Caloundra West State Primary School

Acoustic Report

Master Planning / PDP Stage

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Revision Schedule

Revision No.	Date	Description	Prepared by	Quality Reviewer
001	10/06/2024	Master Planning Report - Draft	MK	MLL
002	29/08/2024	Master Planning Report – Final	MK	MLL
003	23/10/2024	Master Planning Report – Minor edit	MLL	MLL

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Contents

1. Introduction

Stantec Australia Pty Ltd have been engaged as a sub-consultant Hayball Architects (HA) to undertake a preliminary acoustic assessment for the concept master plan of the proposed Caloundra West State Primary School. The project site is located on part of Lot 8SP330410 and falls within the Caloundra South Priority Development Area.

The purpose of conducting the noise impact assessment is to demonstrate that the completed project can be developed such that all future planned activities and usage remains compliant with the acoustic requirements set by:

- Local council policies and relevant development schemes,
- State-based legislation and regulatory requirements including:
    - Queensland Government Environmental Protection Act 1994;
    - Queensland Government Environmental Protection (Noise) Policy 2019; and
- Relevant and current Australian Standards.

This acoustic report:

- Details the site setting in context with surrounding environment,
- Identifies acoustic items to be address during the design stages of the project,
- Outlines the results of noise measurements conducted at the project site,
- Establishes environmental noise limits applicable at the nearest external noise sensitive land uses, as well as noise limits from external sources impacting the proposed development,
- Provides details of acoustic assessments undertaken for the project and, subsequently, nominates noise mitigation measures deemed necessary to comply with the relevant noise targets (internal and external).

The objective of this report is to prove the feasibility of the proposed developments from an acoustic perspective. Since the development designs are likely to change as the project progresses, the acoustic impacts associated with the project are also subject to change; therefore, it is advised that only the noise limits defined within this report should be used as input for future design and that acoustic assessments are revised as the project progresses.

A glossary of acoustic terms used in this report has been provided in **Appendix A**.

The recommendations provided in this report are specific to the building design at the date of issue. The building design is subject to change during subsequent stages of the project. Where this occurs, the assumptions made which 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 specific product information and performances referred to in this report are nominated to meet acoustic requirements only. They do not necessarily consider the requirements of other disciplines 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 only and must not be applied to any other project without prior consultation with Stantec. Design and conditions can vary between projects which can significantly vary the acoustic performance requirements and relevant subsequent advice.

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

2. Referenced Documentation

2.1 Applicable Regulations, Policies and Standards

The following acoustic design related documentation pertinent to the project and referenced in this document are outlined in **Table 1**.

Table 1: Applicable acoustic design related documentation referenced in this report

Title	Abbreviation
REGULATIONS AND LOCAL COUNCIL POLICIES	
Queensland Environmental Protection Act 1994	EPA 1994
Queensland Environmental Protection (Noise) Policy 2019	EPP 2019
Caloundra South Urban Development Area - Development Scheme	CS UDA
State Development Assessment Provisions (v 3.0)	SDAP
AUSTRALIAN AND INTERNATIONAL STANDARDS	
Australian / New Zealand Standard AS/NZS 2107:2016 – *Acoustics – Recommended design sound levels and reverberation times for building interiors*	AS 2107
Australian Standard AS 1055:2018– *Acoustics – Description and measurement of environmental noise*	AS 1055
DESIGN STANDARDS AND GUIDELINES	
Design Standards – *Part C: Education facilities technical specifications Version 4.1 (2024)*	DoE Part C

2.2 Study Inputs

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

Table 2: Received documentation

Date Received	Detail	Revision / Date Prepared	Prepared by	Format
26/08/2024	Architectural drawings: • *2453.01-A00.30-MASTER PLAN- GROUND_(7).pdf* • *2453.01-A00.31-MASTER PLAN- LEVEL 1_(4).pdf* • *2453.01-A00.32-MASTER PLAN- ROOF_(2).pdf* • *2453.01-A01.00-MASTER PLAN- MODE OF TRANSPORT_(1).pdf* • *2453.01-A01.01-MASTER PLAN- ACTIVE TRANSPORT HIERARCHY_(1).pdf* • *2453.01-A06.01-ELEVATIONS.pdf* • *2453.01-A06.10-SECTIONS.pdf*	19/08/2024	HA	pdf
17/04/2023	ASK Acoustic Report - Caloundra West State School – Transport Noise Assessment • *197401.0291.R02V01*	28/11/2019	ASK	pdf
22/05/2024	Proposed finished Ground heights for the site and land extending to the Bruce Highway including the acoustic mounding	22/05/2024	EGIS	12D

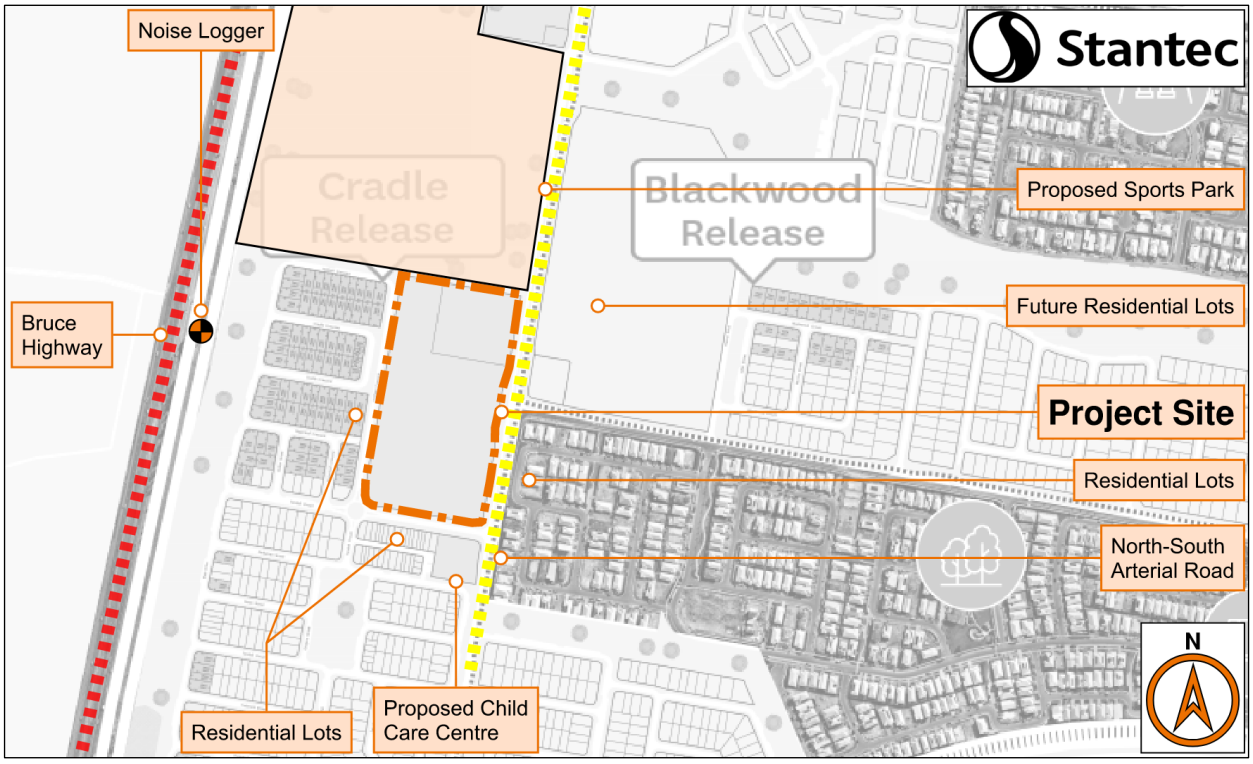
3. Project Description

3.1 Site Description

3.1.1 Project Location

The project site is located on part of Lot 8SP330410 and falls within the Caloundra South Priority Development Area. The project site, noise logging location and surrounding developments for the project are detailed in **Figure 1**.

Figure 1: Project site and surrounding developments



Source: Stockland Aura Masterplan Map (accessed 28/05/2024 Online) | Annotations by Stantec

3.1.2 Surrounding Land Uses / Zoning

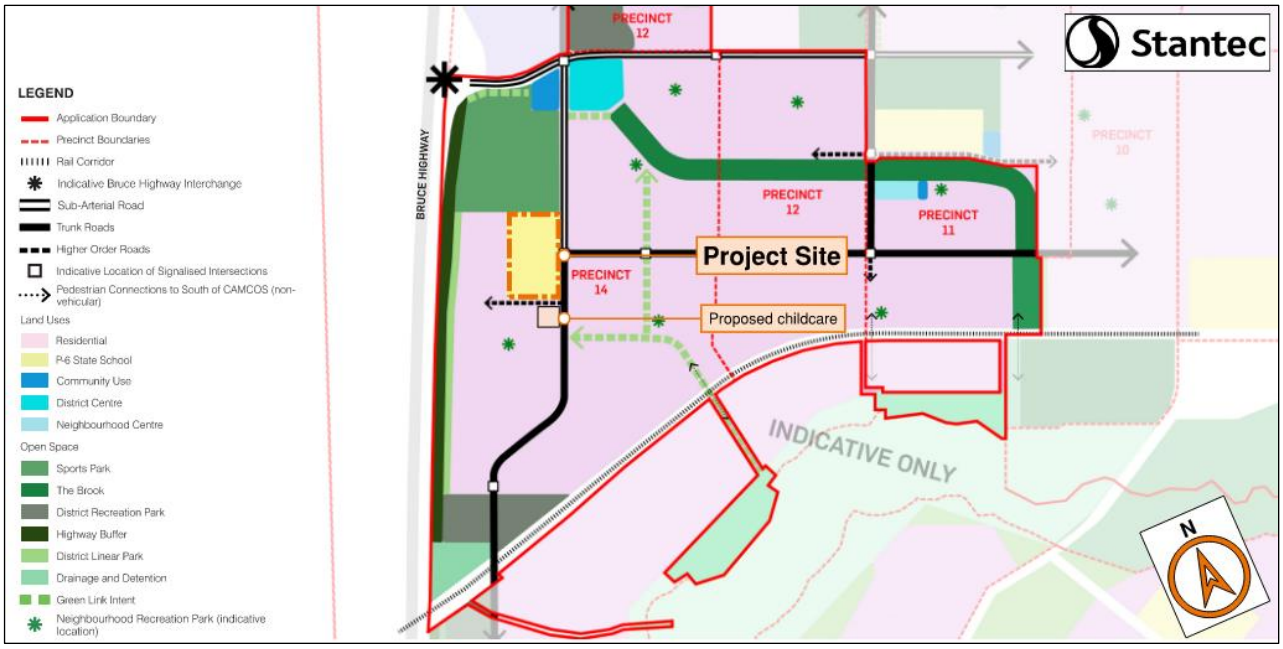
The Caloundra South PDA (online) was accessed and reviewed on the 28th May 2024 to determine existing and proposed land uses surrounding the site (see **Figure 2**). The following was identified:

- The project site:
  - has been designated for a P-6 state school; and is
  - situated within the Caloundra South Priority Development Area (PDA).
- Lots surrounding the proposed site generally consist of;
  - future residential lots to the east, south and west,
  - A childcare centre proposed south of the site; and
  - A planned sports park north of the site.
- The nearest external noise sensitive receivers to the development are;
  - Planned residential lots to the east, south and west of the site; and

- A childcare centre expected to be located south of the school.

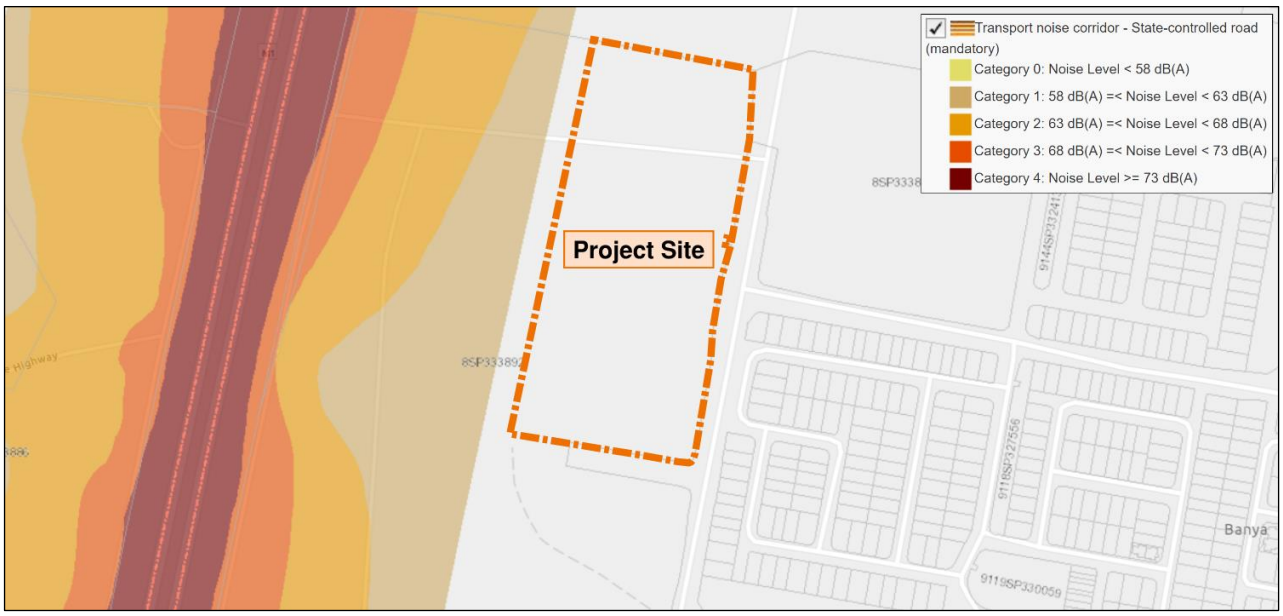
- The proposed development is located outside of the road transport noise corridor contours associated with the Bruce Highway (see **Figure 3**) but is still expected to be impacted by Category 1 noise levels (58 - <63 dB(A)).
- The proposed development is not located within;
  - Rail Transport Noise Corridor Contours; or
  - Aircraft Noise Exposure Forecast (ANEF) contours.

Figure 2: Land use / zoning surrounding the project site



Source: Aura Precinct 11-14 Context Plan (online)

Figure 3: Transport noise corridor overlay



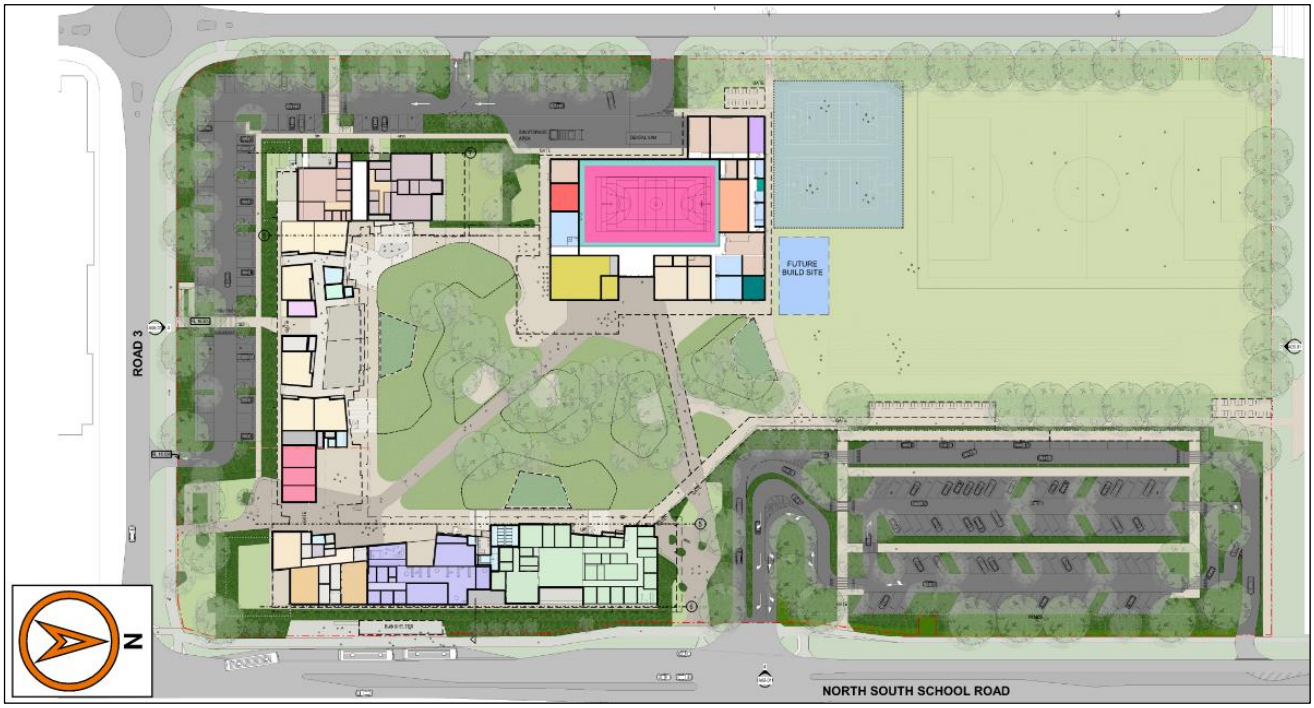
Source: Queensland Government State Planning Policy Interactive Mapping System (online – Transport Infrastructure overlay, accessed 07/06/2024)

3.2 Proposed Concept Masterplan

The proposed masterplan indicates the following for the school (see also **Figure 4**):

Use	Building
Indoor Education / Admin	• Administration / staff building • Resource centre and technology hub • Health hub • Prep learning spaces • Operations hub
Outdoor Education / Play	• Outdoor play areas • Multipurpose outdoor courts and sports field.
Carparking / Loading Docks	• Carpark with drop off zone facility near the northeast boundary. • Carparking adjacent to the south and west boundaries.

Figure 4: Proposed masterplan (staging plan)



Source: Excerpt from 2453.01-A00.30-MASTER PLAN- GROUND_(7) (HB – 19/08/2024)

3.3 Existing Acoustic Environment

3.3.1 Noise Logging (Unattended Noise Measurements)

To quantify the existing noise from the Bruce Highway, an unattended noise monitor was placed at the location shown in **Figure 1** from Tuesday 4th June 2024 to Monday 10th June 2024 (inclusive).

Due to equipment malfunction, the logger recorded data from 4th June 2:45pm to 5th June 2024 7:15pm only. To verify the road traffic model the shortened measurement procedure provided in Section 3, paragraphs 43 – 44 of the UK Department of Transport Welsh Office *Calculation of Road Traffic Noise* 1988 (CoRTN). This method uses the following to calculate the $L_{10(18hr)}$:

$$L_{10(18hr)} = L_{10(3hr)} - 1\ dB(A)$$

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

- A-weighting frequency response;
- FAST time response; and
- 15-minute 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.

A summary of relevant of the average unattended noise levels recorded at the measurement location are presented in **Table 3**. For further details and full measured results, refer to **Appendix B**.

Table 3: Summary of relevant noise descriptors used to determine noise limits and inform acoustic assessment

Monitoring Location	$L_{10(3hr)}$ dB(A) (measured)	$L_{10(18hr)}$ dB(A) (calculated)	$L_{10(12hr)}$ dB(A) (measured)
Refer **Figure 1**	78	77	78

NOTES:

D = Day – 7 AM-6 PM | E = Evening – 6 PM-10 PM | N = Night – 10 PM-7 AM

The data from the Bruce Highway monitoring location is not considered applicable for the background noise at the site given the loggers proximity in relation to the Highway increasing measured levels.

Under normal circumstances noise logging would also be conducted onsite to quantify the existing background noise and specify noise limits for environmental noise emissions. Given that construction and earthworks are occurring around the site this is not currently feasible. Therefore, for the master planning phase background noise levels were assumed based AS1055 noise area categories. Noise area category R3 (Refer to **Table 4)** was deemed suitable as the site acoustic environment will be affected by the adjacent sub-arterial road (North South School Road) as well as the Bruce Highway.

Table 4: AS1055 – 1997 - Estimated average background A-weighted sound pressure levels ($L_{A90,T}$) for different areas containing residences in Australia

Noise area category (Notes 1 and 2)	Description of neighbourhood	Average background A-weighted sound pressure level, $L_{A90,T}$					
		Monday to Saturday			Sundays and public holidays		
		0700–1800	1800–2200	2200–0700	0900–1800	1800–2200	2200–0900
R1	Areas with negligible transportation	40	35	30	40	35	30
R2	Areas with low density transportation	45	40	35	45	40	35
R3	Areas with medium density transportation or some commerce or industry	50	45	40	50	45	40
R4	Areas with dense transportation or some commerce or industry	55	50	45	55	50	45

By applying the R3 background noise limits the noise descriptors relevant to the assessment are provided in **Table 5**.

Table 5: Summary of background noise descriptors used to determine noise limits and inform acoustic assessment

Assumed Background Noise Level, $L_{90,T}$ dB(A)		
Day [1)]	**Evening** [1)]	**Night** [1)]
50 [2)]	45 [2)]	40 [2)]

NOTES:

1) Day – 7am-6pm | Evening – 6pm-10pm | Night – 10pm-7am

2) Background noise levels obtained from AS 1055 – 1997 noise category R3

3.4 Acoustic Design Issues and Considerations

The following items are to be considered for acoustic design of proposed development:

- While the project site is not currently within any transport noise corridors, it will be exposed to road traffic noise from the Bruce Highway and the future north-south arterial road east of the site.
- Environmental noise emissions from the subject site and noise intrusion to the project shall comply with relevant environmental noise limits and guidelines (EPA 1994, EPP 2019, DoE Part C).

4. Acoustic Criteria

4.1 Environmental Noise Emissions

4.1.1 Caloundra South Urban Development Area – Development Scheme

The Caloundra South Urban Development Area – Development Scheme (CS UDA) prepared by the Economic Development Queensland (EDQ) provides the following as guidance for assessment of noise.

3.3.1 Neighbourhoods:

- do not prejudice future core industry and enterprise precincts adjoining the northern boundary outside the UDA[3].

[3] The context planning process will resolve any development constraints and manage the interface between industrial land and sensitive land uses, consistent with State Planning Policy 5/10: Air, Noise and Hazardous Materials.

The State Planning Policy 5/10: Air, Noise and Hazardous Materials makes multiple references to the Environmental Protection (Noise) Policy 2008 for the assessment of noise and is deemed the correct regulation to apply for environmental noise within the CS UDA.

3.3.8 Natural Values

- manages air quality, noise and hazardous materials according to current standards.

3.3.9 Community safety and development constraints:

Development ensures that people and property are safe from potential hazards and disturbances including landslip, bushfire, noise, flooding and the predicted effects of climate change.

Future residents are to be provided with a level of amenity that addresses noise sources. Sensitive uses to nearby noise sources such as the Caloundra Aerodrome and the Bruce Highway are to be protected. The preferred means to control noise impacts will be determined at the development application stage.

Development adjoining the Bruce Highway

A buffer is to be provided between the limit of development, the Bruce Highway corridor and the southwest boundary of the site fulfilling the following:

- provision of a predominantly landscaped treatment that achieves a natural and rural edge as viewed from the Bruce
- Highway
- provision of visual separation between development and the highway. Acoustic walls are not visually prominent and do not result in a continuous, monotonous stretch of acoustic wall along the length of the site's frontage to the Bruce Highway
- inclusion of a variety of techniques at different locations including separation distances, mounding, landscaping, noise attenuation measures and recreational opportunities
- compliance with the applicable noise standards and requirements including:
    - Department of Transport and Main Road Traffic Noise Management: Code of Practice with respect to external road traffic noise levels
    - Queensland Development Code and Section MP 4.4 'Buildings in a Transport Noise Corridor'
- The visual buffer is designed to achieve the principles and standards set out in the applicable ULDA guideline.

Development located near the Caloundra Aerodrome

Development located near the Caloundra Aerodrome must not prejudice the ongoing operations of the Aerodrome. Nearby noise sensitive development that has the potential to receive intrusive noise is required to address the following:

- Justify that the proposed land use is suitable on amenity grounds based on the extent of aircraft noise at the subject site and information about future noise projections from the aerodrome operator comprising both fixed wing aircraft and helicopter movements. This will include information about:
    - Areas forecast to be exposed to above 20 noise events a day exceeding 70dB(A)
    - The Transparent Noise Information Package (TNIP) N70 contour forecast for the year 2030
- Inclusion of a variety of appropriate noise attenuation measures
- Provision of suitable levels of indoor residential amenity (by appropriate building siting and construction) to comply with the indoor design sound levels from the applicable Australian Standard

Relationship with Sunshine Coast Planning Scheme 2014

The CS PDA does not reference the Sunshine Coast Planning Scheme 2014 for acoustic criteria. Therefore, based on guidance from State Planning Policy 5/10, assessment of environmental noise shall be in accordance with EPA 1994, EPP 2019 and the DoE Standard.

4.1.2 Department of Education – Part C: Technical Specifications and Standards

With regards to environmental noise emissions from the project, the *Department of Education – Part C: Technical Specifications and Standards* (DoE Standard) states the following:

- Noise from emanating from buildings and plant and equipment must be attenuated to ensure that the noise impact on neighbouring properties comply with the Environmental Protection (Noise) Policy 2019 (refer to **Section 4.1.4**) and the requirements of the relevant authority (refer to **Section 4.1.1**). Where attenuation relies upon windows being kept closed sufficient mechanical ventilation must be provided to the affected spaces.
- Noise emission levels must be sufficiently low to allow for extended out of school hour use of buildings by community groups.
- Plant that operates at night such as extraction fans must have sufficient noise attenuation to ensure that night-time noise limits are not exceeded.
- Noise from mechanical services must not exceed the following levels in the school grounds:
    - $L_{Aeq,30mins}$ 55 dB - in playing fields or other outdoor areas
    - $L_{Aeq,30mins}$ 50 dB - in outdoor teaching areas.
- Rooms to be used for music performance or rehearsal must be provided with sufficient ventilation to allow windows to be kept closed for extended periods.

4.1.3 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; 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.

Section 440W Indoor venues

(1) An occupier of a building must not use, or permit the use of, the building as an indoor venue on any day—

(a) before 7a.m, if the use makes an audible noise; or

(b) from 7a.m. to 10p.m, if the use makes a noise of more than 5dB(A) above the background level; or

(c) from 10p.m. to midnight, if the use makes a noise of more than 3dB(A) above the background level.

(2) However, subsection (1) (b) does not apply if—

(a) the building is, or is part of, an educational institution; and

(b) the use of the building as an indoor venue is organised by or for the educational institution for non-commercial purposes of the institution.

Table 6: Mechanical Plant Criteria

Receptor	Background Descriptor (time period)	Intrusive Descriptor	Assumed L_{90} dB(A)			Noise Limit $L_{Aeq,adj\ 1hr}$ dB(A)		
			Daytime	Evening	Night	Daytime	Evening	Night
Sensitive Receiver	L_{A90}	$L_{Aeq,adj\ 1hr}$	50	45	40	55	50	43

Table 7: Indoor Venue Criteria

Receptor	Background Descriptor (time period)	Intrusive Descriptor	Assumed L_{90} dB(A)			Noise Limit $L_{Aeq,adj\ 1hr}$ dB(A)			
			Daytime	Evening	Night	Daytime	Evening	Night (10pm – 12pm)	Night (10pm – 7am)
Sensitive Receiver	L_{A90}	$L_{Aeq,adj\ 1hr}$	50	45	40	55	50	43	30

4.1.4 Queensland Environmental Protection (Noise) Policy 2019

The 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.

Acoustic Quality Objectives

The acoustic quality objectives are stated in Schedule 1 of EPP 2019. The acoustic quality objectives are stated for a defined type of noise sensitive and specified time of day (reproduced in **Table 8**). 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 8: Acoustic quality objectives as defined in Schedule 1 of EPP 2019

Sensitive Receptor	Time of Day	Acoustic Quality Objectives [1] (measured at the receptor) dB(A)			Environmental Value
		$L_{Aeq, adj,1hr}$	$L_{A10, adj,1hr}$	$L_{A1, adj,1hr}$	
Dwelling (for outdoors)	Day and evening	50	55	65	Health and wellbeing
Dwelling (for indoors)	Day and evening	35	40	45	Health and wellbeing
	Night-time	30	35	40	Health and wellbeing in relation to the ability to sleep

NOTES:

1) *The $L_{Aeq,Adj,T}$ 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).*

2) *Day – 7 AM-6 PM | Evening – 6 PM-10 PM | Night – 10 PM-7 AM*

Controlling Background Creep

The Acoustic Quality Objectives provided in EPP 2019 do not consider the existing background noise levels when prescribing the criteria. Since the background noise levels are predicted to be high enough to exceed the indoor Acoustic Quality Objectives criteria (i.e., 35 dB(A) day/evening, 30 dB(A) night) after applying a 5 dB(A) façade reduction), Stantec refer to the background creep criteria specified in Schedule 10 of EPP 2008. The Environmental Protection (Noise) Policy 2008 states the following;

(1) To the extent that it is reasonable to do so, noise from an activity must not be—

(a) for noise that is continuous noise measured by $L_{A90,T}$— more than nil dB(A) greater than the existing acoustic environment measured by $L_{A90,T}$; or

(b) for noise that varies over time measured by $L_{Aeq,adj,T}$— more than 5dB(A) greater than the existing acoustic environment measured by $L_{A90,T}$.

Table 9: Intrusive noise limits (for controlling background creep)

Receptor	Background Descriptor (time period)	Intrusive Descriptor	Assumed L_{90} dB(A)			$L_{Aeq,adj\ 1hr}$ dB(A)		
			Daytime	Evening	Night	Daytime	Evening	Night
Sensitive Receiver	L_{A90}	$L_{Aeq,adj\ 1hr}$	50	45	40	55	50	45

4.2 External Noise Intrusion

4.2.1 State Code 1: Development in a state-controlled road environment

While the development is not located within state controlled road noise contours, application of the following criteria from State Development Assessment Provisions v3.0 – *State code 1: Development in a state-controlled road environment* (SDAP SC1) outlined in **Table 10**, **Table 11** and **Table 12** has been applied for assessment of road traffic noise intrusion.

Table 10: Maximum building façade acoustic levels (Table 1, SDAP SC1)

Performance outcomes	Acceptable outcomes
1.2: Childcare centre or educational establishment	≤58 dB(A) L10 (1 hour) façade corrected (maximum hour during normal opening hours)

Table 11: Maximum free field acoustic levels (Table 2, SDAP SC1)

Performance outcomes	Acceptable outcomes
2.3: Outdoor education areas and outdoor play areas in a childcare centre or educational establishment	≤63 dB(A) L10 (12 hour) free field (between 6am and 6pm)

Table 12: Maximum internal acoustic levels (Table 3, SDAP SC1)

Performance outcomes	Acceptable outcomes
3.2: Indoor education areas and indoor play areas in a childcare centre or education establishment	≤35 dB(A) Leq (1 hour) (maximum hour over 24 hours)

4.2.2 Development Affected by Environmental Emissions from Transport Policy Version 4 (October 2017)

The acoustic criteria applicable in this Code are identical to those in Section **4.2.1**.

4.2.3 Department of Education – Part C: Technical Specifications and Standards

Acoustic design of any Queensland state-school building project requires compliance with the performance targets described in the DoE Standard. The following section outlines the main internal acoustic performance requirements as nominated by the DoE Standard.

4.2.4 Internal Noise Levels

Section 5.1 of the DoE Standard defines internal noise level targets which aim to optimise the acoustic amenity, enhance learning capabilities, and limit disruption in various occupied spaces. Internal noise targets are defined for the following sources:

- Building services;
- Rain noise; and
- External noise intrusion (i.e., road traffic) via the building façade.

The internal noise targets for spaces applicable to this project are reproduced in **Table 13**.

Table 13: Internal noise limits based on the defined noise sources (Table 2 – DoE Standard)

Space type	Building Services L_{eq} dB(A) [1)]	Rain Noise L_{eq} dB(A) [2)]	Noise Intrusion $L_{10,30mins}$ dB(A) [3)]
Enclosed learning spaces: seminar rooms, tutorial rooms, language laboratories, small group rooms	35	40	35
Meeting rooms: interview and counselling rooms, video conference rooms	40	45	40
Open collaborative learning spaces: resource and breakout areas	40	45	40
Performance and rehearsal spaces: Drama studios, assembly halls, multi-purpose halls - drama, physical education, dance, audio/visual presentations, assembly, occasional music. Music and dance activity spaces Small and large practice rooms Performance and recital rooms Fitness and exercise spaces	35	40	35

Space type	Building Services L_{eq} dB(A) [1)]	Rain Noise L_{eq} dB(A) [2)]	Noise Intrusion $L_{10,30mins}$ dB(A) [3)]
Designated quiet work areas: study areas, individual teacher preparation areas, yoga, prayer and meditation spaces	40	45	40
Laboratories and workshops: Materials and technology workshops - electronics, systems, textiles, food Art and graphic design studios Project spaces Science laboratories Fume cupboards @ 1m from sash	40 55	45	40
Circulation spaces: Atria, spaces used for circulation and socialising (but not teaching and learning), corridors, stairwells, coat and locker areas	45	50	45
Sports halls (for sport use only)	50	55	50
Hydrotherapy swimming pools	50	55	50
Dining rooms	45	50	45
Kitchens and laundries	60	65	50
Offices, medical rooms and staff rooms	40	45	40
Change rooms	50	55	50
Toilets	50	55	50

NOTES:

1) *L_{Aeq} is the A-weighted equivalent continuous sound pressure level.*
2) *Rainfall noise is to be assessed at a moderately heavy rain event (up to 15mm/h rate).*
3) *L_{A10} is the A-weighted noise level exceeded for 10% of the measurement period and is representative of the 'average maximum' noise level and applies for the whole of normal teaching hours.*

As specific room layouts are not available at this stage, recommendations are based on the most stringent internal noise criterion of 35 dB(A) for all locations as this complies with both SDAP and DoE requirements.

5. Acoustic Assessment

5.1 Environmental Noise Emissions

5.1.1 Carparking

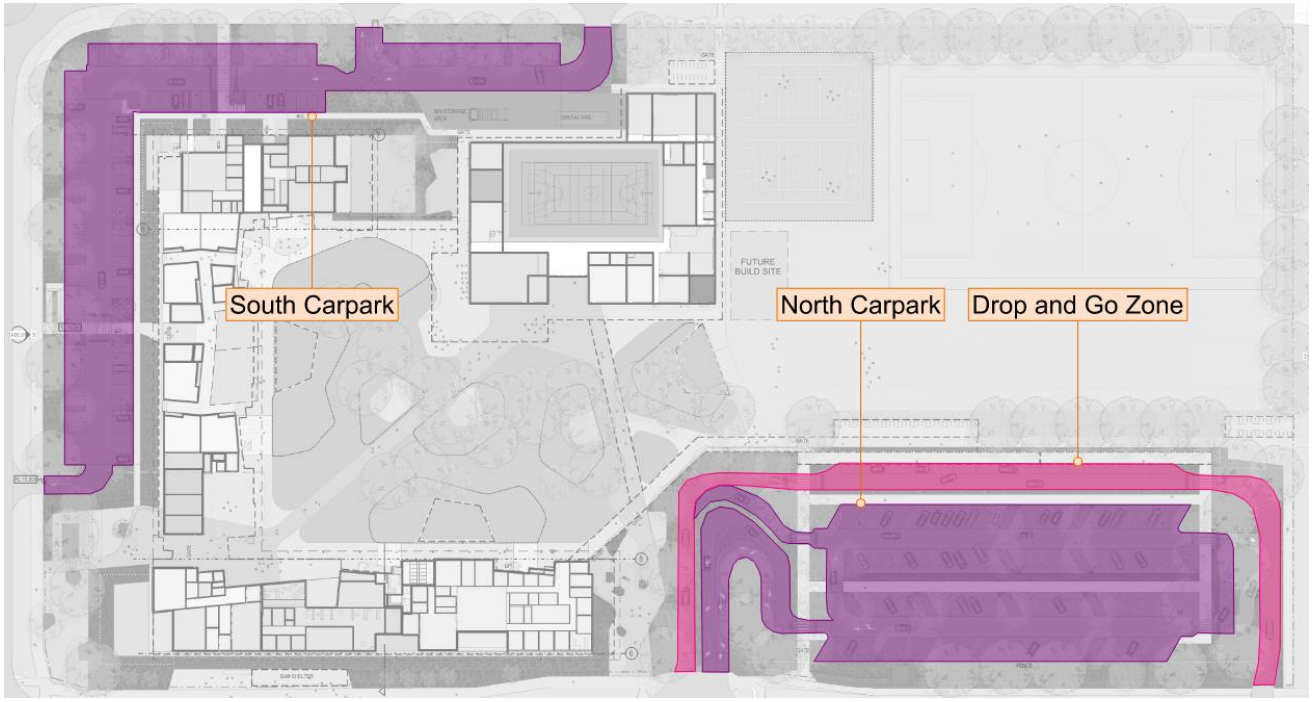
Noise emissions from carparks have the potential to influence the general acoustic amenity of surrounding noise sensitive uses and are required to comply with all relevant environmental noise limits outlined in **Section 4.1** of this report.

The complexity of associated noise events can be difficult to accurately simulate as individual noise sources (i.e., vehicle parking bay turnover rates, location of noise event such as motion (acceleration, deceleration), idling, ignition, door slams etc.). Therefore, acoustic assessment has been based on the technical research paper *"Prediction of parking area noise in Australian conditions"* from the Australian Acoustical Society Conference (Nicol and Johnson, 2011) and parking lot study *"Recommendations for the Calculation of Sound Emissions of Parking Areas, Motorcar Centers and Bus Stations as well as of Multi-Storey Car Parks and Underground Car Parks"* (Bavarian Landesamt für Umwelt, 2007, 6th edn, BayLfU).

5.1.1.1 Noise Source Locations

The site was developed in the acoustic model based on the architectural drawing (refer to **Table 2**). The carparks were split into 3 areas as shown in **Figure 5** below.

Figure 5: Onsite Carparking and Drop-off Zone



Source: Excerpt from 2453.01-A00.30-MASTER PLAN- GROUND_(7) (HB – 19/08/2024) | Annotations by Stantec

5.1.1.2 Assessment Inputs and Assumptions

Carpark quantities were estimated based on the total parking spot area shown divided by a typical 2.7m wide and 5m long carpark. The drop and go zone was modelled as a line source with up to 200 vehicles in each hour period. Minimal car movements are expected outside of typical school hours, so assessment considers the day period only (7am – 6pm).

The following inputs outlined in **Table 14** were applied to the acoustic simulation model.

Table 14: Parking noise assessment noise model inputs

Designation	Parameter	Model Input
Carparks	Number of spaces: North Carpark South Carpark	 105 102
	Parking bay turnover rate	Day – 1 /hr Evening – N/A Night – N/A
	Parking lot type	Visitors and Staff (+4 dB)
	Parking lot area source noise level (dependent on lot size)	L_w 85 - 95 dB(A)
	Vehicle spectrum	Typical Car
	Asphalt driving lanes surface correction	+ 0 dB
Drop and go zone	Peak estimated vehicles/hour	200
	Car pass by source noise level	Ref: L_w 85
	Average car speed	10km/hr

5.1.1.3 Predicted Noise Levels

A noise emissions assessment was conducted based on the inputs outlined above. **Table 15** provides the predicted noise levels at the worst affected receivers assessed against the applied noise limits.

Table 15: Carpark predicted noise impacts

Receptor	Noise source	External noise impact $L_{eq,1hr}$ dB(A)	External noise impacts combined $L_{eq,1hr}$ dB(A)	Complies with EPP 2019 Day Background Creep criteria 55 dB(A)?
East Residential	North Carpark	46	47	Yes
	South Carpark	21		
	Drop and Go Zone	42		
South Residential	North Carpark	24	47	Yes
	South Carpark	47		
	Drop and Go Zone	19		
West Residential	North Carpark	25	48	Yes
	South Carpark	48		
	Drop and Go Zone	20		
Child Care Centre (South)	North Carpark	30	44	Yes
	South Carpark	43		
	Drop and Go Zone	32		

Notes:

1) Includes -5dB adjustment outside to inside for noise travelling through an open window.

5.1.1.4 Discussion and Recommendations

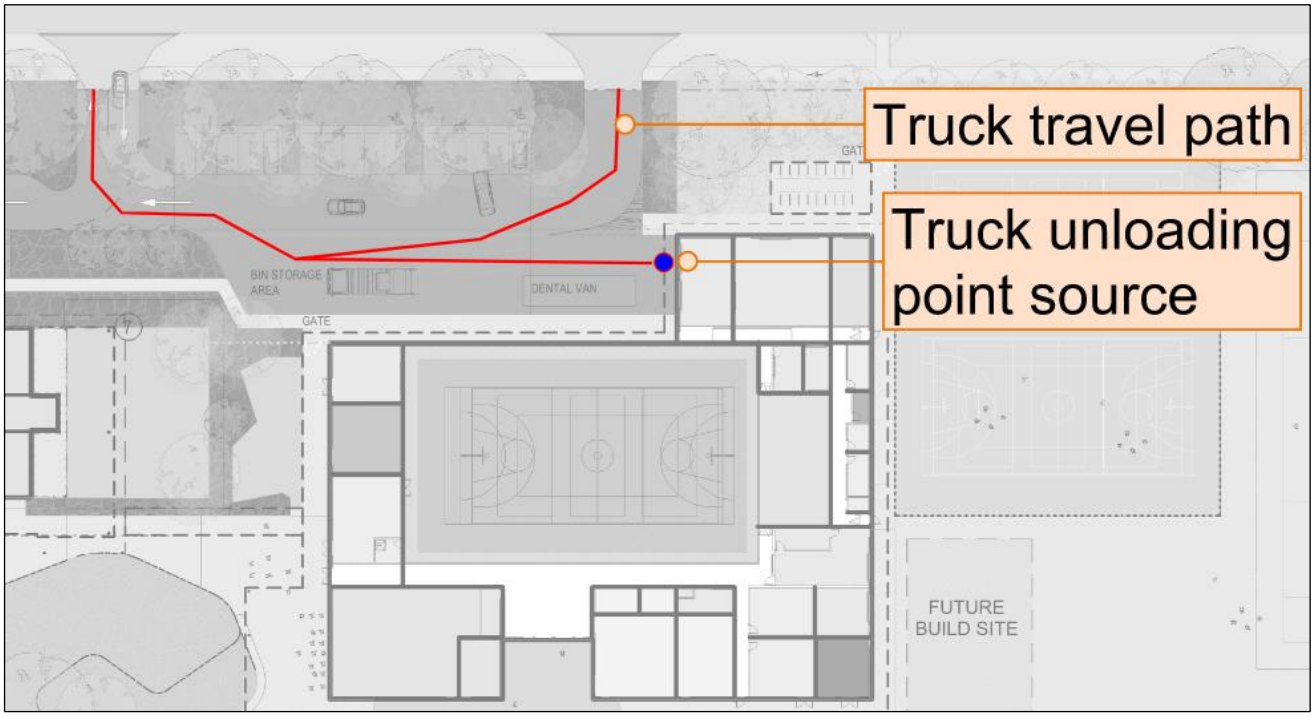
Based on the assumed project noise limits the proposed carparking is predicted to comply without additional acoustic treatment.

5.1.2 Loading Dock

5.1.2.1 Noise Source Locations

The new loading dock noise sources have been modelled as shown on **Figure 6**.

Figure 6: Locations of proposed loading docks



Source: Excerpt from 2453.01-A00.30-MASTER PLAN- GROUND_(7) (HB – 19/08/2024) | Annotations by Stantec

5.1.2.2 Assessment Inputs and Assumptions

Noise emissions from heavy vehicle types and loading dock-related activities can contribute to the acoustic environment of surrounding areas and are typically formed by a combination of successive, often transient, noise events. Events include engine noise (ignition, idle, acceleration, deceleration), reversing alarms (beepers), brake squeals, compression / venting brake release.

The following assumptions have been made in relation to operation of the loading dock:

- Deliveries will generally occur during the day hours (i.e., 7 AM - 6 PM).
- Based on the size of the loading dock indicated on the received drawings the loading dock will be suitable for medium rigid vehicles (MRV) ≤ 12.5 m and smaller trucks/vans. It is expected that trucks with refrigeration units will not access the loading dock.
- Unloading of trucks will occur by means of manual pallet jacks while vans will be hand unloaded.
- Delivery trucks will travel at 10 km/hr time to the dock and leaving the site equates to 5 minutes of a 1-hour period.
- Noise emissions from unloading activities will occur for 15 minutes per truck.
- One (1) delivery is expected to occur in each 1-hour period.
- It is assumed trucks will drive passed the dock to reverse to the unloading space.

Typical noise levels (overall sound power levels – L_w, dB(A)) associated with the above activities are provided in **Table 16**.

Table 16: Typical noise levels associated with expected loading dock activities

Loading Dock Activity	Sound Power Level – L_w dB(A)
Medium rigid truck driving at 10km/hr	94
Truck reverse beeper	103
Unloading truck with pallet jack	92

5.1.2.3 Predicted Noise Levels

A noise emissions assessment was conducted based on the inputs outlined above. **Table 15** provides the predicted noise levels at the worst affected receivers assessed against the applied noise limits. Only residents west of the site were assessed as other nearby sensitive receptors have much greater separation distance and / or screening by school buildings.

Table 17: Carpark predicted noise impacts

Receptor	Noise source	External noise impact $L_{eq,1hr}$ dB(A)	External noise impacts combined $L_{eq,1hr}$ dB(A)	Complies with EPP 2019 Day Background Creep criteria 55 dB(A)?
West Residential	Truck Passby	27	38	Yes
	Reverse Beeper	28		
	Unloading Activities	37		

5.1.2.4 Discussion and Recommendations

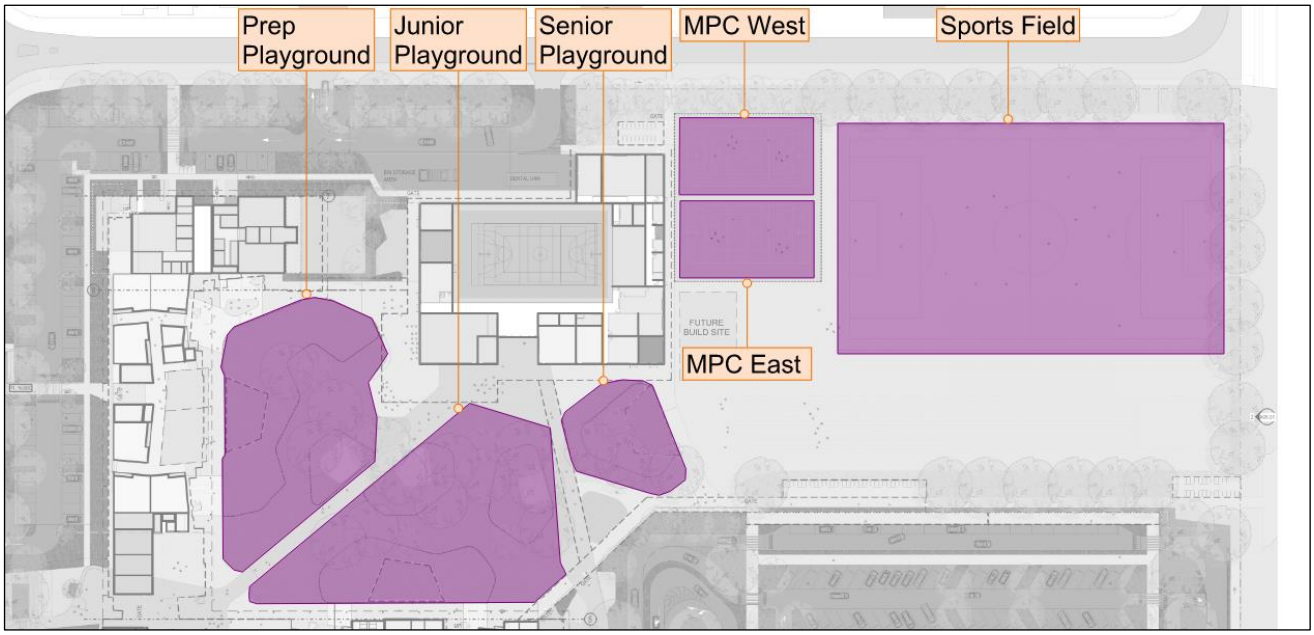
Based on the assumed project noise limits the loading dock is predicted to comply without additional acoustic treatment.

5.1.3 Sports Field, Multi-Purpose Courts, and Playgrounds

5.1.3.1 Noise Source Locations

The site was developed in the acoustic model based on the architectural drawing (refer to **Table 2**) with source distribution as shown in **Figure 7**.

Figure 7: Onsite Carparking and Drop-off Zone



Source: Excerpt from 2453.01-A00.30-MASTER PLAN- GROUND_(7) (HB – 19/08/2024) | Annotations by Stantec

5.1.3.2 Assessment Inputs and Assumptions

Noise from the outdoor sports field, multipurpose courts and playgrounds were assessed to nearby sensitive receivers with source noise levels detailed in **Table 18** below.

Table 18 Noise Source Levels

Source	Source Sound Power Levels Lw	Source Heights
Sports Field	86 dB(A) $L_{eq(1hr)}$	1.5m
Multi-Purpose Courts (each)	86 dB(A) $L_{eq(1hr)}$	1.5m
Senior Playground	92 dB(A) $L_{eq(1hr)}$	1.5m
Junior Playground	92 dB(A) $L_{eq(1hr)}$	1.5m
Prep Playground	92 dB(A) $L_{eq(1hr)}$	1m

Noise source levels were based on the following data:

- Sports field and multi-purpose court source noise level calculated from Sports England Design Guidance Artificial Grass Pitch (AGP) Acoustics – Planning Implications 2015 of 58 dB(A) $L_{eq,1hr}$ @ 10 m for one pitch.
- Noise in playgrounds based on a group of 30 children 3–5 years old as outlined in AAAC Guideline for Child Care Centre Acoustic Assessment Version 3.0. While children in the Junior and Senior playground would be in an older age bracket it is assumed that similar amounts of shouts / squeals will be experienced when children play.

All noise sources were modelled as area sources with the full sound power level emanating from the boundary of each source.

5.1.3.3 Predicted Noise Levels

Based on the inputs above, noise impacts to the worst affected receivers around the school site are presented in **Table 19**.

Table 19: Predicted L_{eq} noise impacts to nearest offsite receivers from school outdoor activities

Receptor	Noise source	External noise impact $L_{eq,1hr}$ dB(A)	External noise impacts combined $L_{eq,1hr}$ dB(A)	Complies with EPP 2019 Day Background Creep criteria 55 dB(A)?
East Residential	Sports Field	29	43	Yes
	Multi-Purpose Court E	28		
	Multi-Purpose Court W	29		
	Senior Playground	40		
	Junior Playground	36		
	Prep Playground	32		
South Residential	Sports Field	20	36	Yes
	Multi-Purpose Court E	16		
	Multi-Purpose Court W	16		
	Senior Playground	31		
	Junior Playground	32		
	Prep Playground	30		
West Residential	Sports Field	34	43	Yes
	Multi-Purpose Court E	37		
	Multi-Purpose Court W	40		
	Senior Playground	31		
	Junior Playground	27		
	Prep Playground	28		

Receptor	Noise source	External noise impact $L_{eq,1hr}$ dB(A)	External noise impacts combined $L_{eq,1hr}$ dB(A)	Complies with EPP 2019 Day Background Creep criteria 55 dB(A)?
Child Care Centre (South)	Sports Field	22	37	Yes
	Multi-Purpose Court E	16		
	Multi-Purpose Court W	16		
	Senior Playground	32		
	Junior Playground	34		
	Prep Playground	29		

Based on the assumed background noise levels the outdoor sports fields and play areas are predicted to comply without any additional acoustic treatments. Further assessment of onsite noise emissions shall be completed in later design stages.

5.1.4 Third Party Hall Hire

It is common for school halls to be may be made available for third party use; therefore, a preliminary noise emission assessment has been completed for the Hall against noise limits for indoor venues defined under EPA 1994 (refer to **Section 4.1.3**).

5.1.4.1 Activity Noise Levels

At this stage specific activities within the Hall are unknown. It is assumed that third parties using amplified music would be the loudest continuous noise source within the Hall and this has formed the basis of the emissions assessment.

Assessment of elevated music levels have considered a pop music spectrum (based on Hayne et al. 2005 [1]) normalised to a source sound power level of L_w 110 dB(A). The following octave band spectrum was included in the calculations.

Table 20: Normalised pop music spectrum

Music Genre	Octave band sound levels, dB								L_w dB(A)
	63 Hz	125 Hz	250 Hz	500 kHz	1 kHz	2 kHz	4 kHz	8 kHz	
Pop	106	106	104	104	104	103	101	99	110

Reverberant Room Effects on Source Noise Levels

For noise within the Hall, the reverberant sound pressure levels occurring within the space was calculated based on Equation 1 below:

Equation 1:

$$L_{p(rev)} = L_w + 14 - 10\log(V) + 10log(T)$$

where;

- V = ≈ 3,600 m^3
- T = 1.5 sec (all frequencies).

Reverberant sound pressure levels used for calculation of noise emissions are provided in **Table 21**.

[1] *Influence of music genre and composition on entertainment noise*, M.J. Hayne et al., AAS Conference November 2005.

Table 21: Reverberant sound pressure levels

Source	Linear Octave Band Reverberant Sound Pressure Level (L_{eq}, dB)								Total Reverberant Sound Pressure Level – L_{eq} dB(A)
	63 Hz	125 Hz	250 Hz	500 Hz	1kHz	2kHz	4kHz	8kHz	
Amplified music	86	86	84	84	84	83	81	79	90

5.1.4.2 General Arrangement and Proposed Construction Types

The following construction types were considered in the assessment of noise emissions. It has been assumed that any doors or windows to the Hall would remain closed during events and achieve the same or better R_w ratings than the preliminary wall/roof construction provided.

Table 22: General building envelope construction types

Element	Assumed Construction Types	Indicative Performance
Walls and Roof	0.54 mm sheet steel lined with 50mm insulation (min 14kg/m^3)	R_w 25

5.1.4.3 Predicted Noise Levels

A noise emissions assessment was conducted based on the inputs outlined above. The following predicted noise levels outlined in **Table 23** have been compared against the relevant noise limits for the relevant time periods.

Table 23: Predicted noise levels for third party uses within the Hall.

Noise Sensitive Receptor / Location	Applicable Noise Limits, L_{eq} dB(A)				Predicted Noise Levels, $L_{eq,t}$ dB(A)
	Day (7AM – 6 PM)	Evening (6PM – 10PM)	Night (10PM – 12AM)	Night (12AM – 7AM)	
East Residential Dwellings	55	50	43	30	47
West Residential Dwellings					50

5.1.4.4 Discussion and Recommendations

As presented above, noise emissions from activities within the Hall are predicted to comply for the day and evening time period (7AM – 10PM) assuming the building façade achieves the minimum reductions provided in **Table 22** and all openings are closed during use.

It is recommended to minimise openings on the east and west facades of the Hall and allow for alternative ventilation so all openings can be closed during use.

5.2 Road Traffic Noise Intrusion

Road traffic noise has been identified to affect the site with the applicable noise criteria defined in **Section 4.2**.

Road traffic noise calculations were conducted by applying the SoundPLAN implementation of the UK Department of Transport Welsh Office *Calculation of Road Traffic Noise* 1988 (CoRTN) algorithms. CoRTN is widely accepted in Australia for the calculation of road traffic noise. Details regarding road traffic volume predictions and inputs, as well as other noise modelling parameters, have been provided in **Appendix C**.

5.2.1 Verification of Road Traffic Noise Model

Results of the road traffic model verification at the unattended monitor, in accordance with the shortened measurement procedure and provided in **Table 24**. The road traffic noise model is considered validated as the predicted and measured noise levels are within ±2 dB and, therefore, was used to predict noise levels for 2034 traffic volumes.

Table 24: Road traffic noise model verification

Predicted $L_{A10,18hr}$ dB(A)	Calculated $L_{A10,18hr}$ dB(A)	Difference
77.6	77.4	+0.2

5.2.2 Predicted Façade Noise Levels

Noise predictions were conducted to estimate the extent of road traffic noise impacts onto the site with **Figure 8** and **Figure 9** providing façade corrected noise contours for ground and first floor levels respectively.

Figure 8: Façade-corrected 2034 road traffic noise contour map 1.8m above ground level

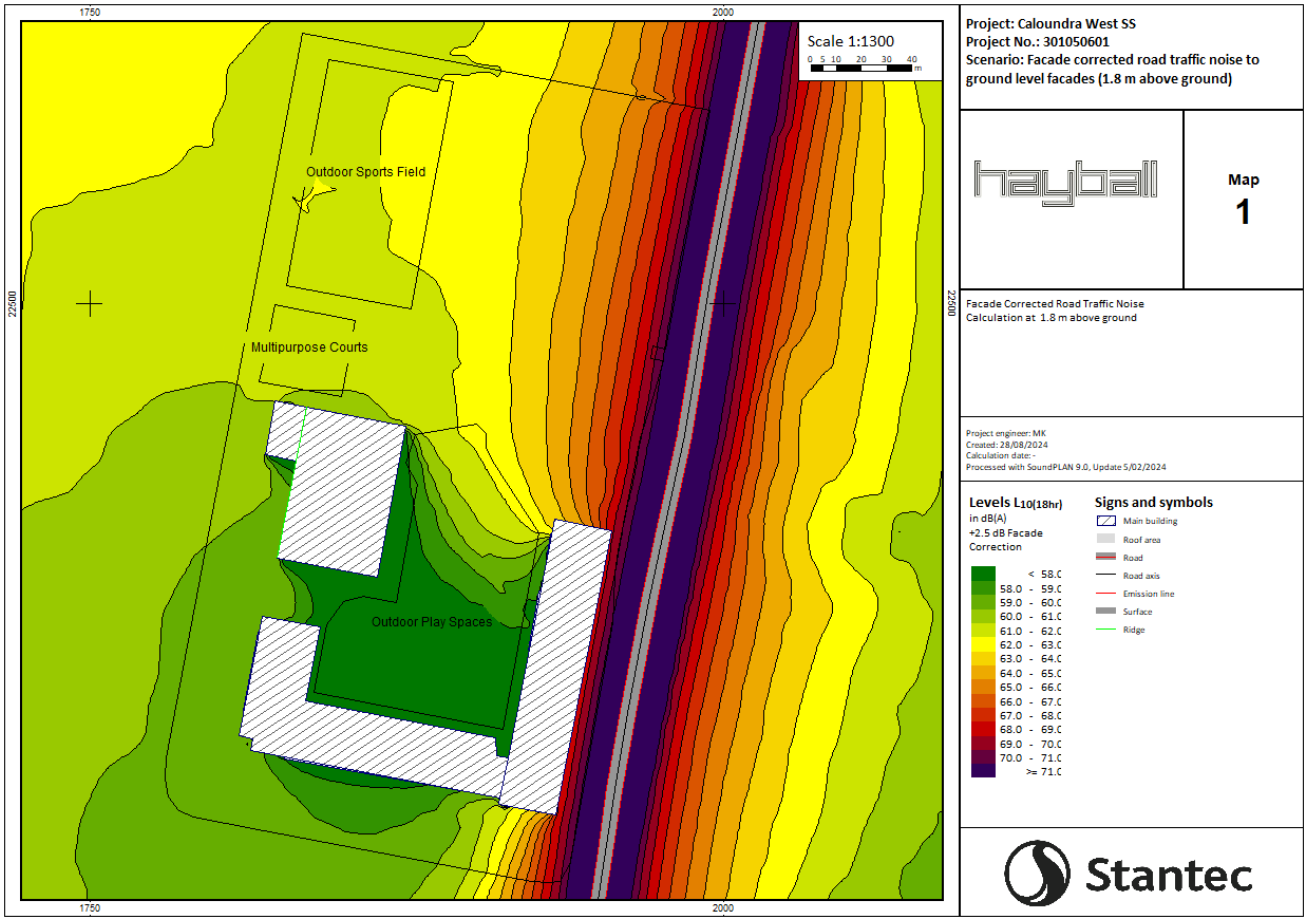
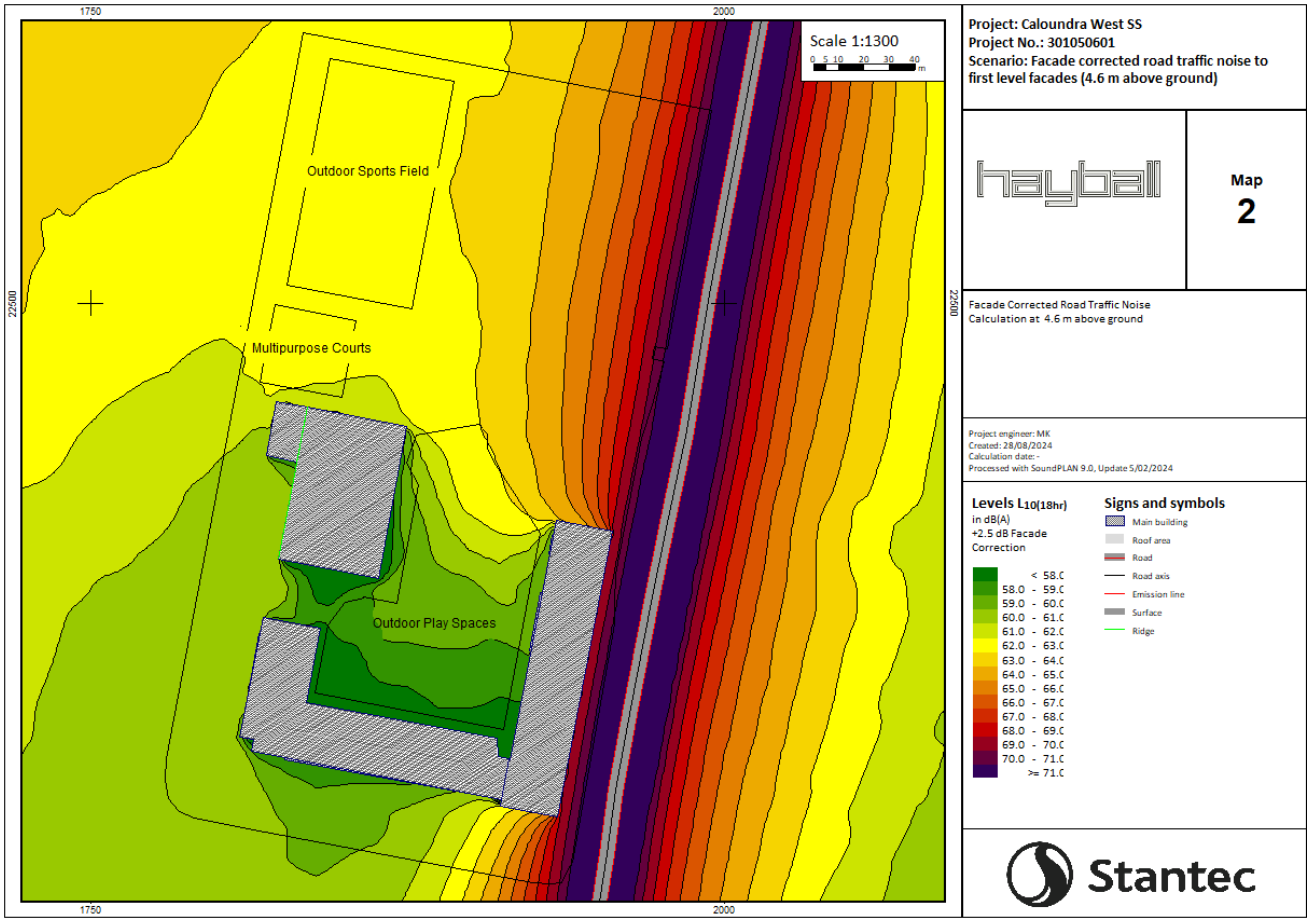


Figure 9: Façade-corrected 2034 road traffic noise contour map 4.6m above ground level



The most stringent internal noise limit specified by SDAP and DoE Part C for indoor areas is ≤35 dB(A) $L_{eq,1hr}$. Based on the contours above, the new buildings should be provided with alternative ventilation to allow windows and doors to remain closed while in use. In addition, as the predicted noise levels are >20 dB above the 35 dB(A) internal criteria, additional façade treatments will be required to provide sufficient reductions in road traffic noise to comply with DoE and SDAP criteria. Construction options shall be determined in later design stages.

5.2.3 Outdoor Education and Play Areas

Outdoor education and play areas are recommended to comply with the SDAP criteria $L_{10,12hr}$ ≤ 63 dB(A). A +2dB adjustment has been applied to the $L_{10,18hr}$ to estimate $L_{10,12hr}$ noise levels. This adjustment is based on previous projects located near arterial roads. **Figure 10** provides free-field noise contours at 1.5m above the ground level.

Figure 10: Free-field 2034 road traffic noise contour map 1.5m above ground level

Based on the noise contours the site outdoor sports fields and play areas comply with the noise criteria without additional acoustic treatment.

6. Conclusion

This report provides master planning advice for the proposed Caloundra West State School project with the following purpose:

- Established the applicable environmental regulation and Policies, and design Guidelines and standards that will guide the school design from an acoustic perspective;
- Identified the potential environmental noise emission and intrusion aspects to be addressed during subsequent design phases; and
- Provided in principle recommendations to mitigate the noise impacts to be further investigated in later design stages.

Based on the assessments conducted, it is expected that new build areas can be designed using reasonable and feasible noise mitigation strategies to meet State, local council and DoE obligations.

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.

Regards,

Marcus Kamppi (Author)
Acoustic Engineer for **Stantec**

Michael Lanchester (Reviewer)
Acoustics Section Manager (QLD) for **Stantec**

Appendix A Glossary of Acoustic Terms

TERM	DEFINITION
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 LA90 noise level.
Barrier	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc. used to reduce noise.
Ctr	A standard weighting curve which replicates low frequency noise, such as that from traffic. Often added to DnT,w or Rw to characterise airborne sound insulation performance.
dB	The abbreviation for decibel.
dB(A)	A-weighted sound level in decibels.
Dw	A single number value that represents a field measurement of the weighted level difference between two adjacent spaces separated by a partition. Dw = 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.
Free Field	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5 m from any acoustic reflecting structures other than the ground.
Hertz	The frequency of vibration and sound is measured in hertz (Hz) and is representative of the number of cycles occurring per second.
Intermittent Noise	Level that drops to the background noise level several times during the period of observation.
LA1	The A-weighted sound pressure level exceeded for 1 % of the measurement time period.
LA10	The A-weighted sound pressure level exceeded for 10 % of the measurement time period.
LA90	The A-weighted sound pressure level exceeded for 90 % of the measurement time period. Typically represents the background noise level of an environment.
LAeq	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. LAeq,15min, symbolising the measurement is evaluated over 15-minutes).
Noise Logger	A sound level meter situated at a particular point of interest. The instrument is typically for an extended period in order to ascertain typical noise patterns associated with the measurement position.
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.
Rw	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 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 Tuesday 4th June 2024 to Monday 10th June 2024 (inclusive) at the location shown in **Figure 1** (coordinates in **Table 25**). This location was considered reasonable for measurement of road traffic noise from the Bruce Highway.

Table 25: Noise monitoring coordinates

Latitude	Longitude
26°49'22.5"S	153°02'09.1"E

The following instrumentation was used:

- NTi XL2 sound level meter (S/N A2A-14215-E0). 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 1055.2018 – *Acoustics – Description and measurement of environmental noise*, and the instruments were configured as follows:

- A-weighting frequency response;
- FAST time response;
- 15-minute 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 - 2018.

Noise monitoring results

The raw sound level meter files were post-processed to determine relevant long-term noise descriptors, some of which were used to verify the road traffic noise model. As the monitor did not record for the full period of deployment the $L_{10(3hr)}$ was used to estimate the $L_{10(18hr)}$ as stated in **Section 3.3.1**.

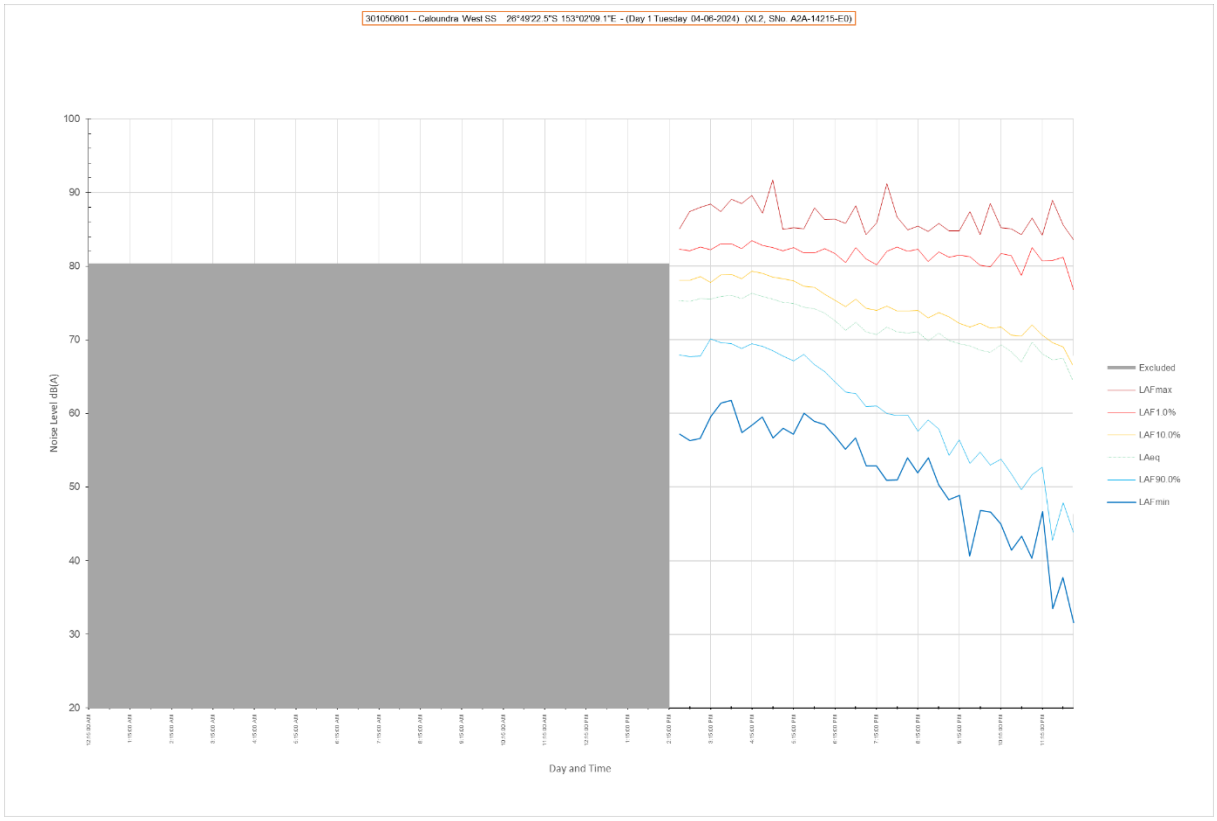
Results and time trace plots of relevant noise descriptors are provided below (see **Table 26** and **Figure 11**). Where data was not measured for a full period (i.e., at the start and end of measurement), the cells are shown dashed in the table. In addition, the noise descriptor averages are presented.

A summary of weather observations by the Bureau of Meteorology (BoM) during the monitoring period is presented in **Table 27**.

Table 26: Summary of measured noise levels (rounded)

Noise descriptor	Average	04-June-24	05-June-24
$L_{10,3hr}$	**78**	78	78
$L_{10,12hr}$	**78**	78	78

Figure 11: Time trace of relevant noise descriptors



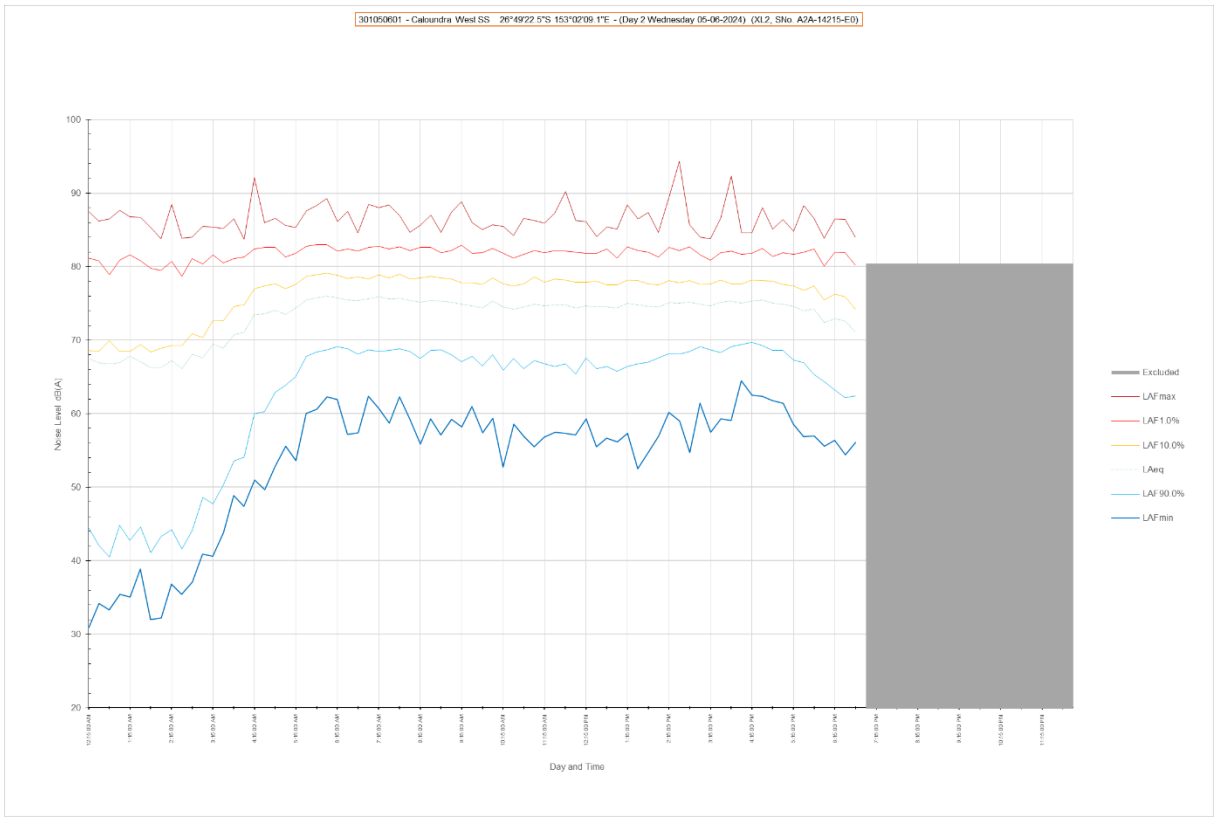


Table 27: BOM weather data

Beerburrum, Queensland
June 2024 Daily Weather Observations

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	Sa	17.0	22.2	14.6			SW	24	18:04	19.1	99		NE	2		21.5	79		NNE	7	
2	Su	11.9	22.2	2.4			NW	22	20:13	15.0	89		SW	2		20.5	48		SW	2	
3	Mo	11.6	21.1	0.2			NNW	31	18:30	15.8	73		W	6		19.8	40		WNW	7	
4	Tu	8.6	21.4	0			WSW	17	06:51	14.1	62		SSW	6		20.8	35		NNW	2	
5	We	7.2	23.1	0			N	17	12:42	16.1	66			Calm		21.1	54		E	6	
6	Th	10.8	22.4	1.8			SW	17	23:33	15.7	88		SSW	2		22.0	47		NW	4	
7	Fr	9.2	19.9	0						13.8	67		WSW	7		16.9	52		W	4	
8	Sa	9.4	21.2				WNW	22	09:12	14.3	66		WSW	7		20.6	52		W	6	
9	Su	10.7	22.8	0			W	19	12:48	16.7	66		SW	6		21.5	50		WNW	6	
10	Mo	11.7	22.8	0			WSW	20	09:14	16.1	64		W	6		22.5	40		NW	4	
11	Tu	9.2		0						16.0	69		SSE	4		22.5	34		WNW	2	
Statistics for the first 11 days of June 2024																					
	Mean	10.7	21.9							15.7	73			4		20.9	48			4	
	Lowest	7.2	19.9							13.8	62			Calm		16.9	34		#	2	
	Highest	17.0	23.1	14.6			NNW	31		19.1	99		WSW	7		22.5	79		#	7	
	Total			19.0																	

Appendix C Noise Modelling Details

A three-dimensional computer model of the study area was created within SoundPLAN 9.0 software. The following inputs were utilised:

- **Building receptors** – These were digitised at the location of the most exposed facades to the relevant noise sources. Single point receptors were modelled at 1.5 m above each finished floor level of each building digitised in the model. These were located at 1 m from the façade.
- **Noise map calculations** – Noise contour maps were calculated as free-field noise levels, 1.5 m, 1.8m and 4.6m above the ground at 3m resolution.
- **Road traffic noise** was calculated using the SoundPLAN implementation of the UK Department of Transport Welsh Office *Calculation of Road Traffic Noise* 1988 (CoRTN), which is accepted by TMR CoP 2013.
- **Ground surface corrections** – 30% ground absorption was applied.
- **Sound reflections –** A reflection order of 3 was used.
- **Façade correction** - +2.5dB façade correction applied for non-free field calculations.
- **Terrain:** A Digital Elevation Model (DEM) provided by Egis Group which includes mounding provided to the west of the site between the site and the Bruce Highway.
- **Road traffic parameters:** Road traffic volumes and growth were obtained from the TMR 2012 - 2022 traffic survey for the Bruce Highway. 2024 and 2034 traffic volumes were estimated based on the growth rates information provided. The North-South arterial road used estimated 2031 traffic volumes from ASK report *197401.0291.R02V01F* with a 4% growth rate applied to conservatively assess 2034 noise levels.

The traffic volumes digitised in the computer model are presented in **Table 28**.

Table 28: Traffic volumes utilised for model verification and noise assessment

TMR Count Site	Road	2022 94% AADT	% HV	Speed, km/h	% Growth	2024 94% AADT	2034 94% AADT
23874	Bruce Highway N-bound	31858	16.2	110	2.5	33470	42845
23874	Bruce Highway S-bound	32068	16.7	110	2.5	33692	43128
-	North-South Arterial Rd	-	3.0	60	4	-	10272

No surface corrections were applied to the Bruce Highway or the North-South Arterial Road.

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