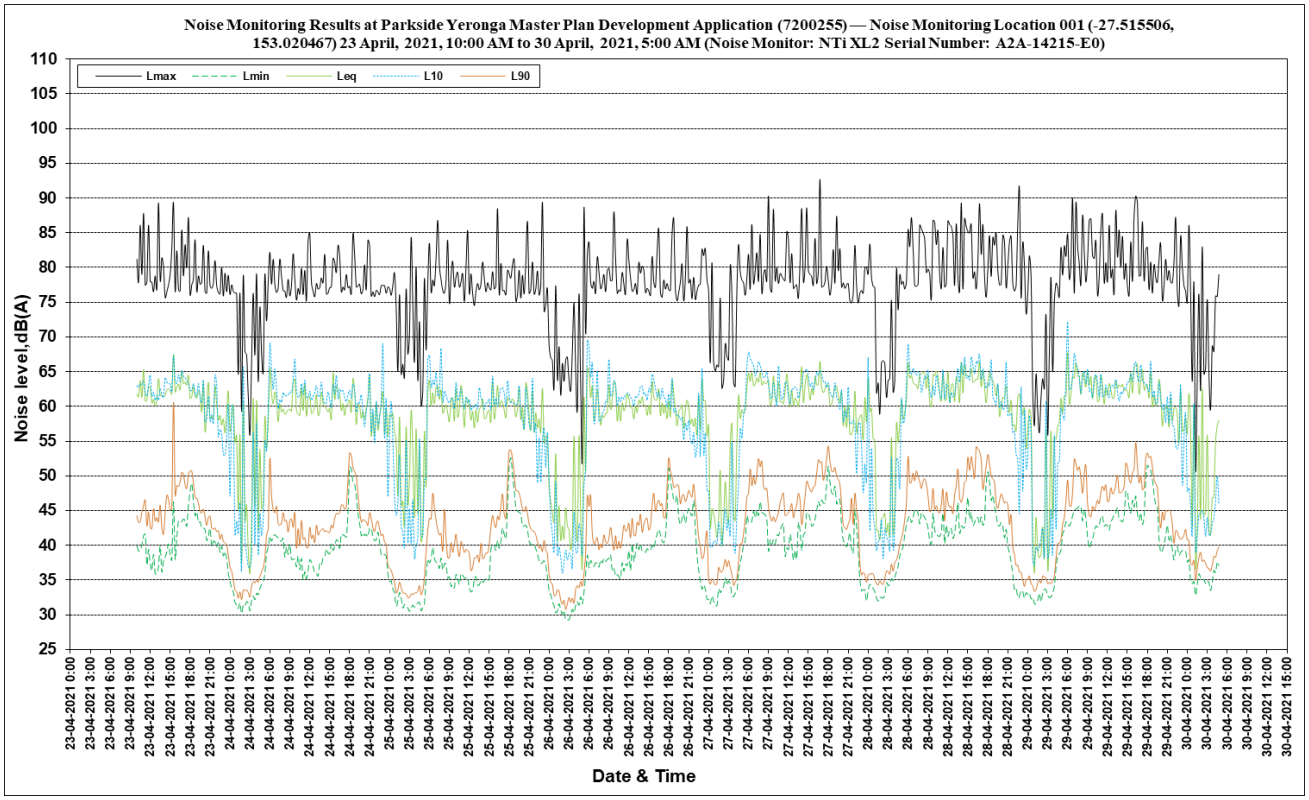


Table 17: Summary of BoM weather observations during unattended monitoring (monitored days highlighted)

Brisbane, Queensland
April 2021 Daily Weather Observations
Most observations from Brisbane City, but some from Brisbane Airport.

Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Th	18.0	26.2	0		5.7	SSE	31	15:09	23.6	57	6	SSW	7	1020.9	23.4	68	7	SSW	4	1018.8
2	Fr	17.9	26.6	2.8		8.8	E	41	14:46	23.7	59	2	SSE	11	1022.5	24.1	53	7	ESE	17	1021.0
3	Sa	20.5	25.4	0		1.2	ESE	33	14:10	22.6	70	7	SSE	7	1021.6	22.5	80	7	ESE	9	1019.0
4	Su	19.6	22.5	8.4		0.0	ENE	20	13:58	20.7	92	8	WSW	2	1019.6	21.4	91	8	ESE	4	1016.4
5	Mo	20.1	23.3	9.4		0.0	SE	30	15:31	21.6	87	8	SSE	11	1016.4	23.0	87	8	SE	13	1013.3
6	Tu	20.9	24.3	45.4		0.9	E	37	05:21	22.1	94	8	S	6	1015.7	22.9	85	7	SSE	11	1013.1
7	We	19.6	27.5	20.6		6.5	SSE	30	11:07	22.4	86	7	SSW	9	1013.0	27.4	57	6	SE	13	1008.8
8	Th	19.2	28.1	0		10.2	S	26	09:51	24.7	63	7	S	11	1008.8	26.7	59	1	S	6	1005.7
9	Fr	18.3	30.6	0		10.6	WNW	19	14:24	23.9	63	0	WSW	4	1009.3	30.3	45	2	W	6	1004.6
10	Sa	17.7	33.0	0		10.9	W	28	13:41	24.2	61	1	WSW	4	1008.7	32.7	30	1	WSW	7	1004.7
11	Su	18.3	29.2	0		7.4	W	30	15:40	22.5	57	7	SW	4	1010.7	29.0	30	1	W	11	1008.3
12	Mo	13.2	24.6	0.2		10.0	SE	26	13:52	18.9	39	1	WSW	9	1018.0	23.6	49	1	ENE	9	1016.1
13	Tu	14.7	24.9	0		10.7	SE	20	10:55	21.4	52	1	SSW	6	1021.9	23.2	42	2	ESE	9	1018.9
14	We	13.6	26.3	0		10.8	NE	19	15:05	19.5	64	1	WSW	6	1020.7	25.4	47	1	NE	6	1016.7
15	Th	15.0	28.4	0		10.9	NE	19	14:25	20.6	69	0	WSW	6	1017.6	26.6	49	1	NNE	7	1014.0
16	Fr	17.1	30.5	0		10.0	E	28	16:05	22.5	63	1	SW	2	1017.6	27.5	52	3	ENE	9	1015.2
17	Sa	19.5	24.7	0		0.7	SE	26	00:32	21.2	67	8	SW	6	1019.6	23.6	68	7	E	6	1016.3
18	Su	15.0	24.9	24.6		8.5	ENE	19	16:40	19.5	63	2	SW	7	1018.6	23.8	49	2	SSE	7	1015.4
19	Mo	14.4	26.5	0.2		10.9	SSE	19	09:24	20.3	61	1	SW	6	1019.1	25.2	44	1	NNE	6	1015.7
20	Tu	14.6	27.6	0		10.7	NNE	19	16:43	20.3	69	0	WSW	6	1019.1	27.4	35	1	WNW	4	1014.4
21	We	14.5	30.1	0		10.9	W	31	15:59	22.4	62	0	WSW	6	1015.1	29.8	26	1	WSW	13	1010.3
22	Th	12.0	22.0	0		1.0	W	24	22:08	16.7	62	7	SSW	6	1016.6	21.1	40	7	W	6	1012.5
23	Fr	11.6	25.0	0		10.9	WSW	17	11:33	18.7	35	1	SSW	7	1018.8	24.6	29	1	N	2	1016.1
24	Sa	12.2	25.1	0		10.7	NE	17	14:27	18.3	60	1	SSW	6	1022.5	23.8	49	1	ENE	7	1019.3
25	Su	13.7	26.6	0		10.5	NE	17	14:59	19.8	70	1	SSW	4	1022.6	25.1	47	1	ENE	7	1019.2
26	Mo	15.0	24.8	0		9.7	ESE	20	20:55	20.2	70	1	SSW	6	1023.7	24.1	48	2	E	9	1020.8
27	Tu	16.0	25.8	0		7.8	ESE	24	15:45	20.7	66	3	SW	6	1025.6	23.6	52	1	E	9	1021.7
28	We	15.7	24.6	0		5.5	E	22	17:54	21.2	63	1	SSW	7	1024.2	22.6	58	7	SE	7	1021.3
29	Th	15.7	25.1	0.6		8.5	E	28	14:56	19.6	69	6	SSW	4	1023.4	22.3	60	6	ESE	15	1020.8
30	Fr	17.1	24.2	0		1.7	ESE	33	13:31	21.5	70	7	SE	9	1025.0	19.8	85	8	ESE	7	1023.8
Statistics for April 2021																					
	Mean	16.4	26.3			7.4				21.2	65	3		6	1018.6	24.9	53	3		8	1015.4
	Lowest	11.6	22.0			0.0				16.7	35	0	#	2	1008.7	19.8	26	1	N	2	1004.6
	Highest	20.9	33.0	45.4		10.9	E	41		24.7	94	8	#	11	1025.6	32.7	91	8	ESE	17	1023.8
	Total			112.2		222.6															

Temperature, humidity, wind, pressure and rainfall observations are from Brisbane (station 040913). Cloud, evaporation and sunshine observations are from Brisbane Aero (station 040842)

Brisbane Airport is located about 12 kilometres north east of the Brisbane City site, and closer to the coast. The evaporation, sunshine and cloud values should be used as a guide only.

IDCJDW4019.202104 Prepared at 13:01 UTC on 5 Sep 2021

Users of this product are deemed to have read the information and accepted the conditions described in the notes at http://www.bom.gov.au/climate/dwo/IDCJDW0000.pdf

Appendix C Noise Modelling Details

C.1 Rail Noise Model Inputs

A three-dimensional computer model of the study area was created within SoundPLAN 8.2 software. The following inputs were utilised in building the model:

- **Topography** – refer to **Table 18** below

Table 18: Topographical inputs for the development of the computer model

File	Description	Date received
210908 Existing Terrain.dxf	Existing terrain used by Civil designers	8th Sept 2021
210908 Proposed ROL Boundaries.dxf	Proposed Reconfiguration of Lot Boundaries	
210908 Proposed Terrain.dxf	Proposed finished terrain levels designed by Civil designers	
Nearmap Aerial Photography	Used to determine and location of existing buildings nearby to the site.	Photography date: 26th August 2021

- **Calculation algorithms** – Rail noise emissions were calculated using the SoundPLAN implementation of the Nordic Rail Prediction Method (Kilde Rep.130) used for both passenger and freight rail noise.
- **Ground surface corrections** – 20% ground absorption factor accounting for predominately compacted soil and concrete / asphalt surface types between source and receiver.
- **Rail traffic parameters** – Rail traffic parameters used are reproduced in **Table 19** and
- **Table** 20.

Table 19: Acoustic simulation model rail inputs and assumptions

Modelling element	Input / Assumption
Ground Elevation Geometry	Refer to
SoundPLAN Assessment Methodology	Rail Noise Impact: Kilde report 67/130
Rail Alignment	From aerial photography (aggregated to one line equidistant between all lines.)
Existing Rail Traffic Flow Data	Supplied by Queensland Rail for the lines Email from Tony.Bennett@qr.com.au Fri 2021/05/14 6:03 AM
Proposed (2026) Rail Traffic Flow Data	Sourced from: https://crossriverrail.qld.gov.au/resources/rfpc4/136_Technical-reports.pdf **Table 9.2. Train volumes for the CRR Project** **Segment** / **Year 2026** (Freight Train Movements, Passenger Train Movements) / **Year 2036** (Freight Train Movements, Passenger Train Movements) Yeerongpilly - Park Road: 34, 488, 42, 577 *Up*: 244, 278 *Down*: 165, 195 *Dual Gauge*: 34, 79, 42, 104
Train Types and Parameters Used	See **Table 20**.

Table 20: Train types and parameters used in modelling

Train type	Number of trains (provided by QR)	Length per train, m	Speed (km/h)	Rail track height above the ground, m	ΔL_{eq}, dB	ΔL_{type} Engine, dB	ΔL_{type} Wagons, dB
Citytrain	255	150	60 est.	0.6	-9.2	-2.0	-2.0
Freight	16	540	30 est.	0.6	-8.0	-3.0	-3.0
Diesel Loco	16	37	30 est.	3.6	-8.0	1.0	1.0

ΔLeq: is the correction factor applied to the standard Kilde report $L_{Aeq,24hr}$ predicted noise level to correct for train length and expected noise levels adjusted / calibrated to unattended noise logging conducted by Stantec.

ΔLtype engine: is the correction factor applied to the standard Kilde report predicted L_{Amax} at 10 metres (engine = moving point source) adjusted / calibrated to unattended noise logging conducted by Stantec.

ΔLtype wagons: is the correction factor applied to the standard Kilde report predicted L_{Amax} at 10 metres (wagons = line source) adjusted / calibrated to unattended noise logging conducted by Stantec.

- **Sound reflections -** The number of reflections from barriers, buildings and the ground has been set to 3. Reflections from buildings to rail noise producing an increase in rail noise at the façade prediction point carry a +3 dB correction as required by Kilde Rep.130 for rail noise predictions.
- **Search radius** - The noise source search radius was setup at 5000m.

Appendix D QDC MP4.4 Schedule 2 - Recommended Construction

QDC MP4.4 Schedule 2 provides construction recommendations based on the required performance of façade elements. These are replicated in **Table 21** for reference.

Table 21: Construction recommendations (reproduced from QDC MP4.4)

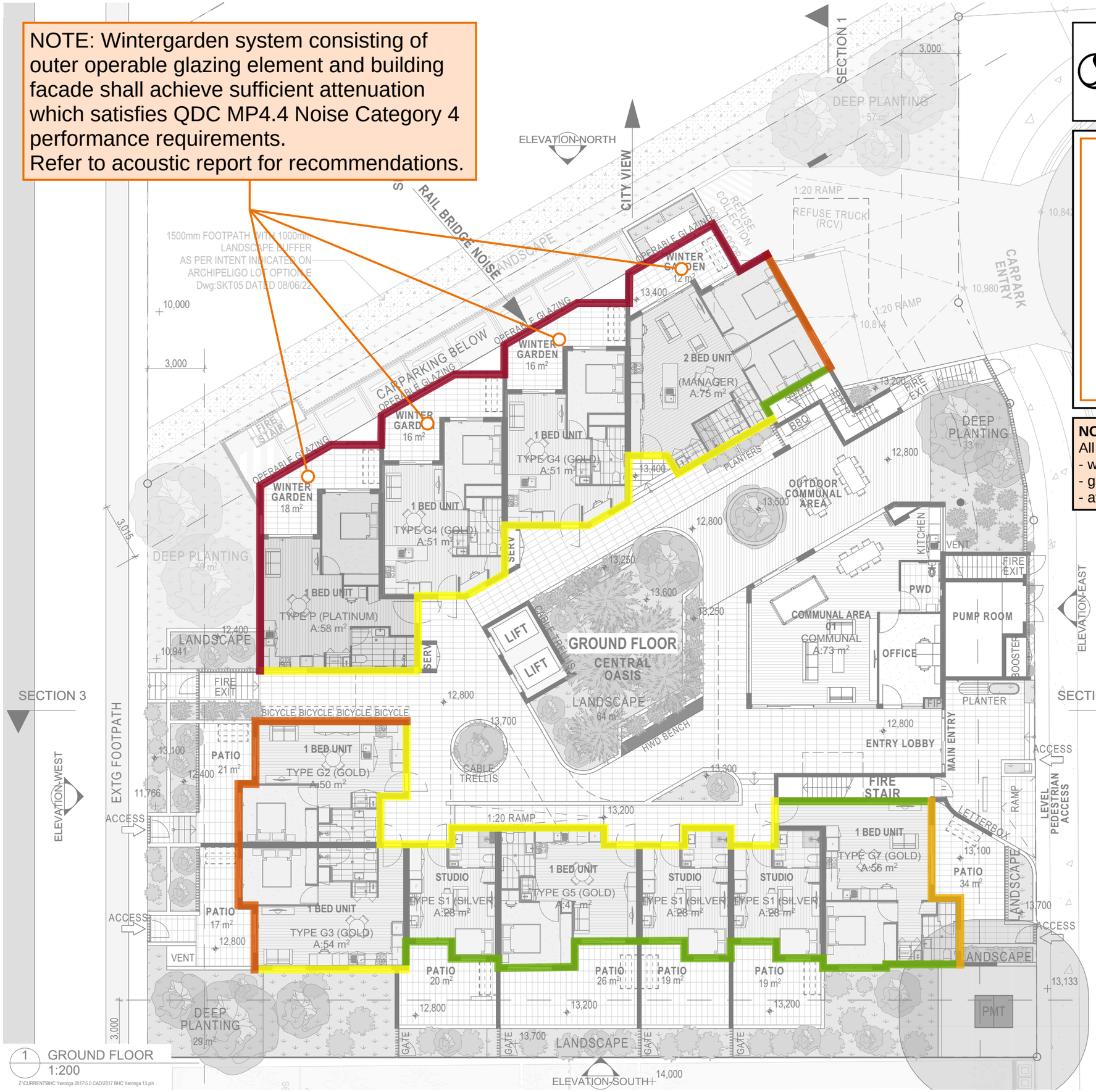
Component of building's external envelope	Minimum R_w	Component of building's external envelope
Glazing	43	Double glazing consisting of two panes of minimum 5 mm thick glass with at least 100 mm air gap and full perimeter acoustically rated seals.
	38	Minimum 14.38 mm thick laminated glass, with full perimeter *acoustically rated seals*; OR Double glazing consisting of one pane of minimum 5 mm thick glass and one pane of minimum 6 mm thick glass with at least 44 mm air gap, and full perimeter *acoustically rated seals*
	35	Minimum 10.38 mm thick laminated glass, with full perimeter *acoustically rated seals*.
	32	Minimum 6.38 mm thick laminated glass with full perimeter *acoustically rated seals*.
	27	Minimum 4 mm thick glass with full perimeter *acoustically rated seals*
	24	Minimum 4 mm thick glass with standard weather seals
External Walls	52	Two leaves of clay brick masonry, at least 270 mm in total, with subfloor vents fitted with noise attenuators.
	47	Two leaves of clay brick masonry at least 110 mm thick with: (i) cavity not less than 50 mm between leaves; and (ii) 50 mm thick mineral insulation or 50 mm thick glass wool insulation with a density of 11 kg/m^3 or 50 mm thick polyester insulation with a density of 20kg/m^3 in the cavity. OR Two leaves of clay brick masonry at last 110 mm thick with: (i) cavity not less than 50 mm between leaves; and (ii) at least 13 mm thick cement render on each face OR Single leaf of clay brick masonry at least 110 mm thick with: (i) a row of at least 70 mm x 35 mm timber studs or 64 mm steel studs at 600 mm centres, spaced at least 20 mm from the masonry wall; and (ii) Mineral insulation or glass wool insulation at least 50 mm thick with a density of at least 11 kg/m^3 positioned between studs; and (iii) One layer of plasterboard at least 13 mm thick fixed to outside face of studs. OR Single leaf of minimum 150 mm thick masonry of hollow, dense concrete blocks, with mortar joints laid to prevent moisture bridging.

Component of building's external envelope	Minimum R_w	Component of building's external envelope
	41	Two leaves of clay brick masonry at least 110 mm thick with cavity not less than 50 mm between leaves OR Single leaf of clay brick masonry at last 110 mm thick with: (i) a row of at least 70 mm x 35 mm timber studs or 64 mm steel studs at 600 mm centres, spaced at least 20 mm from the masonry wall; and (ii) mineral insulation or glass wool insulation at least 50 mm thick with a density of at least 11 kg/m^3 positioned between studs; and (iii) One layer of plasterboard at least 10 mm thick fixed to outside face of studs OR Single leaf of brick masonry at least 110 mm thick with at least 13 mm thick render on each face OR Concrete brickwork at least 110 mm thick OR In-situ concrete at least 100 mm thick OR Precast concrete at least 100 mm thick and without joints.
	35	Single leaf of clay brick masonry at least 110 mm thick with: (i) a row of at least 70 mm x 35 mm timber studs or 64 mm steel studs at 600 mm centres, spaced at least 20 mm from the masonry wall; and (ii) One layer of plasterboard at least 10 mm thick fixed to outside face of studs OR Minimum 6 mm thick fibre cement sheeting or weatherboards or plank cladding externally, minimum 90 mm deep timber stud or 92 mm metal stud, standard plasterboard at least 13 mm thick internally.
Roof	45	Concrete or terracotta tile or sheet metal roof with sarking, acoustically rated plasterboard ceiling at least 13 mm thick fixed to ceiling joists, cellulose fibre insulation at least 100 mm thick with a density of at least 45 kg/m^3 in the cavity. OR Concrete or terracotta tile or sheet metal roof with sarking, 2 layers of acoustically rated plasterboard at least 16 mm thick fixed to ceiling joists, glass wool insulation at least 50 mm thick with a density of at least 11 kg/m^3 or polyester insulation at least 50 mm thick with a density of at least 20 kg/m^3 in the cavity.
	41	Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10 mm thick fixed to ceiling joists, glass wool insulation at least 50 mm thick with a density of at least 11 kg/m^3 or polyester insulation at least 50 mm thick with a density of at least 20 kg/m^3 in the cavity. OR Concrete suspended slab at least 100 mm thick.
	38	Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10 mm thick fixed to ceiling cavity, mineral insulation or glass wool insulation at least 50 mm thick with a density of at least 11 kg/m^3.
	35	Concrete or terracotta tile or metal sheet roof with sarking, plasterboard ceiling at least 10 mm thick fixed to ceiling cavity.
Floors	51	Concrete slab at least 150 mm thick.
	45	Concrete slab at least 100 mm thick; OR Tongued and grooved boards at least 19 mm thick with: (i) timber joists not less than 175 mm x 50 mm; and (ii) mineral insulation or glass wool insulation at least 75 mm thick with a density of at least 11 kg/m^3 positioned between joists and laid on plasterboard at least 10 mm thick fixed to underside of joists; and (iii) mineral insulation or glass wool insulation at least 25 mm thick with a density of at least 11 kg/m^3 laid over entire floor, including tops of joists before flooring is laid; and (iv) secured to battens at least 75 mm x 50 mm; and (v) the assembled flooring laid over the joists, but not fixed to them, with battens lying between the joists.
Entry Doors	35	Solid core timber not less than 45 mm thick, fixed so as to overlap the frame or rebate of the frame by not less than 10 mm, with full perimeter acoustically rated seals.

Component of building's external envelope	Minimum R_w	Component of building's external envelope
	33	Fixed so as to overlap the frame or rebate of the frame by not less than 10 mm, fitted with full perimeter acoustically rated seals and constructed of - (i) solid core, wood, particleboard or blockboard not less than 45 mm thick; and/or (ii) acoustically laminated glass not less than 10.38 mm thick.
	28	Fixed so as to overlap the frame or rebate of the frame, constructed of - (i) Wood, particleboard or blockboard not less than 33 mm thick; or (ii) Compressed fibre reinforced sheeting not less than 9 mm thick; or (iii) Other suitable material with a mass per unit area not less than 24.4 kg/m^2; or (iv) Solid core timber door not less than 35 mm thick fitted with full perimeter *acoustically rated seals*.

Appendix E Predicted Façade Noise Levels (L_{Amax}) and QDC MP4.4 Noise Categories

NOTE: Wintergarden system consisting of outer operable glazing element and building facade shall achieve sufficient attenuation which satisfies QDC MP4.4 Noise Category 4 performance requirements.
Refer to acoustic report for recommendations.



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SKETCH TITLE *Prepared By: CE*

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QDC MP4.4 Facade Noise Categories

PROJECT No.	SKETCH No.	DATE	REV
301050151	AC-SK-001	12/01/2023	002

Queensland Development Code MP 4.4

Buildings in a Transport Noise Corridor

Single event maximum noise (Lmax) for railway land

Noise Category 0	-	≤69 dB(A)
Noise Category 1	-	70 - 74 dB(A)
Noise Category 2	-	75 - 79 dB(A)
Noise Category 3	-	80 - 84 dB(A)
Noise Category 4	-	≥85 dB(A)

NOTES
All balcony balustrade are to be constructed with:
- with solid material minimum surface mass of 10kg/m²;
- gap free (except for drainage purposes as required by BCA); and
- at least 1.10 m high

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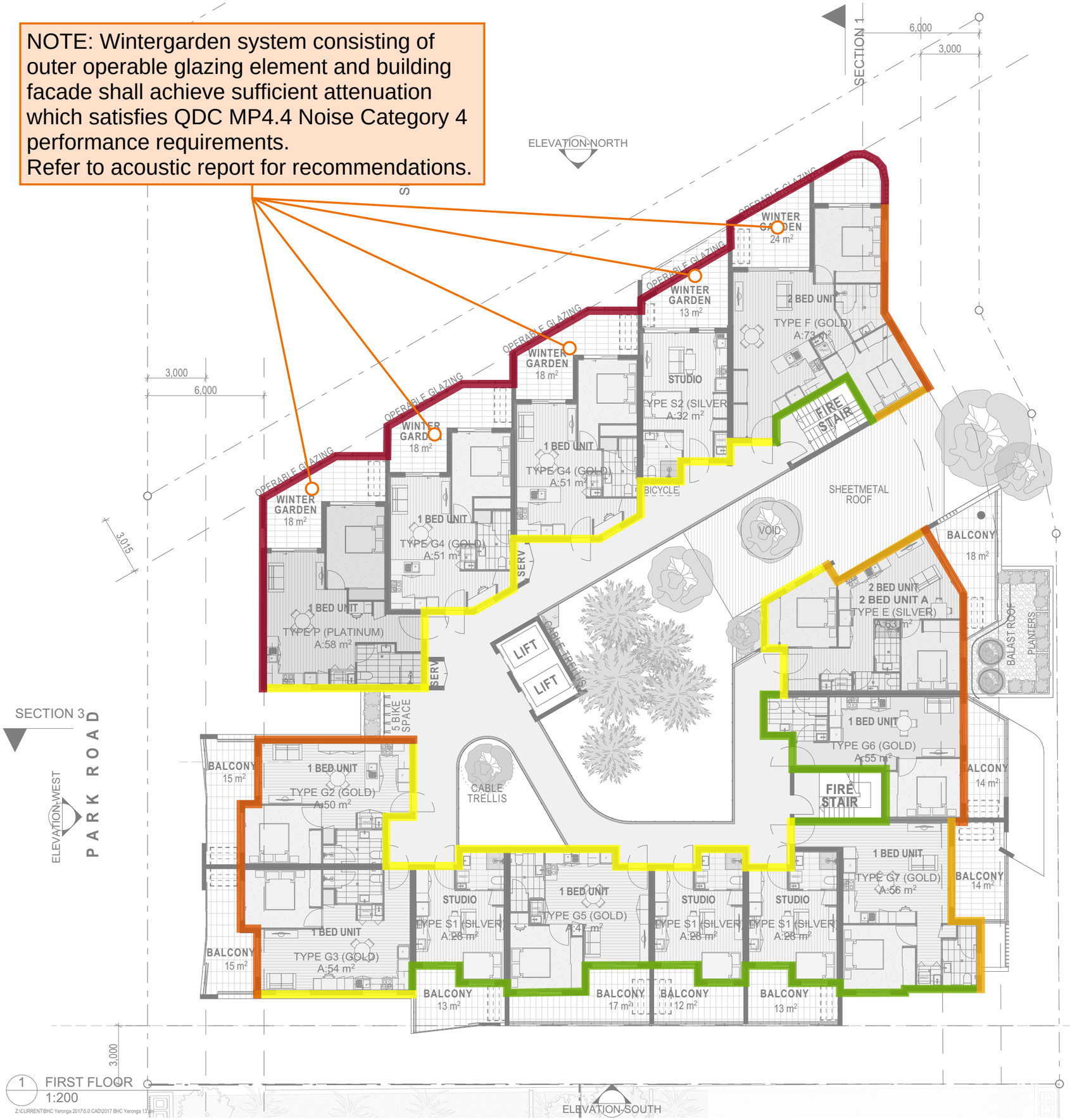
NOTE: Wintergarden system consisting of outer operable glazing element and building facade shall achieve sufficient attenuation which satisfies QDC MP4.4 Noise Category 4 performance requirements.
Refer to acoustic report for recommendations.



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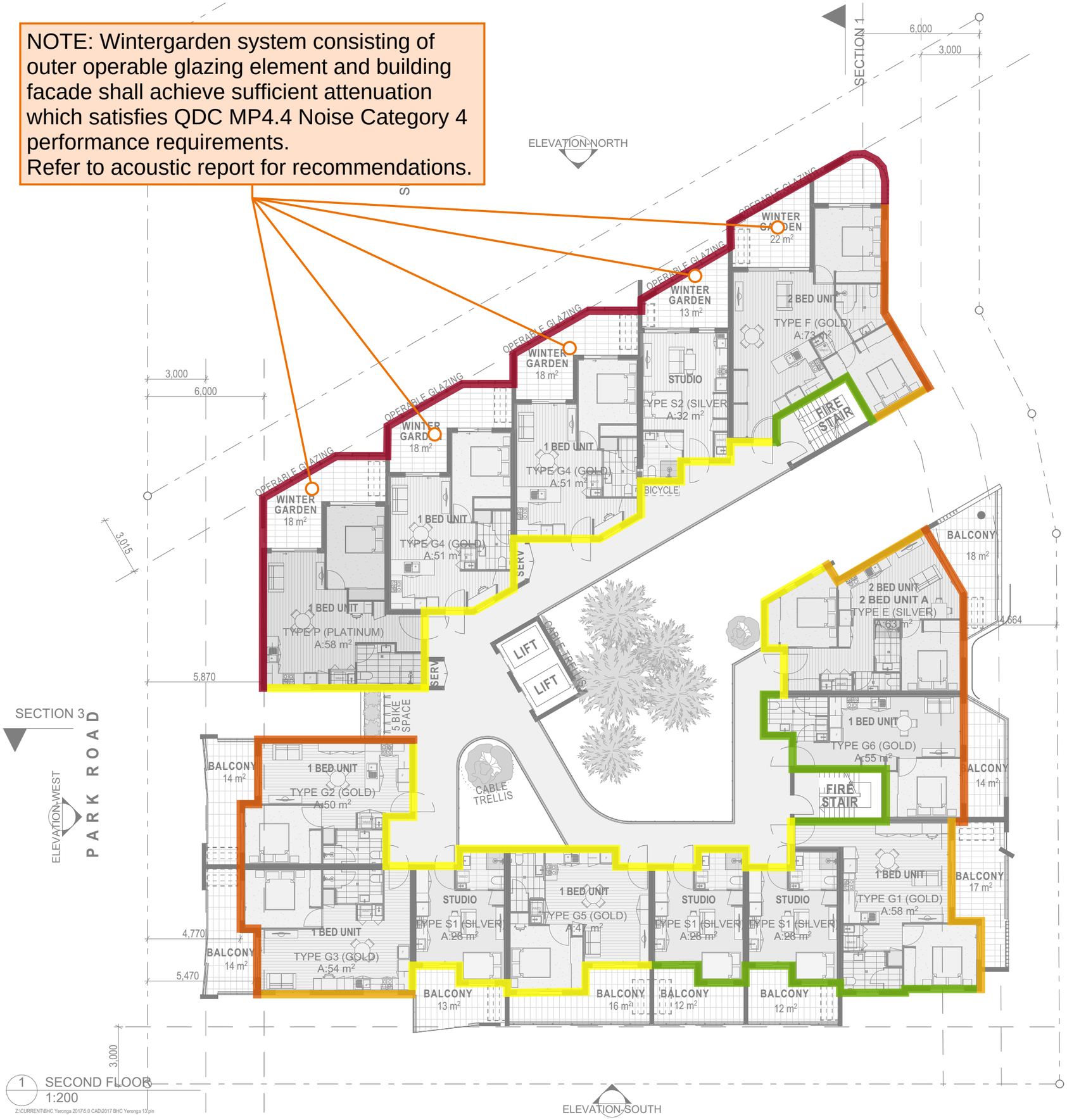

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1 FIFTH FLOOR
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