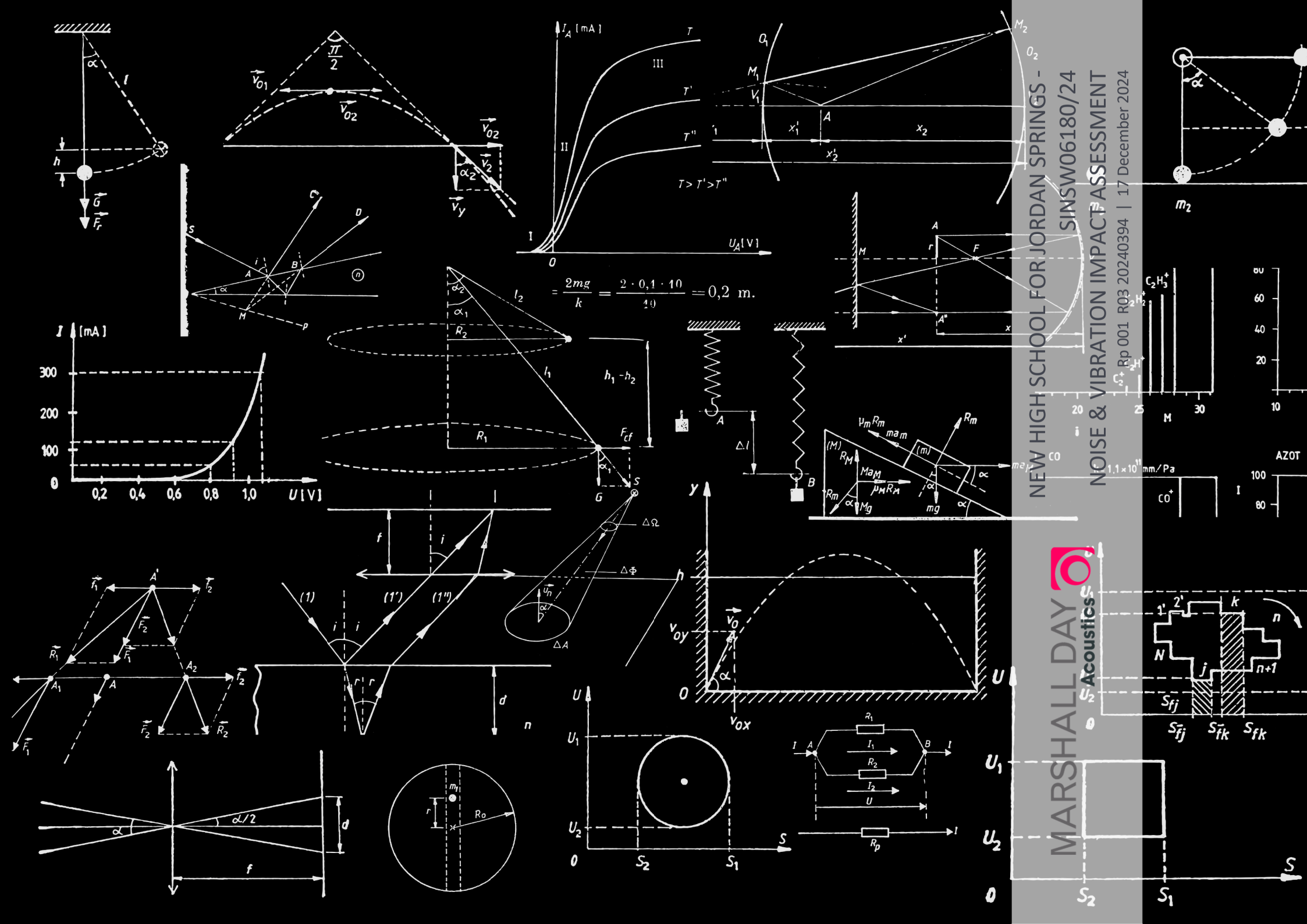
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AZOT
NEW HIGH SCHOOL FOR JORDAN SPRINGS - SINSW06180/24
NOISE & VIBRATION IMPACT ASSESSMENT
MARSHALL DAY Acoustics
Rp 001 R03 20240394 | 17 December 2024

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Project: **NEW HIGH SCHOOL FOR JORDAN SPRINGS - SINSW06180/24**

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EXECUTIVE SUMMARY

The purpose of this report is to present the findings of an assessment of the noise and vibration impacts associated with a new high school at Lot 2 and Lot 3 in DP 1248480, corner of Infantry Street and Armoury Road, Jordan Springs, NSW. The new school will address demand from the residential areas of Jordan Springs/Ropes Crossing as there is currently no high school in this area.

The proposal will deliver a 1000 student capacity school and includes three 3- storey buildings (48 teaching spaces + 3 teaching space support learning hubs) and a hall.

The report examines the potential noise and vibration impacts associated with the construction and operation of the future high school on existing and future sensitive receivers surrounding the site. The impacts from later stage construction works on the operational areas of the school are also addressed. Noise from the operation of the future Western Sydney International (Nancy-Bird Walton) Airport that may impose constraints on the future educational use of the site are examined, and appropriate design strategies to minimise and manage the impacts are recommended.

Criteria for the assessment of noise and vibration impacts, including those generated during construction, have been adopted based on the results of an ambient noise monitoring and current regulatory requirements, guidelines and standards.

A model of the site and surrounds has been developed using computer modelling software and future scenarios developed to evaluate the noise emissions from construction and operational scenarios for the high school upon surrounding receivers.

Construction noise and vibration

Prediction of construction noise for possible works scenarios indicate exceedances of noise management levels at existing residential receivers during standard hours. These exceedances should be managed with available feasible and practicable management techniques. At this stage, construction methodology, plant selection and scheduling has not been developed. A Construction Noise and Vibration Management Plan (CNVMP) will be required to be prepared by the principal contractor, once appointed.

Operational noise impacts

Mechanical services design details were unavailable at this stage. Acceptable noise levels due to plant operation are likely to be achieved with considered plant selection and layout. Implementation of engineering noise control measures would be developed where necessary. Further assessment will be required when detailed mechanical services design becomes available.

Noise level emissions from teaching spaces, the school hall and the school carpark have been predicted to existing and future surrounding residential properties. All relevant criteria can generally be achieved by the development.

The noise emissions associated with outdoor sport and informal outdoor play activities are expected to be generally within the emission guideline of background L_{A90} + 10 dBA and less than the recommended Acceptable Noise Level (ANL) for 'Suburban' acoustic amenity at existing residential receivers. Informal outdoor play during recess and lunch may result in marginal to moderate exceedances of the emission guideline at some exposed existing receivers and at future residential allotments once operational. The recommended amenity levels will not be exceeded.

Aircraft noise

The potential L_{Amax} levels generated by aircraft, established in consultation with the *WSI Airport Aircraft Overflight Noise Tool* (Department of Infrastructure, Transport, Regional Development, Communications and the Arts) were compared with internal design noise limits recommended by AS 2021:2015 and the EFSG 2.0. Standard building construction will adequately reduce aircraft noise within sensitive spaces to acceptable levels. External window and door openings may be required to be closed to achieve the recommended design levels during periods of multiple aircraft movements. Provision of an alternative method of ventilation to allow design requirements for airflow to be met within acoustically sensitive spaces will be provided when external openings are closed.

Ventilation louvres are proposed at high level on the hall's eastern elevation. Acceptable internal design levels will be achieved for sports mode use under the current design. When assembly or event mode is required, the 55 dBA internal noise level target may be marginally exceeded during maximum noise level events with the louvres open (65 dBA during wide body jet takeoffs). Internal design levels would be achieved with the louvres closed, or with the inclusion of acoustic louvres.

Road traffic

Exposure of residential receivers to traffic generation has been given consideration in the design strategy. In Scenario 1 and Scenario 2 Stage 3, the main drop off zones and carpark entry will be located along the new Park Edge Road . The bus bay has been located on Armoury Road, the main access corridor road through the Jordan Springs northern extent and the future new land release area of East Llandilo.

Under Scenario 2 Stage 1 and 2, a temporary 17 – space drop off facility would be located on the Armoury Road boundary with the carpark also accessed from Armoury Road.

It is likely there will be some noise impacts due to additional vehicles on public roads. We note however that Educational Establishment is a permissible use.

It is considered reasonable to expect that the short-term increases in noise levels due to increased traffic flows associated with school arrivals and departures would be considered acceptable by the surrounding residential community given the context of the school in terms of social benefit.

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1.0 INTRODUCTION

This noise and vibration impact assessment has been prepared to accompany a Review of Environmental Factors (REF) for the Department of Education (DoE) for the construction and operation of a New High School for Jordan Springs(the activity) under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and *State Environmental Planning Policy (Transport and Infrastructure) 2021* (SEPP TI).

This document has been prepared in accordance with the *Guidelines for Division 5.1 assessments – Consideration of environmental factors for health services facilities and schools, October 2024* (the Guidelines) by the Department of Planning, Housing and Infrastructure.

This report examines and takes into account the relevant environmental factors in the Guidelines and *Environmental Planning and Assessment Regulations 2021* under Section 170, Section 171 and Section 171A of the EP&A Regulation as outlined in Table 1.

Table 1: Summary of Relevant Section of the Part 5 Guidelines and EP&A Regulation

Regulation / Guideline Section	Requirement	Response	Report Section
Section 171(2)(a)	the environmental impact on the community	Impacts of noise and vibration during construction addressed to surrounding residential receivers Impacts of noise generated as a result of school operation addressed to surrounding residential receivers	5.0 7.0 10.0 11.0 12.0
Section 171(2)(d)	reduction of the aesthetic, recreational, scientific or other environmental quality or value of the locality	Impacts of noise and vibration during construction addressed to operational areas of the school and surrounding residential receivers Impacts of noise generated as a result of school operation addressed on surrounding community	5.0 7.0 10.0 11.0 12.0
Section 171(2)(h)	long-term effects on the environment	Impacts of noise generated as a result of ongoing school operation addressed to surrounding residential receivers	5.0 7.0 11.0 12.0
Section 171(2)(i)	degradation of the quality of the environment	Impacts of noise and vibration during construction addressed to operational areas of the school and surrounding residential receivers Impacts of noise on the acoustic environment addressed to surrounding residential receivers	5.0 7.0 10.0 11.0 12.0

Regulation / Guideline Section	Requirement	Response	Report Section
Section 171(2)(l)	pollution of the environment	Impacts of noise and vibration during construction addressed	5.0 7.0
		Impacts of noise generated as a result of school operation addressed to surrounding residential receivers	10.0 11.0 12.0

The following plans/ reports identified in Table 2 have been reviewed to inform the assessment contained within this report:

Table 2: Plans and Reports Reviewed

Discipline	Document name	Revision	Date
DJRD	• New High School for Jordan SpringsFinal Draft Issue for REF	02	06.12.2024
Stantec Aust	• *Intrusive Geotechnical Investigation Report Proposed New High School for Jordan Springs*	3	14.11.2024
Stantec Aust	• *New High School for Jordan Springs Transport Impact Assessment*	B	08.11.2024
WSP Golder	• *Jordan Springs East (JSE) – Stage 3-6 Earthworks Construction Methodology Report*		15.05.2024
AS 1055:2015	• *Acoustics – Description and measurement of environmental noise*		
AS 2021:2015	• *Acoustics – Aircraft noise intrusion – Building siting and construction*		
NSW DoE & SI	• *Jordan Springs High School Concept Masterplan for a new school*	*3*	June 2024
NSW DoE & SI	• *Jordan Springs High School Masterplan Verification Report*	*B*	31 May 2024
NSW DoE & SI	• *The Expanding High School*	*5*	12.03.2024
NSW DoE & SI	• *Education Facilities Standards and Guidelines*	EFSG 2.0	
NSW DoE & SI	• *Education Facilities Standards and Guidelines* - Technical Standards	EFSG 2.0	
NSW EPA	• *NSW Road Noise Policy*		2011
NSW EPA	• *NSW Noise Policy for Industry*		2017
NSW EPA	• *Interim Construction Noise Guideline*		2009
NSW Govt	• *SEPP (Transport and Infrastructure) 2021*		2021

2.0 PROPOSED ACTIVITY DESCRIPTION

The proposed activity for the construction and operation of a New High School for Jordan Springs is proposed to have a capacity of 1,000 students and 80 staff to meet forecast enrolment demand associated with population growth in Jordan Springs and Ropes Crossing. The school will provide permanent General Learning Spaces (GLS), Support Learning Spaces (SLS), staff facilities and a library across three (3), three storey buildings, a single storey hall, sports field, three (3) outdoor sport courts, 72 operational at grade parking spaces (including two (2) accessible spaces), 100 bicycle spaces and landscaping.

Public domain works and the off-site OSD Basin are to be constructed by others under separate planning pathways.

3.0 PROPOSED ACTIVITY SCENARIOS

The project scope of works includes two (2) Scenarios, to allow construction and operation of the school, with (Scenario 1 – Preferred Option) or without (Scenario 2 – Interim Solution) the public domain works and permanent off-site basin being constructed by others under a separate planning pathway.

3.1 Scenario 1 – Preferred Option

Road Network completed and permanent OSD Basin Constructed

External works undertaken by others to facilitate Scenario 1

- Construction of Park Edge Road;
- Any adjustments to Infantry Street;
- Kiss and drop zone along Park Edge Road;
- Support kiss and drop zone located along Infantry Street; and
- Construction and operation of permanent OSD Basin off site.

Note – Scenario 1 is not to proceed if external works undertaken by others is not completed.

Scenario 1

- Construction and Operation of the New High School for Jordan Springs, including:
  - Decommissioning of existing on-site OSD basin;
  - Demolition of roads and associated services within the site boundary;
  - Tree removal within the site boundary;
  - Earthworks;
  - Three (3) multi-storey classroom buildings;
  - One (1) school hall;
  - Three (3) outdoor sport's courts;
  - One (1) sport's field;
  - 72 at grade car parking spaces, including two (2) accessible parking spaces, and waste services, accessed via Park Edge Road;
  - 100 bicycle parking spaces across the site; and
  - Landscaping.

3.2 Scenario 2 - Interim Solution

Road network not completed, Permanent OSD Basin not constructed.

Scenario 2 - Stage 1

- Construction and operation of a temporary on-site OSD Basin;
- Construction and operation of the New High School for Jordan Springs, including;
  - Demolition of roads and associated services within the site boundary;
  - Tree removal within the site boundary;
  - Earthworks;

- Three (3) multi-storey classroom buildings;
- One (1) sport's field;
- Temporary carpark - 72 at grade car parking spaces, including two (2) accessible parking spaces and waste services, located on the northwest corner of the site, accessed off Armoury Road;
- 100 bicycle parking spaces across;
- Temporary Kiss and drop facilities on Armoury Road; and
- Associated landscaping.

Scenario 2 - Stage 2

Stage 2 is not to be undertaken until the temporary on-site OSD basin under stage 1 works is completed and operational.

- Decommissioning of existing on-site OSD basin, prior to the following works being undertaken:
  - 72 at grade car parking spaces, including two (2) accessible parking spaces, and waste services, located on the southeast corner of the site. This car park cannot be constructed until the decommissioning of the existing OSD basin is completed and will be non-operational with no road connection until completion of Scenario 2 – Stage 3;
  - One (1) school hall;
  - Three (3) outdoor sport's courts; and
  - Associated landscaping.

External works undertaken by others to facilitate Stage 3

- Construction of Park Edge Road;
- Any adjustments to Infantry Street;
- Kiss and drop zone along Park Edge Road;
- Support kiss and drop zone located along Infantry Street; and
- Construction and operation of OSD Basin off site.

Note – Scenario 2 - Stage 3 is not to proceed until the external works undertaken by others have been completed.

Scenario 2 - Stage 3

- Connection of the southeast carpark to Park Edge Road;
- Rectification works along Armoury Road to remove temporary kiss and drop facilities and cross over for temporary carpark;
- Demolition of temporary carpark, once permanent car park is operational; and
- Decommissioning of temporary OSD basin.

3.3 Other Approvals

External works and construction of the permanent off-site OSD Basin are to be constructed by others.

4.0 ACTIVITY SITE

The project site is located on the corner of Armoury Road and Infantry Street in Jordan Springs and is legally described as part of Lots 2 and 3 in DP 1248480.

Figure 1 provides an aerial photograph of the project site, outlines the boundaries of the project site (in red) and the boundaries of Lots 2 and 3 in DP 1248480 (in blue).

Figure 1: Project Site

The project site is within the Central Precinct of the St Mary's Release Area in the Penrith Local Government Area.

The proposed New High School for Jordan Springs Scenario 1 site plan is shown in Figure 2. The Contingent Option (Scenario 2) site plan is shown in Figure 3.

Bell times for the senior and junior cohorts were not confirmed at the time of preparation of this assessment.

Typical hours of high school operation at surrounding schools are as follows:

- school classes 8.30 am to 3.00 pm
- assumed office hours 8.00 am to 4.00 pm.

Figure 2: Scenario 1 & Scenario 2 Stage 3 Operational (Source: DJRD Architects)

Figure 3: Scenario 2 Stage 1 & 2 Operational (Source: DJRD Architects)

5.0 NOISE AND VIBRATION CONSIDERATIONS

Noise and vibration impact assessment of the project involves two main components:

- evaluating the potential impact of the surrounding noise environment on a future education facility developed at the site
- evaluating the potential impact of noise generated by a future education facility on the surrounding environment and receivers including the impact of noise from construction works on operational component of the school.

The primary source of noise that may potentially impact upon the future high school has been identified as that resulting from the partial location of the site within a 'departure transition area' based on the Western Sydney International (Nancy-Bird Walton) Airport Aircraft Noise Tool.

The future school site is located in the recently planned community area in the eastern portion of Jordan Springs and is surrounded to the north, south and west by residential properties. There are no other local noise sources likely to impact upon the future school.

The sources of noise generated by the proposed activity that may potentially impact on the surrounding environment and receivers are identified as:

- noise (and vibration) generated during construction
- mechanical services plant and equipment
- outdoor maintenance activities
- learning activities within noise-generating spaces (wood and metal technology, performing arts)
- sporting events and performances held within the hall
- outdoor activities (formal supervised classes and general student noise before school and during recess and lunch)
- vehicular activities in the on-site carparks and during school peak hours at the drop off/pick-up zones.

6.0 SURROUNDING LAND USE

The potential school site has been identified in the recently planned community area in the eastern portion of Jordan Springs.

The precincts of Jordan Springs, Jordan Springs East and Ropes Crossing are planned communities by Lendlease which will deliver approximately 9000 dwellings (Lendlease Jordan Springs Open Space Assessment Report, Clousten Associates, 2017).

The area is within the Penrith LGA, on land that formerly comprised ADI property and borders Wianamatta Regional Park. The site will have connections east and west via Wianamatta Parkway. The area is served by several existing schools including Chifley College Dunheved Campus, Cambridge Park High School and Cranebrook High School.

The masterplan site is generally surrounded by existing and future residential properties to the north, south and west and bushland to the east.

The location of surrounding existing and future residential properties considered for noise modelling are listed in Table 3 and shown in Figure 4.

Table 3: Residential Receivers Considered for Noise Modelling

Receiver	Location
R1	12 Charlie Street
R2	124 Armoury Road
R3	135 Armoury Road
R4	137 Armoury Road
R5	143 Armoury Road
R6	145 Armoury Road
R7	153 Armoury Road
R8	25 Squadron Street
R9	Future Residence Lasetter Street - NW
R10	Future Residence Lasetter Street - NE
R11	Future Residence Infantry Street - SW
R12	Future Residence Infantry Street - S

Figure 4: Existing and Future Residential Receivers and Noise Monitoring Location

7.0 EXISTING NOISE ENVIRONMENT

7.1 Ambient noise survey

The existing noise environment at residential properties surrounding the project area was quantified by unattended measurements as detailed below.

The existing noise environment is principally controlled by traffic on the Wianamatta Parkway which provides an east-west link between Jordan Springs and Ropes Crossing and traffic on local roads.

Other contributing sources include naturally occurring noise from birds, insects, foliage rustling, construction works, and local residential activities.

In order to quantify and characterise the existing noise environment in the area, long-term ambient noise levels were monitored at the site between Wednesday 3 July and Monday 15 July 2024. The measurement location was selected as being representative of surrounding existing and future receivers.

The long-term noise monitoring location is illustrated in Figure 4. Instrumentation used for the survey is documented in Table 4.

Table 4: Ambient Noise Monitoring

Logger	Location	Equipment Type	Serial Number
NM1	Academy Street between Charlie Street and Infantry Street	Fusion	15360

Monitoring location NM1 was selected to determine the minimum background sound levels for the purposes of establishing criteria for the assessment of future operational noise from the project to existing and future residential receivers surrounding the site.

The logger continuously sampled noise levels over the entire survey period and calculated relevant statistical indices for each 15-minute interval. All measurements were undertaken in general accordance with AS1055:2018 *Acoustics – Description and Measurement of Environmental Noise* and the NSW EPA's *Noise Policy for Industry* (NpfI). Calibration of the loggers was checked prior to and following measurements. Drift in calibration did not exceed ±0.5 dBA. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates. Data measured during periods of adverse weather, established through consultation with the weather station set up adjacent to the noise logger at NM 1, has been excluded in accordance with EPA guidance published in Fact Sheet A4 of the EPA NSW Noise Policy for Industry (https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/noise/17p0524-noise-policy-for-industry.pdf). The survey results are included in Appendix B.

7.2 Ambient noise survey results

To determine project specific criteria on which to base assessment of noise emissions associated with construction and operation of the future high school, the measured data was processed according to the NPfI assessment time periods. Table 5 details the Rating Background Level (RBL) noise levels and the L_{Aeq} (equivalent average) noise levels recorded during the day, evening and night periods. Refer to Appendix A for a glossary of acoustic terminology.

Table 5: **Ambient Noise Survey Results – dBA**

Location	Day 7:00[1] am to 6:00 pm		Evening 6:00 pm to 10:00 pm		Night 10:00 pm to 7:00[1] am	
	RBL	L_{Aeq}	RBL	L_{Aeq}	RBL	L_{Aeq}
NM1	35	48	39	43	34	41

Note 1: 8:00 am on Sundays and public holidays

8.0 ASSESSMENT CRITERIA

8.1 Construction noise and vibration

8.1.1 Construction noise

Noise generated during project construction has the potential to impact on surrounding residential receivers and the operational component of the school.

The NSW EPA *Interim Construction Noise Guideline* (ICNG) provides guidance for assessing noise associated with construction activities and sets out management levels above which there may be community reaction to construction noise.

Management levels are described as:

- Noise Affected level – a level "above which there may be some community reaction to noise"
- Highly Noise Affected level – a level "above which there may be a strong community reaction to noise".

The ICNG also sets out recommended standard hours for construction work, as follows:

- Monday to Friday 7.00 am - 6.00 pm (based on the above)
- Saturdays 8.00 am - 1.00 pm
- No work on Sundays or public holidays.

The noise affected management level is derived by considering the background noise level (referred to in the ICNG as the rating background level, RBL) and hours at which construction works occur, adding 10 dB for work during the recommended hours or adding 5 dB outside these recommended hours.

Works outside the standard hours may potentially be requested. In this case the RBL + 5 dB management level would apply.

The Highly Noise Affected level for residential receivers is set independently of the RBL, as 75 dB $L_{Aeq,15min}$.

Based upon the measured daytime background noise level, the construction noise management levels which would apply at surrounding residential properties, are summarised in Table 6.

Background noise levels are likely to increase in the future following the high school's establishment and progressive suburban development.

Table 6: Construction Noise Management Levels for Residential Receivers

Receiver	Management Level, dB $L_{Aeq,15min}$		
	Recommended Standard Hours		Outside Recommended Standard Hours[1]
	Noise Affected	Highly Noise Affected	
Residential	45	75	40

Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level.

Other sensitive receivers such as schools would typically consider construction noise to be disruptive during school hours. The ICNG recommended noise management level for schools is shown in Table 7.

Table 7: Construction Noise Management Levels for Noise Sensitive Land Uses (other than residences)

Land Use	Management Level, dB $L_{Aeq,15min}$	Time of Day
Classrooms at schools and other educational establishments	Internal noise level 45	When in use

8.1.2 Construction vibration

Vibration generated by construction works is unlikely to require consideration at the existing residential receivers surrounding the project site due to the construction methodologies identified in the *Intrusive Geotechnical Investigation Report Proposed New High School for Jordan Springs* prepared by Stantec Australia Pty Ltd dated 14 November 2024 and the distance separating dwellings from the site. The recommended guidelines for assessment of human comfort and structural damage have been included for completeness.

Vibration limits – human comfort

Humans can detect vibration levels which are well below those causing any risk of damage to a building or its contents. Recommendations for vibration from construction works in relation to human comfort is assessed under the NSW EPA document *Assessing Vibration – a technical guideline* (AVTG).

The AVTG provides guidance with respect to intermittent, impulsive and continuous vibration sources, which can be generated by construction activities. The vibration characteristics of many construction activities (e.g. excavation, rock breaking and piling) are generally considered to be intermittent. Continuous vibration sources may include tunnel boring and impulsive vibration sources may include drop piling or blasting.

Intermittent vibration

The vibration characteristics of most construction activities (e.g. excavation and piling) are considered to be intermittent. Intermittent vibration can be defined as interrupted periods of continuous vibration (e.g. heavy truck pass-bys or rock breaking) or continuous periods of impulsive vibration (e.g. impact pile driving). Higher vibration levels are allowed for intermittent vibration compared with continuous vibration on the basis that the higher levels occur over a shorter time period. Hence, for intermittent vibration, human disturbance vibration levels are assessed on the basis of the Vibration Dose Value (VDV), based on the level and the duration of the vibration events. Vibration criteria applicable to the site for intermittent vibration sources, are summarised in Table 8.

Table 8: Preferred and Maximum Vibration Levels for Human Comfort – Intermittent Vibration

Location	Day[1]		Night[1]	
	Preferred Value VDV	Maximum Value VDV	Preferred Value VDV	Maximum Value VDV
Residences	0.2	0.4	0.13	0.26

Location	Day[1]		Night[1]	
	Preferred Value VDV	Maximum Value VDV	Preferred Value VDV	Maximum Value VDV
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Note 1: Daytime period is 7.00 am to 10.00 pm and night-time period is 10.00 pm to 7.00 am.

Continuous vibration

Vibration criteria applicable to the site for continuous vibration sources, is summarised in Table 9.

Table 9: Preferred and Maximum Vibration Levels for Human Comfort - Continuous Vibration

Vibration type	Location	Assessment Period	Preferred Values (m/s^2)		Maximum Values (m/s^2)	
			z axis	x and y axes	z axis	x and y axes
Continuous vibration	Residences	Day	0.010	0.0071	0.020	0.014
		Night	0.007	0.005	0.014	0.010
	Offices, schools, educational institutions and places of worship	Day or night	0.020	0.0014	0.040	0.028
	Workshops	Day or night	0.04	0.0029	0.080	0.058

Note 1: The preferred and maximum values are weighted RMS acceleration values in accordance with NSW EPA document *Assessing Vibration – a technical guideline*.

Vibration limits – effects on structures

Whilst the AVTG provides guidelines for the assessment of vibration impacts on people (human comfort), no direct instruction or guidance is provided for the assessment of impacts on structures. For assessment of vibration effects on structures, the German standard DIN4150-3 *Structural vibration – Effects of vibration on structures – 1999* is generally adopted.

The guideline vibration limits, as reproduced from the standard, are detailed in Table 10.

Table 10: Structural Damage Criteria DIN 4150 (PPV mm/s)

Line	Type of structure	Vibration at the foundation of building, at a frequency of			Vibration in horizontal plane of highest floor, at all frequencies
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz and above	
I	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20[1]	20 to 40	40 to 50	40
II	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15

8.2 Operational Noise

8.2.1 Noise Policy for Industry (NPfI)

Operational noise from the proposed new school facilities may be generated by the following:

- mechanical services plant
- teaching and practical activities
- school announcements and bells
- sporting activities and events in the hall
- sports-related classes held in the outdoor play area
- outdoor play area during breaks
- vehicular movements on site and at drop off/pick-points during the morning and afternoon.

The NPfI does not provide specific assessment requirements for schools. Some of the sources of noise from schools operate in a continuous or near-continuous manner and on that basis may be considered in a similar way to the sources that are explicitly addressed under the NPfI. Such sources include external mechanical plant and activity-related noise generated during the use of spaces like the hall, technology rooms and performing arts areas. It is therefore reasonable and appropriate to consider these sources of noise in the context of the NPfI.

The NPfI documents a procedure for assessment and management of industrial noise which involves determining the project noise trigger levels for a development. The project noise trigger level is a benchmark level above which noise management measures are required to be considered. They are derived by considering short-term intrusiveness due to changes in the existing noise environment (applicable to residential receivers only) and maintaining noise amenity levels for particular land uses for residents and other sensitive receivers.

Intrusiveness noise level

For assessing intrusiveness, the background noise level (L_{A90}) is measured and the Rating Background Level (RBL) determined in accordance with the NPfI procedures. The intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous noise level (L_{Aeq}) of the source (measured over a 15-minute period) does not exceed the background noise level L_{A90} (RBL) by more than 5 dB.

Amenity noise level

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include transportation noise (when on public transport corridors), noise from motor sport, construction noise, community noise, blasting, shooting ranges, occupational workplace noise, wind farms or amplified music/patron noise.

The amenity noise level aims to limit continuing increases in noise levels which may occur if the intrusiveness level alone is applied to successive developments within an area.

The recommended amenity noise level represents the objective for total (industrial or other applicable sources) noise at a receiver location. The project amenity noise level represents the objective for noise from a single (industrial) development at a receiver location.

To prevent increases in the overall ambient noise environment due to the cumulative effect of several developments, the project amenity noise level for each new source is set at 5 dBA below the recommended amenity nose level.

The following exceptions are applicable to determining the project amenity noise level:

- For high traffic areas the amenity criterion for industrial noise becomes the $L_{Aeq,period(traffic)}$ minus 15 dBA.
- Where cumulative industrial noise is not a consideration because no other industries are present in, or likely to be introduced into the area, the relevant amenity noise level is assigned as the project amenity noise level for the development.
- Additionally, where a greenfield development is proposed, and it can be demonstrated that existing levels of industrial noise are more than 5 dB lower than the recommended amenity noise level, the relevant amenity noise level is assigned as the project amenity noise level for the development.

Amenity noise levels are not used directly as regulatory limits. They are used in combination with the project intrusiveness noise level to assess the potential impact of noise, assess mitigation options and determine achievable noise requirements.

An extract from the NSW NPfI that relates to the amenity noise levels for surrounding receivers is given in Table 11.

Table 11: NPfI Amenity Noise Levels

Receiver	Noise Amenity Area	Time of Day[1]	Recommended Amenity Noise Level L_{Aeq} (dBA)
Residential	Suburban	Day	55
		Evening	45
		Night	40

Note 1: Daytime 7.00 am–6.00 pm; Evening 6.00 pm–10.00 pm; Night 10.00 pm-7.00 am.

8.2.2 Project noise trigger levels

The amenity and intrusiveness noise levels and resulting project trigger levels (shown in bold) applicable to sources of continuous operational noise associated with the project are shown in Table 12.

These levels apply to the assessment of noise generated by the following sources within the proposed school boundaries:

- mechanical services plant
- teaching and practical activities
- sporting activities and events conducted in the hall.

The current noise environment is principally controlled by local and distant traffic, community-based and environmental sources and local road traffic. Residential subdivision development and associated construction and road traffic also contribute to the ambient noise levels. There are no existing industrial noise contributions of significance and given the residential zoning, there is unlikely to be any in the future. The ongoing urbanisation of the area can be expected to lead to an increase in background noise, resulting in levels that more closely align with those typically experienced in suburban communities. Accordingly, the relevant amenity noise level applicable to a suburban area is assigned as the project amenity noise level.

When land uses in an area are undergoing significant change, such as residential subdivisions with associated local and regional roads, the background noise levels would be expected to change. According to the NPfI Section 2.4.3, assessment of the impact of noise on a proposed new residential area should be made using the recommended amenity noise level, not the project intrusiveness noise level.

For the purpose of assessing the impact of noise associated with the operation of the future high school, the intrusiveness level has been adopted as reflecting the most conservative (more stringent) approach and is considered applicable to the proposed development (refer Table 12).

Table 12: Project Noise Trigger Levels

Receiver	Period	Intrusiveness Noise Level $L_{Aeq,15min}$ (dBA)	Project Amenity Noise Level $L_{Aeq,15min}$ (dBA)[2]
Residential	Day	**40**	58
	Evening	**40**[1] (39)	48
	Night	39	43

Note 1: In accordance with the NPfI Section 2.3, where the RBL measured during the evening period () exceeds the RBL measured during the daytime, the daytime RBL should be applied to determine the intrusiveness criterion applicable to the evening period.

Note 2: The L_{Aeq} descriptor is used for both the intrusiveness noise level and the amenity noise level. The L_{Aeq} is determined over a 15-minute period for the project intrusiveness noise level and over an assessment period (day, evening and night) for the project amenity noise level. To standardise the time periods for the intrusiveness and amenity noise levels the $L_{Aeq,15min}$ is taken to be equal to the $L_{Aeq,period}$ + 3 dB.

8.2.3 Outdoor sport and activity noise

Outdoor sporting facilities provided under Scenario 1 of the high school proposal include a sports field and three (3) multi-sports courts located centrally within the site. For Scenario 2, the sports field would be included in Stage 1 and the three sports courts in Stage 2. Scenario 2 Stage 1 and Stage 2 will be operational at the same time.

Noise will be generated by students during supervised PE classes on the sporting fields and by students located generally across the whole outdoor campus area for a short time in the morning prior to commencement of classes, during recess and lunch.

There are no regulatory criteria or guidelines applicable to the assessment of noise generated by outdoor activities from schools. The noise source cannot be assessed appropriately in the same manner as noise generated by the use of learning facilities such as performing arts and technology rooms, gymnasiums and halls.

Schools are an essential part of residential community infrastructure. Noise emissions from school children engaged in active outdoor games are unlikely to comply with a 'background + 5 dBA' intrusiveness criterion adjacent to the site boundary or at a neighbouring residential property.

In general, the impact of outdoor activity noise from schools should be considered acceptable at surrounding receivers due to the planning approval based on site zoning. On this basis, and together with the limited periods of outdoor recreational and physical activities and the times at which they occur, quantitative assessment of noise emissions should not typically be warranted.

A 'background + 10 dBA' criterion, based upon the guideline for the assessment of noise from childcare centres prepared by the Association of Australasian Acoustical Consultants (AAAC), has previously been applied by Marshall Day Acoustics to the assessment of other schools within NSW.

In the case of Al-Faisal College Limited v Canterbury Bankstown Council (2018), which involved the development of a new primary school, the Land and Environment Court accepted that the 'background + 10 dBA' approach may be considered a 'datum' of acceptability when considering whether acoustical impacts arising from an educational establishment are reasonable in a merit assessment of the application. The Court however also found that this guideline was not intended to be directly applied to the assessment of noise from outdoor play at a school.

In the absence of any other quantitative criterion for assessment of noise emissions from outdoor play, the 'background + 10 'BA' criterion can be applied as a 'yardstick' or 'datum' for determining the acceptability of noise emissions from the outdoor sporting fields and recreational spaces.

Applying this guideline for the assessment of outdoor activity noise, the relevant 'limits' applicable are presented in Table 13.

Table 13: Guideline Assessment Criteria for Outdoor Sport & Activity Noise

Receiver	RBL [1] $L_{A90,(15min)}$ dB	Emission Guideline $L_{Aeq,15min}$ dB
Residential	35	45

Note 1: Outdoor use during daytime period only

8.3 Road traffic noise

The NSW Road Noise Policy (2011) was released by the EPA to replace the *Environmental criteria for road traffic noise* (1999) from 1 July 2011. The key provisions of the policy are an emphasis on the use of land use planning, better road design and vehicle noise emission control to avoid or minimise road traffic noise impacts. The assessment criteria for residences potentially affected by additional traffic generated by land use developments on arterial, sub-arterial and local roads are summarised in Table 14.

Table 14: Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of Development	Assessment Criteria – dBA	
		Day (7 am-10 pm)	**Night (10 pm-7 am)**
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,15hr}$ 60 (external)	$L_{Aeq,9hr}$ 55 (external)
	Relative Increase Criteria	Existing traffic $L_{Aeq,15hr}$ + 12 dB (external)	Existing traffic $L_{Aeq,9hr}$ + 12 dB (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq,(1hour)}$ 55 (external)	$L_{Aeq,(1hour)}$ 50 (external)

Where predicted noise levels exceed the project-specific noise criteria, an assessment of all feasible and reasonable mitigation options should be considered. The RNP states that an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

The project would contribute to increased traffic on local roads accessing the school.

8.4 Aircraft noise

The new high school will be located approximately 17 km north of the future Western Sydney International (Nancy-Bird Walton) Airport (WSI Airport).

According to the WSI *Airport Aircraft Overflight Noise Tool* (Department of Infrastructure, Transport, Regional Development, Communications and the Arts), although the future school is located well beyond the ANEC 20 contour, the site lies below the flight path for departures from Runway 05, and in close proximity to the flight path for arrivals on Runway 23.

In Australia, exposure to aircraft noise at major airports is measured using a number of tools that include the Australian Noise Exposure Concept (ANEC) and the Australian Noise Exposure Forecast (ANEF). An ANEC is based on the runway direction and indicative flight paths for take-offs and landings. An ANEC is a cumulative noise measure which illustrates aircraft noise exposure based on various operational scenarios.

An ANEF chart is similar to an ANEC but is generated based on the final approved airport flight path design. ANEF noise contours are formally endorsed for technical accuracy and practical operational application by Airservices Australia (the government air navigation services provider).

Australian Standard AS 2021:2015 *Acoustics - Aircraft noise intrusion - Building siting and construction* (AS 2021) documents guidelines for the assessment of site suitability for proposed developments near airports.

The NSW DoE *Education Facilities Standards and Guidelines* (EFSG) *Design Checklist – Acoustics* provides the following guidance on internal noise levels for new school buildings:

> *Aircraft Noise for general learning areas, music, drama, movement studios and halls are to be assessed where the school site lies within Australian Noise Exposure Forecast (ANEF) 25 (or higher) as shown on airport planning instruments. The procedures in AS 2021 are to be followed in the assessment.*

In accordance with AS 2021, a school should be located outside the ANEF 20 contour. Sites within the ANEF 20 to ANEF 25 contours are considered 'conditionally acceptable' and would typically require acoustic assessment and building treatment to achieve acceptable noise environments within learning and study areas. Schools would not normally be considered 'acceptable' in zones from ANEF 25 and above.

AS 2021 provides recommendations for acceptable internal noise levels within various areas of occupancy inside buildings during aircraft flyovers. The AS 2021 recommended internal (L_{Amax}) design levels for spaces within educational establishments are documented in Table 15. On sites that are subject to high levels of aircraft noise, windows may be required to be closed to achieve these recommended levels.

Table 15: AS 2021:2015 Recommended Indoor Design Sound Levels – Schools and Universities

Building Type and Activity	Indoor Design Sound Level, dB L_{Amax}
Schools, universities	
Libraries, study areas	50
Teaching areas, assembly areas	55
Workshops, gymnasia	75

The recommendations within AS 2021 therefore indicate an internal level of 50 dB L_{Amax} may be more appropriate for noise sensitive spaces.

9.0 ACOUSTIC MODELLING

9.1 Overview

In assessing the potential noise impact of the proposed high school on the existing and future community, the following require consideration:

- noise and vibration generated during construction
- noise sources which may impact upon the suitability of the site for the intended future usage
- sources of noise generation associated with the development.

By determining the extent of noise affectation across the site and surrounds, the acoustic opportunities and constraints can be identified to assist future design.

To this end, computer modelling has been carried out to establish the extent to which construction noise and vibration and operational noise may affect residential amenity.

The potential impact of noise on future educational development due to aircraft movements associated with the future WSI Airport has been considered based on the WSI Airport Aircraft Overflight Noise Tool (Department of Infrastructure, Transport, Regional Development, Communications and the Arts).

9.2 Modelling assumptions and inputs

9.2.1 Noise model

A 3D computer model of the project site and surrounds has been created using the environmental noise modelling program SoundPLANnoise v9.0. The potential noise impacts resulting from the two delivery scenarios, Scenario 1 and Scenario 2 have been conducted based on information and building layouts provided (refer Table 2). Scenario 2 has been evaluated for the stages identified to contribute operational noise sources (ie Stage 1 and Stage 2). Scenario 2 Stage 3 involves civil, construction and demolition works that are considered under the construction noise assessment.

The assumptions included in the model are summarised in the following sections.

Modelling of outdoor noise propagation has been conducted in accordance with ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation (ISO 9613-2). The noise model calculates noise levels over a wide area, and accounts for key considerations including site arrangement, terrain and atmospheric conditions, air absorption, reflections, screening, and ground effects.

It is noted that although ISO 9613-2:2024 has recently been released, this calculation method as previously documented and implemented in the model, provides a suitable methodology for the purposes of predicting environmental noise levels from industry and other sources and has been adopted for this assessment.

Terrain data for the model and digital elevation models was based upon the survey data supplied by the DoE.

9.2.2 Construction noise and vibration

9.2.2.1 Scenario 1 Assessment

The following external works would be completed by others to facilitate Scenario 1:

- Construction of Park Edge Road
- Any adjustments to Infantry Street
- Kiss and drop zone along Park Edge Road
- Support kiss and drop zone located along Infantry Street
- Construction and operation of permanent OSD Basin off site.

During Scenario 1 the following works would be conducted:

- Construction and Operation of the New High School for Jordan Springs, including:
  - Decommissioning of existing on-site OSD basin
  - Demolition of roads and associated services within the site boundary
  - Tree removal within the site boundary
  - Earthworks
  - Three (3) multi-storey classroom buildings
  - One (1) school hall
  - Three (3) outdoor sport's courts
  - One (1) sport's field
  - 72 at grade car parking spaces, including two (2) accessible parking spaces, and waste services, accessed via Park Edge Road
  - 100 bicycle parking spaces across the site
  - Landscaping.

9.2.2.2 Scenario 2 Stage 1 Assessment

Scenario 2 is an Interim Solution. The road network would not be completed and a permanent OSD basin would not be constructed.

During Scenario 2 Stage 1 the following works would be conducted:

- Construction and operation of a temporary on-site OSD Basin
- Construction and operation of the New High School for Jordan Springs, including:
  - Demolition of roads and associated services within the site boundary
  - Tree removal within the site boundary
  - Earthworks
  - Three (3) multi-storey classroom buildings
  - One (1) sport's field
  - Temporary carpark - 72 at grade car parking spaces, including two (2) accessible parking spaces and waste services, located on the northwest corner of the site, accessed off Armoury Road
  - 100 bicycle parking spaces across
  - Temporary Kiss and drop facilities on Armoury Road
  - Associated landscaping.

9.2.2.3 Scenario 2 Stage 2 Assessment

Scenario 2 Stage 2 is not to be undertaken until the temporary on-site OSD basin under Stage 1 works is completed and operational. The following works would be conducted:

- Decommissioning of existing on-site OSD basin, prior to the following works being undertaken:
  - 72 at grade car parking spaces, including two (2) accessible parking spaces, and waste services, located on the southeast corner of the site. This car park cannot be constructed until the decommissioning of the existing OSD basin is completed and will be non-operational with no road connection until completion of Scenario 2 – Stage 3
  - One (1) school hall
  - Three (3) outdoor sport's courts
  - Associated landscaping.

9.2.2.4 Scenario 2 Stage 3 Assessment

Scenario 2 Stage 3 would not proceed until the external works as required for Scenario 1 are completed. Following completion of these works, the following works would be conducted:

- Connection of the southeast carpark to Park Edge Road

- Rectification works along Armoury Road to remove temporary kiss and drop facilities and cross over for temporary carpark
- Demolition of temporary carpark, once permanent car park is operational
- Decommissioning of temporary OSD basin.

9.2.2.5 Construction Noise Assessment Scenarios

A preliminary assessment based on typical construction processes has been undertaken for each of the works scenarios. A detailed evaluation and preparation of a CNVMP will be required once a contractor has been appointed and specific construction processes can be identified.

At this early planning stage, specific details regarding proposed construction processes are not known, with the types of activities, plant and scheduling not yet determined.

The construction phases shown in Table 16 were selected to represent the typical works throughout the course of the project delivery for the preferred and interim scenarios:

Table 16: Construction Assessment Phases

Scenario	Description	Works
1	Bulk excavation & earthworks	Site preparation and excavation works – mainly using excavators. Grading, rolling and compaction works. Dust suppression and truck movements. Trucks assumed to operate 50% of the time over 15 minutes.
1	Piling, drainage works, slabs	Bored piling, concreting and lifting. Bored piling rig, concrete pumps & boom, material hoist, crane, dust suppression are assumed to operate continuously over 15 minutes. Concrete trucks and normal delivery trucks assumed to operate 50% of the time over 15 minutes.
1	General building works façade / fitout	General construction works including façade and internal fitout. Power tools operational and mobile crane operating continuously.
2 – Stage 1	Bulk excavation & earthworks	Site preparation and excavation works – mainly using excavators. Grading, rolling and compaction works. Dust suppression and truck movements. Trucks assumed to operate 50% of the time over 15 minutes.
	Piling, drainage works, slabs	Bored piling, concreting and lifting. Bored piling rig, concrete pumps & boom, material hoist, crane, dust suppression are assumed to operate continuously over 15 minutes. Concrete trucks and normal delivery trucks assumed to operate 50% of the time over 15 minutes.
	General building works façade / fitout	General construction works including façade and internal fitout. Power tools operational and mobile crane operating continuously.
2 – Stage 2	Earthworks & drainage	Carpark preparation and earthwork – mainly using excavators. Grading, rolling and compaction works. Dust suppression and truck movements. Trucks assumed to operate 50% of the time over 15 minutes.

Scenario	Description	Works
	General building works façade / fitout, sports courts	General construction works including façade and internal fitout. Power tools operational and mobile crane operating continuously.
Stage 3	Demolition Decommissioning of temporary OSD basin and temporary carpark, rectification works on Armoury Road	Excavators, trucks, grading, rolling and compaction works.

Noise modelling has been conducted for each of the above scenarios and stages, with plant positioned in locations representative of typical operation during the works across the construction sites.

The modelling assumes a 'typical worst-case' scenario whereby it has been assumed plant operates continuously and simultaneously on the site. Trucks have been assumed to operate continuously for 50% of the time over a 15-minute assessment time period. As such, predictions represent the noise levels that can be expected to occur during intensive periods of construction. The resultant noise levels can be considered in the upper range expected at surrounding receivers throughout the course of construction works

9.2.2.6 Construction equipment and source noise levels

No comprehensive plan for staging and equipment selection is available at this early stage of the project. In the absence of further detailed information, construction plant typically associated with the works phases considered have been assumed. These assumptions must be reviewed in the detailed design phase when information is available on the schedule for the works and the equipment to be used and a further, more comprehensive, assessment of construction noise and vibration can be carried out. A summary of equipment anticipated to be used on the site during the three major construction stages for both development stages is documented in Table 17. The noise levels attributed to each item were based on:

- BS5228-1-2009: *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*.

Table 17: Typical Construction Plant Noise Levels

Noise Source	Sound Power Level, L_{Aeq} dB SWL	Source
Tracked 22t excavator (2 off)	106	BS5228-1-2009
Grader 25t	114	BS5228-1-2009
Articulated Dump Truck 23t (4off)	102	BS5228-1-2009
Roller 18t	101	BS5228-1-2009
Dust Suppression	104	BS5228-1-2009
Bored Piling	107	BS5228-1-2009

Noise Source	Sound Power Level, L_{Aeq} dB SWL	Source
Concrete Truck & Pump (4 off)	103	BS5228-1-2009
Concrete Vibrator	97	BS5228-1-2009
Concrete Floats	100	BS5228-1-2009
Mobile Crane 110t	95	BS5228-1-2009
Electric Winch & Material Hoist	96	BS5228-1-2009
Generator 120kW	93	BS5228-1-2009
Air Compressor 70kW	93	BS5228-1-2009
Nail Gun	101	BS5228-1-2009
Hand Drill	105	BS5228-1-2009

9.2.2.7 Construction traffic

According to the *Transport Impact Assessment* prepared by Stantec, the project traffic consultants (refer Project/File 300305098 rev B dated 08.11.2024) the site will be accessed by various types of construction vehicles. The largest would include 12.5 m heavy rigid vehicles. A limited number of larger special purpose vehicles (such as floats for plant and equipment, large mobile cranes) will be required. These would be subject to a separate oversize application process. Construction vehicles would enter and exit the site via the Wianamatta Parkway and Armoury Road.

As part of the detailed Construction Traffic Management Plan, a traffic guidance scheme (TGS) will be prepared in accordance with the principles of the Transport for NSW Traffic Control at Work Sites manual. The Principal Contractor will be required to provide TGSs for the proposed works which consider the following to minimise short-term noise impact on receivers along the vehicle route and in proximity to the work site:

- Construction vehicle activity, including loading/unloading to be conducted within the work site
- Clear definition of work site boundary by erection of site fencing or A and B Class hoardings
- All construction vehicle activity will be minimised during peak periods where possible.

9.2.3 Operational noise

9.2.3.1 Assessment scenarios

The proposed new high school will accommodate 1000 students.

It is assumed that the school campus would operate within normal school hours generally between 8.30 am and 3.00 pm. Recess and lunch may be staggered, however no information regarding bell times for the senior and junior cohorts were available at the time of preparation of this assessment.

Occasional evening use may occur for school academic and performance presentations. Operation past 10.00 pm would be unlikely.

The proposal does not include the use of school facilities by external community groups. This will be facilitated under a separate planning pathway if required.

The proposed plans of the secondary campus have been produced by DJRD Architects and are included separately within the submission.

Operational noise has been considered for the following scenarios:

- Scenario 1- Preferred Option
    - 3 x classroom buildings
    - School hall
    - 3 x outdoor sports courts
    - Sports field
    - Carpark – 72 spaces accessed off Park Edge Road
- Scenario 2 – Interim Option – Stage 1
    - 3 x classroom buildings
    - Sports field
    - Carpark – 72 spaces accessed off Armoury Road
- Scenario 2 – Interim Option – Stage 2
    - School hall
    - 3 x outdoor sports courts

Note that Scenario 2 Stage 3 includes the connection of the southeast carpark to Park Edge Road.

9.2.3.2 Noise sources

As previously documented, operational noise from the proposed new school facilities may be generated by the following:

- mechanical services plant
- teaching and practical activities
- school announcements and bells
- sporting activities and events in the hall
- sports-related classes held in the outdoor play area
- outdoor play area during breaks
- vehicular movements on site and at drop off/pick-up areas
- maintenance activities.

Table 18 summarises the sources and associated noise levels input to the model for the assessment of continuous and semicontinuous operational noise from the high school development.

Table 18: Noise Modelling L_{eq} Source Data

Source	Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1000	2000	4000	8000	
Wood Workshop Reverberant Sound pressure level dB	50	57	70	74	77	81	83	76	87
Metal Workshop Reverberant Sound pressure level dB	73	78	75	75	72	76	78	79	84
Performing Arts Reverberant Sound pressure level dB	92	84	89	86	86	84	76		88
Hall – Sports Mode Reverberant Sound pressure level dB	84	77	75	80	86	82	73		88
Hall – Event Mode Reverberant Sound pressure level dB	92	87	82	84	87	84	76	67	90
Outdoor Sports – Soccer Sound Power level dB	98	94	87	84	88	86	77	63	92
Outdoor Sports- Netball Sound Power level dB	86	82	82	84	86	85	82	66	90

Source	Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1000	2000	4000	8000	
Outdoor play Sound Power level dB per student	62	59	63	70	76	74	66	53	79
Outdoor play Sound Power level dB 500 students	89	86	90	97	103	101	93	80	106
Carpark Low speed movement 5 – 10 km Sound Power level dB	94	90	86	82	82	78	73	N/A	86

10.0 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

10.1 Construction noise

10.1.1 Residential receivers

The results of modelling to estimate noise generated by construction works to deliver the facilities included in the preferred and interim options (and associated stages) are shown in Table 19 to Table 22. The location of the surrounding residential receivers adopted for prediction of construction noise are shown in Figure 4. Exceedances of the construction noise management levels (NMLs) and highly noise affected level (HNL) are listed applicable to works during recommended standard hours.

Table 19: Scenario 1 - Predicted $L_{Aeq(15\ min)}$ Construction Noise Levels

Receiver	Address	Predicted Noise Level dB	NML dB	Exceedance over NML dB	HNL dB	Exceedance over HNL dB
			Bulk Excavation and Earthworks			
R1	12 Charlie Street	54	45	+9	75	0
R2	124 Armoury Road	56	45	+11	75	0
R3	135 Armoury Road	64	45	+19	75	0
R4	137 Armoury Road	65	45	+20	75	0
R5	143 Armoury Road	63	45	+18	75	0
R6	145 Armoury Road	61	45	+16	75	0
R7	153 Armoury Road	58	45	+13	75	0
R8	25 Squadron Street	51	45	+6	75	0
R9	Future Residence Lasetter Street - NW	57	45	+12	75	0
R10	Future Residence Lasetter Street - NE	56	45	+11	75	0
R11	Future Residence Infantry Street - SW	58	45	+13	75	0
R12	Future Residence Infantry Street - S	60	45	+15	75	0
			Piling, Drainage Works & Slabs			
R1	12 Charlie Street	55	45	+10	75	0
R2	124 Armoury Road	57	45	+12	75	0
R3	135 Armoury Road	62	45	+17	75	0
R4	137 Armoury Road	64	45	+19	75	0
R5	143 Armoury Road	66	45	+21	75	0
R6	145 Armoury Road	64	45	+19	75	0
R7	153 Armoury Road	60	45	+15	75	0

Receiver	Address	Predicted Noise Level dB	NML dB	Exceedance over NML dB	HNL dB	Exceedance over HNL dB
R8	25 Squadron Street	53	45	+8	75	0
R9	Future Residence Lasetter Street - NW	59	45	+14	75	0
R10	Future Residence Lasetter Street - NE	56	45	+11	75	0
R11	Future Residence Infantry Street - SW	61	45	+16	75	0
R12	Future Residence Infantry Street - S	60	45	+15	75	0
	General Building Works – Facade/Fitout					
R1	12 Charlie Street	56	45	+11	75	0
R2	124 Armoury Road	59	45	+14	75	0
R3	135 Armoury Road	64	45	+19	75	0
R4	137 Armoury Road	66	45	+21	75	0
R5	143 Armoury Road	66	45	+21	75	0
R6	145 Armoury Road	65	45	+20	75	0
R7	153 Armoury Road	60	45	+15	75	0
R8	25 Squadron Street	53	45	+8	75	0
R9	Future Residence Lasetter Street - NW	59	45	+14	75	0
R10	Future Residence Lasetter Street - NE	57	45	+12	75	0
R11	Future Residence Infantry Street - SW	65	45	+20	75	0
R12	Future Residence Infantry Street - S	61	45	+16	75	0

Table 20: Scenario 2 Stage 1 - Predicted $L_{Aeq(15\ min)}$ Construction Noise Levels

Receiver	Address	Predicted Noise Level dB	NML dB	Exceedance over NML dB	HNL dB	Exceedance over HNL dB
	Bulk Excavation and Earthworks					
R1	12 Charlie Street	49	45	+4	75	0
R2	124 Armoury Road	49	45	+4	75	0

Receiver	Address	Predicted Noise Level dB	NML dB	Exceedance over NML dB	HNL dB	Exceedance over HNL dB
R3	135 Armoury Road	54	45	+9	75	0
R4	137 Armoury Road	56	45	+11	75	0
R5	143 Armoury Road	59	45	+14	75	0
R6	145 Armoury Road	62	45	+17	75	0
R7	153 Armoury Road	64	45	+19	75	0
R8	25 Squadron Street	55	45	+10	75	0
R9	Future Residence Lasetter Street - NW	66	45	+21	75	0
R10	Future Residence Lasetter Street - NE	62	45	+17	75	0
R11	Future Residence Infantry Street - SW	50	45	+5	75	0
R12	Future Residence Infantry Street - S	52	45	+7	75	0
		Piling, Drainage Works & Slabs				
R1	12 Charlie Street	54	45	+9	75	0
R2	124 Armoury Road	56	45	+11	75	0
R3	135 Armoury Road	64	45	+19	75	0
R4	137 Armoury Road	65	45	+20	75	0
R5	143 Armoury Road	63	45	+18	75	0
R6	145 Armoury Road	61	45	+16	75	0
R7	153 Armoury Road	58	45	+13	75	0
R8	25 Squadron Street	51	45	+6	75	0
R9	Future Residence Lasetter Street - NW	57	45	+12	75	0
R10	Future Residence Lasetter Street - NE	56	45	+11	75	0
R11	Future Residence Infantry Street - SW	58	45	+13	75	0
R12	Future Residence Infantry Street - S	60	45	+15	75	0
		General Building Works – Facade/Fitout				
R1	12 Charlie Street	55	45	+10	75	0
R2	124 Armoury Road	59	45	+14	75	0

Receiver	Address	Predicted Noise Level dB	NML dB	Exceedance over NML dB	HNL dB	Exceedance over HNL dB
R3	135 Armoury Road	64	45	+19	75	0
R4	137 Armoury Road	66	45	+21	75	0
R5	143 Armoury Road	65	45	+20	75	0
R6	145 Armoury Road	64	45	+19	75	0
R7	153 Armoury Road	59	45	+14	75	0
R8	25 Squadron Street	50	45	+5	75	0
R9	Future Residence Lasetter Street - NW	58	45	+13	75	0
R10	Future Residence Lasetter Street - NE	54	45	+9	75	0
R11	Future Residence Infantry Street - SW	65	45	+20	75	0
R12	Future Residence Infantry Street - S	60	45	+15	75	0

Table 21: Scenario 2 Stage 2 - Predicted $L_{Aeq(15\ min)}$ Construction Noise Levels

Receiver	Address	Predicted Noise Level dB	NML dB	Exceedance over NML dB	HNL dB	Exceedance over HNL dB
Excavation and Earthworks						
R1	12 Charlie Street	52	45	+7	75	0
R2	124 Armoury Road	53	45	+8	75	0
R3	135 Armoury Road	55	45	+10	75	0
R4	137 Armoury Road	56	45	+11	75	0
R5	143 Armoury Road	56	45	+11	75	0
R6	145 Armoury Road	54	45	+9	75	0
R7	153 Armoury Road	51	45	+6	75	0
R8	25 Squadron Street	47	45	+2	75	0
R9	Future Residence Lasetter Street - NW	51	45	+6	75	0
R10	Future Residence Lasetter Street - NE	50	45	+5	75	0
R11	Future Residence Infantry Street - SW	56	45	+11	75	0

Receiver	Address	Predicted Noise Level dB	NML dB	Exceedance over NML dB	HNL dB	Exceedance over HNL dB
R12	Future Residence Infantry Street - S	59	45	+14	75	0
		Piling, Drainage Works & Slab				
R1	12 Charlie Street	54	45	+9	75	0
R2	124 Armoury Road	56	45	+11	75	0
R3	135 Armoury Road	64	45	+19	75	0
R4	137 Armoury Road	65	45	+20	75	0
R5	143 Armoury Road	63	45	+18	75	0
R6	145 Armoury Road	61	45	+16	75	0
R7	153 Armoury Road	58	45	+13	75	0
R8	25 Squadron Street	51	45	+6	75	0
R9	Future Residence Lasetter Street - NW	57	45	+12	75	0
R10	Future Residence Lasetter Street - NE	56	45	+11	75	0
R11	Future Residence Infantry Street - SW	58	45	+13	75	0
R12	Future Residence Infantry Street - S	60	45	+15	75	0
		General Building Works – Facade/Fitout				
R1	12 Charlie Street	55	45	+10	75	0
R2	124 Armoury Road	56	45	+11	75	0
R3	135 Armoury Road	58	45	+13	75	0
R4	137 Armoury Road	59	45	+14	75	0
R5	143 Armoury Road	58	45	+13	75	0
R6	145 Armoury Road	55	45	+10	75	0
R7	153 Armoury Road	51	45	+6	75	0
R8	25 Squadron Street	47	45	+2	75	0
R9	Future Residence Lasetter Street - NW	51	45	+6	75	0
R10	Future Residence Lasetter Street - NE	49	45	+4	75	0
R11	Future Residence Infantry Street - SW	59	45	+14	75	0

Receiver	Address	Predicted Noise Level dB	NML dB	Exceedance over NML dB	HNL dB	Exceedance over HNL dB
R12	Future Residence Infantry Street - S	62	45	+17	75	0

Table 22: Scenario 2 Stage 3 - Predicted $L_{Aeq(15\ min)}$ Construction Noise Levels

Receiver	Address	Predicted Noise Level dB	NML dB	Exceedance over NML dB	HNL dB	Exceedance over HNL dB
		Demolition, Earthworks & Civil Works				
R1	12 Charlie Street	49	45	+4	75	0
R2	124 Armoury Road	49	45	+4	75	0
R3	135 Armoury Road	54	45	+9	75	0
R4	137 Armoury Road	56	45	+11	75	0
R5	143 Armoury Road	58	45	+13	75	0
R6	145 Armoury Road	62	45	+17	75	0
R7	153 Armoury Road	64	45	+19	75	0
R8	25 Squadron Street	55	45	+10	75	0
R9	Future Residence Lasetter Street - NW	66	45	+21	75	0
R10	Future Residence Lasetter Street - NE	62	45	+17	75	0
R11	Future Residence Infantry Street - SW	50	45	+5	75	0
R12	Future Residence Infantry Street - S	52	45	+7	75	0

During construction works, noise levels may exceed the NML by up to 21 dB during periods when construction plant operates in close proximity to the perimeter of the site. These exceedances will progressively reduce as construction plant moves away from the receiver location and the distance between source and receiver increases. The implementation of noise management measures as detailed in the CNVMP prepared by the Head Contractor may be required to mitigate impacts on the surrounding residential properties should disturbances arise.

No exceedances of the High Noise Level are expected.

The predicted levels are consistent with noise levels generated during typical construction works on a site in reasonably close proximity to a receiver.

The exceedances of the NML are higher in this case due to the low background noise environment currently experienced in the newly developing area.

The implementation of noise management measures will be required to mitigate impacts on the surrounding residential properties. A detailed CNVMP should be prepared prior to construction works commencing.

With the implementation of noise management measures, impacts on the surrounding residential receivers can be minimised.

10.1.2 School Operations

Construction works during Scenario 2 Stage 2 and Scenario 2 Stage 3 would be undertaken after the school facilities are constructed in Scenario 2 Stage 1 and we have been requested by the client to assess the impact on the school facilities in this report. To evaluate the extent of potential disruption to future school activities during these works, modelling has been carried out to receiver locations within the school. The results are shown in Table 23 and

Table 24. Exceedances of the construction noise management levels (NMLs) and highly noise affected level (HNL) are listed applicable to works during recommended standard hours.

The locations within the school adopted for construction noise predictions are shown in Figure 5. The results for upper floor have been presented as the worst case. The NML recommended for classrooms at schools is an internal noise level (refer Table 7). In accordance with ICNG procedures, the NML included represents an external level by adopting a conservate difference between internal and external noise levels of 10 dB where windows are normally open for ventilation.

Figure 5: Construction noise assessment locations

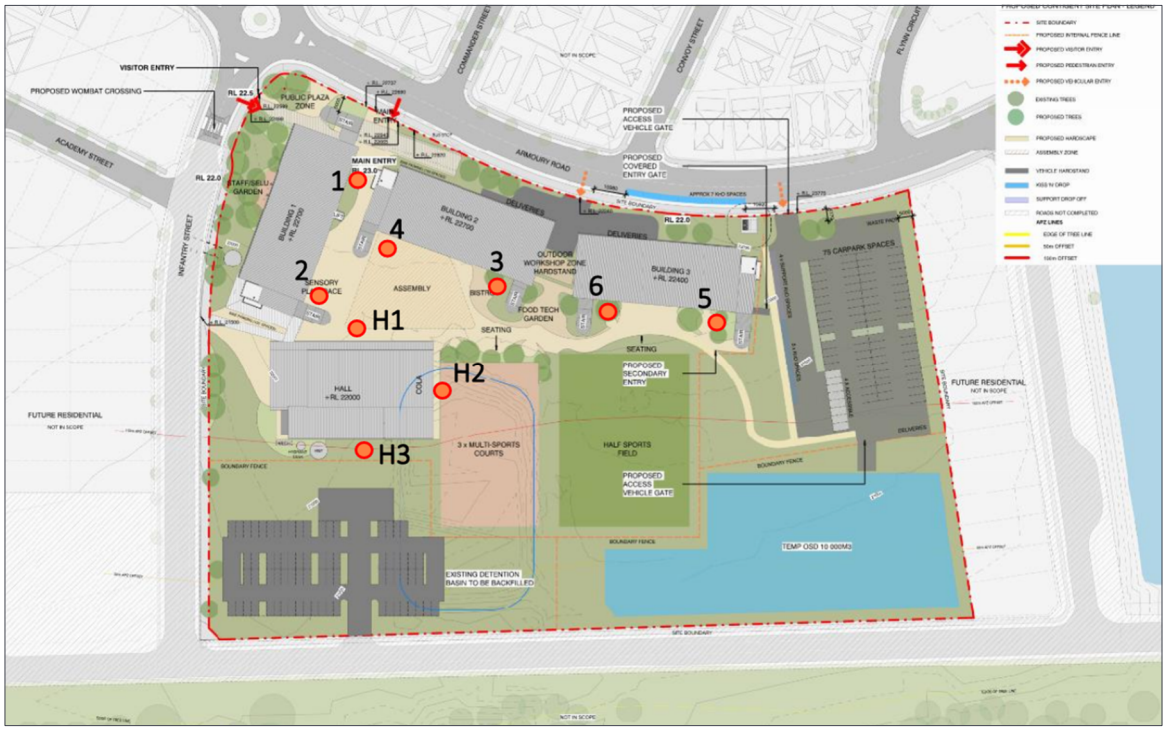


Table 23: Scenario 2 Stage 2 - Predicted $L_{Aeq(15\ min)}$ Construction Noise Levels

Receiver	Location	Predicted Noise Level dB	NML dB	Exceedance over NML dB	HNL dB	Exceedance over HNL dB
		Excavation and Earthworks				
1	Building 1 - West	68	55	+13	75	0
2	Building 1 - East	64	55	+9	75	0
3	Building 2- North	67	55	+12	75	0
4	Building 2 - South	68	55	+13	75	0
5	Building 3 - North	62	55	+7	75	0
6	Building 3 - South	68	55	+13	75	0
H1	Hall - West	-	55		75	0
H2	Hall - North	-	55		75	0
H3	Hall - East	-	55		75	0
		Piling, Drainage Works & Slab				

Receiver	Location	Predicted Noise Level dB	NML dB	Exceedance over NML dB	HNL dB	Exceedance over HNL dB
1	Building 1 - West	68	55	+13	75	0
2	Building 1 - East	64	55	+9	75	0
3	Building 2- North	67	55	+12	75	0
4	Building 2 - South	68	55	+13	75	0
5	Building 3 - North	62	55	+7	75	0
6	Building 3 - South	68	55	+13	75	0
H1	Hall - West	-	55		75	0
H2	Hall - North	-	55		75	0
H3	Hall - East	-	55		75	0
		General Building Works – Facade/Fitout				
1	Building 1 - West	68	55	+13	75	0
2	Building 1 - East	68	55	+13	75	0
3	Building 2- North	66	55	+11	75	0
4	Building 2 - South	67	55	+12	75	0
5	Building 3 - North	59	55	+4	75	0
6	Building 3 - South	62	55	+7	75	0
H1	Hall - West	-	55		75	0
H2	Hall - North	-	55		75	0
H3	Hall - East	-	55		75	0

Table 24: Scenario 2 Stage 3 - Predicted $L_{Aeq(15\ min)}$ Construction Noise Levels

Receiver	Location	Predicted Noise Level dB	NML dB	Exceedance over NML dB	HNL dB	Exceedance over HNL dB
Demolition, Earthworks & Civil Works						
1	Building 1 - West	57	55	+2	75	0
2	Building 1 - East	52	55	0	75	0
3	Building 2- North	58	55	+3	75	0
4	Building 2 - South	58	55	+3	75	0
5	Building 3 - North	66	55	+11	75	0
6	Building 3 – South	63	55	+8	75	0
H1	Hall - West	52	55	0	75	0
H2	Hall - North	53	55	0	75	0
H3	Hall - East	54	55	0	75	0

During construction works, noise levels may exceed the NML by up to 13 dB during periods when construction plant operates in close proximity to the classroom buildings. These exceedances will progressively reduce as construction plant moves away from the receiver location and the distance between source and receiver increases.

Where external windows and doors are closed an additional outdoor to indoor attenuation of 15 dB would be expected, compared to an open windows condition (i.e. outdoor to indoor loss of ~25 dB overall). On that basis internal noise level with windows and doors closed would be generally below the Noise Management Level.

Significant variation in noise levels can be expected depending upon the plant operating, the source noise level, the time active, the manner in which the plant is operated and many other factors.

The levels presented in the above tables should be considered as indicative.

No exceedances of the High Noise Level are expected.

The predicted levels are consistent with noise levels generated during typical construction works on a site in reasonably close proximity to a receiver.

The implementation of noise management measures will be required to minimise impacts on the school buildings. A detailed CNVMP should be prepared by the Head Contractor prior to construction works commencing.

With the implementation of noise management measures, particularly scheduling periods of noise intensive works as possible outside school hours, impacts on the school operations can be minimised.

10.2 Construction vibration

According to the Geotechnical Report prepared by Stantec Australia Pty Ltd:

> *Excavation will be limited to minor cutting, filling, and levelling and is expected to encounter mostly overburden soils comprising topsoil and cohesive fill. Excavation of soil may be readily achieved using conventional earthmoving equipment such as excavators. Ripping or hammering will not be required for the proposed earthwork. Therefore, the induced vibration and monitoring plan will not be required.*

Foundations for buildings with pile footings only are recommended. Considering the subsidence issue across the area, the Geotechnical Report recommends:

- removal of the existing filling to a depth of 1m within the proposed development footprint
- proof roll the exposed surface with six passes of a 10-12 tonne roller
- filling placed in horizontal layers of 300 mm loose thickness with each layer placed and compacted to dry density ratios as documented.

Deep piles are recommended to support the proposed building structure. Suitable pile types include concrete or grout-injected CFA piles, bored piles drilled with temporary or permanent casing or driven pile-types such as precast concrete, steel tube or steel H-section piles.

CFA piles and bored piles have the capacity of achieving the allowable end bearing capacity. Use of driven piles is considered difficult given the cobble and boulder encountered in the fill profile.

- Given the likely construction methodology involved and the distance between works and the closest surrounding residential and associated structures, ground vibration is not considered to be a potential issue.

Table 25 sets out the typical safe working distances applicable for structural damage and human comfort for vibration caused by construction plant. On review of the site layout and surrounding receivers, the minimum distance between any potentially vibration-generating activities and surrounding residences is estimated to be 35 metres. School buildings will also be located at distances exceeding the recommendations shown in Table 25. Safe working distances will be achieved, and vibration levels received are likely to be significantly lower than levels of ambient vibration. On this basis no further assessment of vibration is warranted.

Table 25: Recommended Safe Working Distances for Vibration-Intensive Plant

Item	Description	Safe Working Distance	
		Cosmetic Damage	Human Response
Pile Boring	≤ 800mm	2m (nominal)	N/A
Excavator		1m (nominal)	Avoid contact with structure

Note: The minimum working distances are indicative and will vary depending on a particular item of plant and local conditions. The values in this table, apply to residential receivers.

10.3 Construction traffic noise

Details of truck movements during construction works were not available at the time of this study. A detailed Construction Traffic Management Plan (CTMP) should be prepared and submitted to Council in response to any conditions of consent.

Vehicle access routes to and from the site would be along local roads and the Wianamatta Parkway. Depending on projected traffic volumes, consultation with key stakeholders, to minimise impacts to the surrounding residential communities may need to be undertaken.

Truck routes should allow all vehicles to enter and egress the site in a forward direction so that there will be no reversing on public roadways. On-site parking for contractors is envisaged. These arrangements will require further examination as part of the detailed CTMP.

10.4 Construction noise and vibration mitigation measures

Assessment of noise potentially generated during construction works have been undertaken based on typical construction processes. As part of the detailed design phases of the project, and once a contractor is appointed and proposed construction methodologies and plant and equipment are finalised, it will be necessary carry out a detailed evaluation and prepare a CNVMP. The CNVMP is a documented plan that should assist the construction team in managing and mitigating noise impacts as well as communicating effectively with impacted stakeholders. Whilst the preparation of a CNVMP is beyond the scope of this document the following precautions are provided for the consideration during future plan preparation.

10.4.1 Site awareness

- Regularly train workers and contractors (e.g. toolbox talks) to use equipment in ways to minimise noise.
- Ensure site managers periodically check the site and nearby residences and other sensitive land uses for noise problems so that solutions can be quickly applied.
- Include in tenders, employment contracts, subcontractor agreements and work method statements clauses that require minimisation of noise and compliance with directions from management to minimise noise.
- Avoid the use of radios or stereos outdoors where neighbours can be affected.
- Avoid the overuse of public address systems.
- Avoid shouting and minimise talking loudly, using inappropriate language and slamming vehicle doors.
- Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes, and no extended periods of engine idling).
- Develop a one-page summary of approval or consent conditions that relate to relevant work practices and pin it to a noticeboard so that all site operators can quickly reference noise information.
- Workers may at times need to discuss or negotiate practices with their managers.

10.4.2 Consultation and negotiation

The community is more likely to be understanding and accepting of noise if the information provided is frank, does not attempt to understate the likely noise level, and if commitments are firmly adhered to.

An effective community relations programme should be put in place to keep the surrounding community informed of work progress, and to forewarn potentially affected receivers (e.g. by letterbox drop, meetings with surrounding owners/occupants, etc.) of any anticipated changes in noise and vibration emissions prior to critical stages of the works, and to explain complaint procedures and response mechanisms.

Close liaison should be maintained between the internal and external stakeholders and the parties associated with the construction works to provide effective feedback in regard to perceived emissions. In this manner, equipment selections and work activities can be coordinated where necessary to minimise disturbance to the school and neighbouring community, and to ensure prompt response to complaints, should they occur.

10.4.3 Notification before and during construction

- Provide, reasonably ahead of time, information such as total building time, what works are expected to be noisy, their duration, what is being done to minimise noise and when respite periods will occur. For works outside standard hours, inform affected residents and other sensitive land use occupants between five and 14 days before commencement.
- Provide information to neighbours before and during construction through media such as letterbox drops, meetings or individual contact. In some areas, the proponent will need to provide notification in languages other than English. A website could also be established for the project to provide information.
- Use a site information board at the front of the site with the name of the organisation responsible for the site and their contact details, hours of operation and regular information updates. This signage should be clearly visible from the outside and include after-hours emergency contact details.
- Maintain good communication between the community and the project staff.
- Appoint a community liaison officer where required.
- Consider a regular newsletter with site news, significant project events and timing of different activities.
- Provide a toll-free contact phone number for enquiries during the works.
- Facilitate contact with people to ensure that everyone can see that the site manager understands potential issues, that a planned approach is in place and that there is an ongoing commitment to minimise noise.

10.4.4 Complaints handling

- Provide a readily accessible contact point, for example, through a 24-hour toll-free information and complaints line.
- Give complaints a fair hearing.
- Have a documented complaints process, including an escalation procedure so that if a complainant is not satisfied there is a clear path to follow.
- Call back as soon as possible to keep people informed of action to be taken to address noise problems. Call back at night-time only if requested by the complainant to avoid further disturbance.
- Provide a quick response to complaints, with complaint handling staff having both a good knowledge of the project and ready access to information.
- Implement all feasible and reasonable measures to address the source of the complaint.

- Keep a register of any complaints, including details of the complaint such as date, time, the person receiving the complaint, complainant's contact number, the person referred to, description of the complaint, work area (for larger projects), time of verbal response and timeframe for written response where appropriate.

10.4.5 Plant and equipment

In terms of both cost and results, controlling noise at the source is one of the most effective methods of minimising the noise impacts from any construction activities.

- Examine and implement, where feasible and reasonable, alternatives to rock-breaking work methods, such as hydraulic splitters for rock and concrete, hydraulic jaw crushers, chemical rock and concrete splitting, and controlled blasting such as penetrating cone fracture. The suitability of alternative methods should be considered on a case-by-case basis.
- Use alternatives to diesel and petrol engines and pneumatic units, such as hydraulic or electric controlled units where feasible and reasonable. Where there is no electricity supply, use an electrical generator located away from residences.
- Examine different types of machines that perform the same function and compare the noise level data to select the least noisy machine. For example, rubber-wheeled plant can be less noisy than steel tracked plant.
- Noise labels are required by NSW legislation for pavement breakers, mobile compressors, chainsaws and mobile garbage compactors. These noise labels can be used to assist in selecting a less noisy plant.
- Pneumatic equipment is traditionally a problem – select super silenced compressors, silenced jackhammers and damped bits where possible.
- When renting, select quieter items of plant and equipment where feasible and reasonable.
- When purchasing, select, where feasible and reasonable, the most effective mufflers, enclosures and low-noise tool bits and blades. Always seek the manufacturer's advice before making modifications to plant to reduce noise.
- Operate plant in a quiet and efficient manner.
- Reduce throttle setting and turn off equipment when not being used.
- Examine and implement, where feasible and reasonable, the option of reducing noise from metal chutes and bins by placing damping material in the bin.

10.4.6 Maintain equipment

- Regularly inspect and maintain equipment to ensure it is in good working order. Also, check the condition of mufflers.
- Equipment must not be operated until it is maintained or repaired, where maintenance or repair would address the annoying character of noise identified.
- For machines with enclosures, check that doors and door seals are in good working order and that the doors close properly against the seals.
- Return any hired equipment that is causing noise that is not typical for the equipment – the increased noise may indicate the need for repair.
- Ensure air lines on pneumatic equipment do not leak.

10.4.7 On-site

Barriers and acoustic sheds are most suited to longer-term fixed works, as in these cases the associated cost is typically outweighed by the overall time savings.

10.4.8 Location of plant

- Place as much distance as possible between the plant or equipment and residences and other sensitive land uses.
- Restrict areas in which mobile plant can operate so that it is away from residences and other sensitive land uses at particular times.
- Locate site vehicle entrances away from residences and other sensitive land uses.
- Carry out noisy fabrication work at another site (for example, within enclosed factory premises) and then transport to site.

10.4.9 Alternatives to reversing alarms

- Avoid the use of reversing alarms by designing site layout to avoid reversing, such as by including drive-through for parking and deliveries.
- Install, where feasible and reasonable, less annoying alternatives to the typical 'beeper' alarms taking into account the requirements of the Occupational Health and Safety legislation; examples are smart alarms that adjust their volume depending on the ambient level of noise and multifrequency (squawker) alarms that emit noise over a wide range of frequencies.
- In all circumstances, the requirements of the relevant Occupational Health and Safety legislation must be complied with for information on replacing audible warning alarms on a mobile plant with less annoying alternatives.

10.4.10 Maximise shielding

- Reuse existing structures rather than demolish and reconstruct.
- Use temporary site buildings and materials stockpiles as noise barriers.
- Schedule construction of any permanent walls so that they can be used as early as possible as noise barriers.
- Use natural landform as a noise barrier – place fixed equipment in cuttings, or behind earth berms.
- Note large reflecting surfaces on and off-site that might increase noise levels and avoid placing noise-producing equipment in locations where reflected noise will increase noise exposure or reduce the effectiveness of mitigation measures.

10.4.11 Work scheduling

Scheduling noisy work during periods when people are least affected is an important way of reducing noise impact.

Provide respite periods

- Where night work near residences cannot be feasibly or reasonably avoided, restrict the number of nights per week and/or the number of nights per calendar month that the works are undertaken, in consultation with residents who will be most affected.

Schedule activities to minimise noise impacts

- Organise work to be undertaken during the recommended standard hours where possible.

- When works outside the recommended standard hours are planned, avoid scheduling on Sundays or public holidays.
- Schedule work when neighbours are not present (for example schools will not generally be operational outside school hours or on weekends).
- Schedule noisy activities around times of high background noise (local road traffic or when other local noise sources are active) where possible to provide masking or to reduce the amount that the construction noise intrudes above the background.
- Consult with affected receivers about scheduling activities to minimise noise impacts.

Organise deliveries and access

- Nominate an off-site truck parking area (e.g. along the new Park Edge Road), away from residences, for trucks arriving prior to gates opening.
- Optimise the number of vehicle trips to and from the site – movements can be organised to amalgamate loads rather than using a number of vehicles with smaller loads.
- Designate access routes to the site, through consultation with potentially noise-affected residences and other sensitive land uses and make drivers aware of nominated vehicle routes.
- Provide on-site parking for staff and on-site truck waiting areas away from residences and other sensitive land uses (e.g. along the eastern or new Park Edge Road).
- Schedule deliveries to nominated hours only.

10.4.12 Transmission path

Physical methods to reduce the transmission of noise between the construction works and residences or other sensitive land uses are generally suited to works where there is longer-term exposure to the noise.

- Reduce the line-of-sight noise transmission to residences or school classrooms using temporary barriers.
- Temporary noise barriers can be constructed from hoarding (plywood boards, panels of steel sheeting or compressed fibre cement board) with no gaps between the panels at the site boundary. Stockpiles, shipping containers and portable site office buildings can be effective barriers.
- Erect temporary noise barriers before work commences to reduce noise from works as soon as possible.
- Consult with most affected neighbours about how effective the proposed noise mitigation measures will be in addressing their concerns.

11.0 OPERATIONAL NOISE ASSESSMENT - CONTINUOUS NOISE SOURCES

11.1 Noise sources

11.1.1 Mechanical services

Noise emissions from mechanical plant associated with the new secondary school campus should be controlled so that the operation of such plant does not adversely impact upon surrounding residential properties. Air-conditioning will be provided throughout the general school and the school hall and would generally operate only during daytime hours. No design information was available at the time of preparation of this assessment.

Exhaust fans will be required for the food and metal technology rooms and a dust extraction system is located in an enclosure within the wood workshop. Further assessment of this plant will be required during the detailed design phase to determine any necessary noise control measures.

11.1.2 Classroom and internal activities

Activity noise levels throughout the general learning areas and other teaching spaces are expected to be relatively low. Further consideration of noise emissions from general teaching and learning spaces is not considered warranted. Classrooms can operate with windows open for ventilation.

Teaching spaces that can be expected to generate significant noise levels periodically include the performing arts space, wood and metal workshops. Wood and metal workshops will be located at ground level within Building B. An ALU workshop will be located on the ground level of Building C. The reverberant sound pressure level within each space has been calculated based on the overall sound power level of various items of typical plant operating simultaneously for 50% of the time over the 15-minute assessment period (refer Table 18). The nature of the activities conducted are not expected to be generally continuous over a 15-minute duration.

The architectural documentation includes roller shutter doors on the western elevations of the Building B metal and wood workshops and the Building C ALU workshop. Calculations for noise emissions from these rooms have included the typical low sound insulation performance of a standard roller shutter door. Glazing on the western elevation has been assumed to be closed and include 6 mm glass.

The performing arts space is located in Building A Level 2. The reverberant sound pressure level adopted for assessment purposes has been based on previous measurements of pre-recorded music played over a 15-minute duration at serious listening level in a domestic scenario.

Glazing on the southern elevation has been assumed to be closed and include 6 mm glass.

The assessments conducted are considered to be conservative and represent worst-case scenarios.

11.1.3 Hall

Multi-purpose halls can be a source of noise generation when sporting activities, performances or school social events are held.

To assess noise emissions from the hall under sports mode, the reverberant sound pressure level within the space was based on previous measurements of two classes of high school students playing basketball and indoor hockey within a school sports hall (refer Table 18).

To assess an event scenario, the reverberant sound pressure level within the hall was based on previous measurements conducted within a school hall during a school dance with amplified music (refer Table 18).

Based on the architectural documentation for the proposed hall the following minimum construction systems have been included in the model:

- Wall construction minimum R_w 37

- Steel frame with combination minimum 0.42 BMT steel and 9mm FC wall cladding
- Internal wall cladding minimum 13 mm plasterboard with cavity insulation.

- Roof construction minimum R_w 37
  - Steel frame roofing with 0.48 BMT steel roof sheeting
  - Internal lining minimum 13 mm plasterboard with insulation to underside of roof sheeting.
- Glazing minimum R_w 30
  - Glazed tilt and access doors – thermal double glazing assumed for tilt doors. Single 6 mm assumed for single access doors.
- Ventilation Louvres
  - Operable weather louvres on eastern elevation

The proposed hall design includes storage, amenities, office, first aid room and canteen on the southern and eastern elevations. Glazed tilt and access doors are located along the northern and western elevations. Glazing is assumed to be closed. A COLA is located at the northern end of the hall building.

11.1.4 Carpark

Carpark activities associated with the future school carpark have been modelled in accordance with the *Parking Area Noise* (*Bayerisches Landesamt für Umwelt*, 2007) methodology. The study incorporates various selectable acoustic parameters including parking area type. Noise generated was based on 1 vehicle event per hour per space (i.e. 1 vehicle movement, either one in or one out) was adopted. This would reflect a worst-case scenario during morning arrival and afternoon departures.

11.2 Predicted levels of operational noise

The predicted noise levels at the surrounding residential premises for each of the modelled noise sources considered under the preferred and interim project scenarios are shown in Table 26, Table 27 and Table 28. For clarity results are shown as an overall $L_{Aeq(15min)}$ level and have been rounded to the nearest whole decibel.

Table 26: Scenario 1 - Predicted $L_{Aeq(15min)}$ Noise Levels

Receiver	Address	Classroom Activities dB	Hall Sport/Event dB	Carpark dB	Criterion Daytime/ Evening[1] dB	Compliance
R1	12 Charlie Street	< 20	33/31	29	40	Yes
R2	124 Armoury Road	22	30/28	27	40	Yes
R3	135 Armoury Road	30	34/32	20	40	Yes
R4	137 Armoury Road	33	33/31	21	40	Yes
R5	143 Armoury Road	34	31/29	20	40	Yes

Receiver	Address	Classroom Activities dB	Hall Sport/Event dB	Carpark dB	Criterion Daytime/ Evening[1] dB	Compliance
R6	145 Armoury Road	31	31/29	18	40	Yes
R7	153 Armoury Road	25	28/26	16	40	Yes
R8	25 Squadron Street	< 20	34/32	21	40	Yes
R9	Future Residence Lasetter Street - NW	24	26/24	21	40	Yes
R10	Future Residence Lasetter Street - NE	26	37/35	25	40	Yes
R11	Future Residence Infantry Street - SW	27	32/30	29	40	Yes
R12	Future Residence Infantry Street - S	24	40/38	36	40	Yes

Note 1: Evening operation would be infrequent throughout the school year. The evening criterion has been based on the lower measured daytime background noise level.

Based on the results of modelling for Scenario 1, the Preferred Option, the daytime/evening project noise trigger level is achieved at all existing residential receivers and at future residential allotments for all sources of operational noise.

Table 27: Scenario 2 (Stage 1) - Predicted $L_{Aeq(15min)}$ Noise Levels

Receiver	Address	Classroom Activities dB	Carpark dB	Criterion Daytime/ Evening[1] dB	Compliance
R1	12 Charlie Street	< 20	< 20	40	Yes
R2	124 Armoury Road	22	20	40	Yes
R3	135 Armoury Road	30	27	40	Yes

Receiver	Address	Classroom Activities dB	Carpark dB	Criterion Daytime/ Evening[1] dB	Compliance
R4	137 Armoury Road	33	29	40	Yes
R5	143 Armoury Road	34	32	40	Yes
R6	145 Armoury Road	31	37	40	Yes
R7	153 Armoury Road	25	40	40	Yes
R8	25 Squadron Street	< 20	32	40	Yes
R9	Future Residence Lasetter Street - NW	24	42	40	Yes
R10	Future Residence Lasetter Street - NE	26	38	40	Yes
R11	Future Residence Infantry Street - SW	27	< 20	40	Yes
R12	Future Residence Infantry Street - S	24	22	40	Yes

Based on the results of modelling for Scenario 2 Stage 1, the Interim Solution, the daytime/evening project noise trigger level is achieved at all existing residential receivers and at future residential allotments for all sources of operational noise.

Table 28: Scenario 2 (Stage 2) - Predicted $L_{Aeq(15min)}$ Noise Levels

Receiver	Address	Classroom Activities dB	Hall Sport/Event dB	Carpark dB	Criterion Daytime/ Evening[1] dB	Compliance
R1	12 Charlie Street	< 20	33/31	29	40	Yes
R2	124 Armoury Road	22	30/28	27	40	Yes
R3	135 Armoury Road	30	34/32	19	40	Yes
R4	137 Armoury Road	33	33/31	21	40	Yes
R5	143 Armoury Road	34	31/29	20	40	Yes
R6	145 Armoury Road	31	31/29	18	40	Yes
R7	153 Armoury Road	25	28/26	16	40	Yes

Receiver	Address	Classroom Activities dB	Hall Sport/Event dB	Carpark dB	Criterion Daytime/ Evening[1] dB	Compliance
R8	25 Squadron Street	< 20	34/32	21	40	Yes
R9	Future Residence Lasetter Street - NW	24	26/24	21	40	Yes
R10	Future Residence Lasetter Street - NE	26	37/35	25	40	Yes
R11	Future Residence Infantry Street - SW	27	32/30	29	40	Yes
R12	Future Residence Infantry Street - S	24	40/38	36	40	Yes

Based on the results of modelling for Scenario 2 Stage 2, the daytime/evening project noise trigger level is achieved at all existing residential receivers and at future residential allotments for all sources of operational noise.

12.0 OPERATIONAL NOISE – EXTERNAL AND SHORT DURATION EVENTS AND ACTIVITIES

12.1 Outdoor sport and informal outdoor activities

The proposal does not include the use of sporting fields outside of the normal school hours. Any such use would be considered under a separate planning pathway.

The potential noise generated during use of the sporting fields has been based on previous measurements undertaken by MDA of school students involved in outdoor sports. For each of the netball/basketball courts, two teams have been assumed to be engaged in a netball match. For the sports field, soccer training involving approximately 25 players has been assumed (refer Table 18).

For prediction of noise emissions from outdoor play and recreation, students are assumed to be evenly distributed across the sports courts and playing fields and the outdoor open space areas. Two staggered recess and lunch breaks have been assumed with the school cohort divided equally for each break period. The number of students has then been allocated proportionally according to the area of each outdoor space.

Based upon the results of previous measurements conducted of children engaged in outdoor play at a combined primary and secondary campus, an L_{Aeq} sound power level of 79 dB per student has been adopted. The sound power level (L_w) across each outdoor play area has been calculated according to the number of students included (500 students – refer Table 18).

The noise levels generated during outdoor play periods will vary according to the following factors:

- the number of students in the area – students will be spread around the outdoor areas
- the level of noise made by each student – this is obviously different from individual to individual, and various factors such as age, personality, mood, activity and countless other factors will play a part. The louder events are not capable of being sustained over an extended period
- the location of the students relevant to the residences – as the distance between the source and the receiver increases, the noise level at the receiver will decrease.

The noise levels ($L_{Aeq, 15min}$) generated during use of the outdoor sports fields and informal recreational activities have been predicted at the surrounding existing and future residential receivers. The modelling results under the preferred and interim project scenarios are shown, together with the relevant emissions guideline, in Table 29, Table 30 and Table 31.

Table 29: Predicted $L_{Aeq(15min)}$ Noise Levels Scenario 1 – Outdoor Sports & Informal Outdoor Activities

Receiver	Address	Outdoor Sports Courts/Fields dB	Informal Outdoor Activities dB	Emission Guideline dB	Assessment
R1	12 Charlie Street	35	44	45	Yes
R2	124 Armoury Road	23	31	45	Yes
R3	135 Armoury Road	24	41	45	Yes
R4	137 Armoury Road	38	45	45	Yes

Receiver	Address	Outdoor Sports Courts/Fields dB	Informal Outdoor Activities dB	Emission Guideline dB	Assessment
R5	143 Armoury Road	40	48	45	Informal Outdoor Play +3 dB exceedance
R6	145 Armoury Road	36	41	45	Yes
R7	153 Armoury Road	31	43	45	Yes
R8	25 Squadron Street	35	45	45	Yes
R9	Future Residence Lasetter Street - NW	38	47	45	Yes
R10	Future Residence Lasetter Street - NE	38	49	45	Informal Outdoor Play +4 dB exceedance
R11	Future Residence Infantry Street - SW	21	30	45	Yes
R12	Future Residence Infantry Street - S	40	51	45	Informal Outdoor Play Up to +6 dB exceedance

Table 30: Predicted $L_{Aeq(15min)}$ Noise Levels Scenario 2 Stage 1 – Outdoor Sports & Informal Outdoor Activities

Receiver	Address	Outdoor Sports Field dB	Informal Outdoor Activities dB	Emission Guideline dB	
R1	12 Charlie Street	31	44	45	Yes
R2	124 Armoury Road	21	31	45	Yes
R3	135 Armoury Road	22	41	45	Yes

Receiver	Address	Outdoor Sports Field dB	Informal Outdoor Activities dB	Emission Guideline dB	
R4	137 Armoury Road	32	45	45	Yes
R5	143 Armoury Road	23	48	45	Informal Outdoor Play +3 dB exceedance
R6	145 Armoury Road	34	41	45	Yes
R7	153 Armoury Road	28	43	45	Yes
R8	25 Squadron Street	34	45	45	Yes
R9	Future Residence Lasetter Street - NW	38	47	45	Yes
R10	Future Residence Lasetter Street - NE	36	49	45	Informal Outdoor Play +4 dB exceedance
R11	Future Residence Infantry Street - SW	18	30	45	Yes
R12	Future Residence Infantry Street - S	36	51	45	Informal Outdoor Play Up to +6 dB exceedance

Table 31: Predicted $L_{Aeq(15min)}$ Noise Levels Scenario 2 Stage 2 – Outdoor Sports & Informal Outdoor Activities

Receiver	Address	Outdoor Sports Courts/Fields dB	Informal Outdoor Activities dB	Emission Guideline dB	Assessment
R1	12 Charlie Street	35	44	45	Yes
R2	124 Armoury Road	23	31	45	Yes

Receiver	Address	Outdoor Sports Courts/Fields dB	Informal Outdoor Activities dB	Emission Guideline dB	Assessment
R3	135 Armoury Road	24	41	45	Yes
R4	137 Armoury Road	38	45	45	Yes
R5	143 Armoury Road	40	48	45	Informal Outdoor Play +3 dB exceedance
R6	145 Armoury Road	36	41	45	Yes
R7	153 Armoury Road	31	43	45	Yes
R8	25 Squadron Street	35	45	45	Yes
R9	Future Residence Lasetter Street - NW	38	47	45	Yes
R10	Future Residence Lasetter Street - NE	38	49	45	Informal Outdoor Play +4 dB exceedance
R11	Future Residence Infantry Street - SW	21	30	45	Yes
R12	Future Residence Infantry Street - S	40	51	45	Informal Outdoor Play Up to +6 dB exceedance

Based on the results of modelling, the daytime objective is achieved at all existing residential receivers and future residential allotments during use of the sports courts and playing field. During recess and lunch periods with 500 students assumed to be engaged in vigorous activities across the school outdoor areas, a marginal exceedance of the RBL + 10 dB 'emission guideline' can be expected at receivers along Armoury Road that do not benefit from the shielding provided by Building B and Building C.

Exceedance of the emissions guideline of up to 6 dB can be expected at future residential allotments to the north (Lasseter Street) and south (Infantry Street) when the larger student cohort are outside during recess and lunch breaks.

The noise levels received will vary considerably. The projected noise levels assume all students are physically active to represent a worst-case scenario. In reality, many of the students, particular the seniors, would not be engaged in such energetic pursuits.

The predicted noise levels during periods of informal outdoor play are below the daytime project amenity level for suburban residential receivers and can be expected to occur during limited periods throughout the day (ie recess and lunch breaks). Solid perimeter fencing (generally 2.1 m in height) can be expected to achieve a nominal 5 dB reduction in noise levels for ground level receivers with higher attenuation at mid to high frequencies. Little to no reduction in noise levels would be achieved at receivers at first floor level and above with a solid screen of reasonable and feasible construction.

12.2 Bells and PA

Announcements and school bells are typical activities associated with school operations. Typically, these are produced by the school PA system and can vary significantly depending on the volume setting of the system.

PA system design was not available at this stage. The following measures should be adopted to ensure that impact at all surrounding residences is minimised:

- Speakers should be located and orientated to provide good coverage of the school areas whilst being directed away from residences. System coverage should be reviewed during the detailed design stage.
- The volume of the system should be adjusted on site so that announcements and bells are clearly audible on the school site without being excessive. The system should initially be set so that maximum noise levels at surrounding residences do not exceed the ambient noise level by more than 5dBA.
- Once the appropriate level has been determined on site, the system should be limited to the acceptable level so that staff cannot increase noise levels.
- The system bell should be set so that it only occurs on school days.

12.3 Maintenance

Maintenance activities would be conducted during daytime hours, are unlikely to be stationary and would also generally be of a non-continuous nature.

No maintenance works are to take place prior to 7.00 am. This includes operation of equipment such as leaf blowers, lawn mowers, high pressure water cleaners and any other high noise power tools.

12.4 Deliveries, loading bays and waste collection

Schools do not typically generate significant numbers of truck or service vehicle movements. Garbage and recycling collection will be undertaken by a contractor typically using a small capacity waste removal truck. Occasional deliveries involving courier or small commercial vehicles could be expected to occur generally during school hours.

Given the limited number of service vehicles likely to be associated with the proposed school operations, and the times at which such events will occur, noise emissions are not considered to be acoustically significant.

12.5 Outside hours use

The proposal does not include the use of school facilities by external community groups. This will be facilitated under a separate planning pathway if required.

12.6 Road traffic noise

Under Scenario 1 the 'kiss & drop' will be located on the Park Edge Road adjacent to the eastern boundary of the site. This planning strategy removes the direct exposure of residential receivers to vehicles queuing to pull in and drop students and then depart.

A support drop off is located on Infantry Street midway along the southern site boundary, adjacent to Building A administration. The drop off is expected to be of limited use.

The majority of staff and student traffic would be expected to travel along Armoury Road, into Infantry Road and then via the new Park Edge Road to access the carpark. This route minimises traffic flows along local roads.

A bus bay is located on Armoury Road, adjacent to the pedestrian entrance.

Under the Scenario 2 Stage 1 Interim Solution, a limited 17-space kiss & drop facility will be located on the Armoury Road site boundary, near the temporary carpark entry point. A bus stop would be located on Armoury Road, adjacent to the pedestrian entrance.

As kiss & drop and bus zones are located on public roads outside the school boundaries, they are not acoustically assessed under criteria applicable to site noise sources (such as on-site carparks). Noise generated as a result to their operations forms part of the general road traffic noise environment.

Service vehicles and deliveries would be via a dedicated driveway further to the north on Armoury Road.

Under the site zoning, Educational Establishment is a permissible use. It is likely there will be some noise impacts resulting from additional vehicles on public roads during the peak morning arrivals and afternoon departures periods.

These impacts are temporary and are restricted to limited daytime periods.

According to the transport impact assessment the assumed trip generation for the high school in the AM peak (7.45 am to 8.45 am) was 0.47 trips per student and the PM peak (5.00 pm to 6.00 pm) trip generation rate was 0.27 trips per student. The PM period trip generation rate aligns with the commuting peak and will not align with the school pick-up period which is likely to be around 2.30 pm to 3.30 pm.

Based on the proposed 1000 student capacity, and applying the trip generation rates detailed above, the morning peak traffic generation would be 470 vehicle trips with the afternoon vehicle trip generation expected to be around 270.

Based on a typical setback distance of 12 m between the nearside traffic lane and front façade for residences along Armoury Road, the noise level for the peak morning period is expected to be in the order of $L_{Aeq,1hour}$ 64 dB. For the afternoon an $L_{Aeq,1hour}$ 61 dB is predicted. These levels exceed the RNP recommended daytime level of $L_{Aeq,1hour}$ 55 dB.

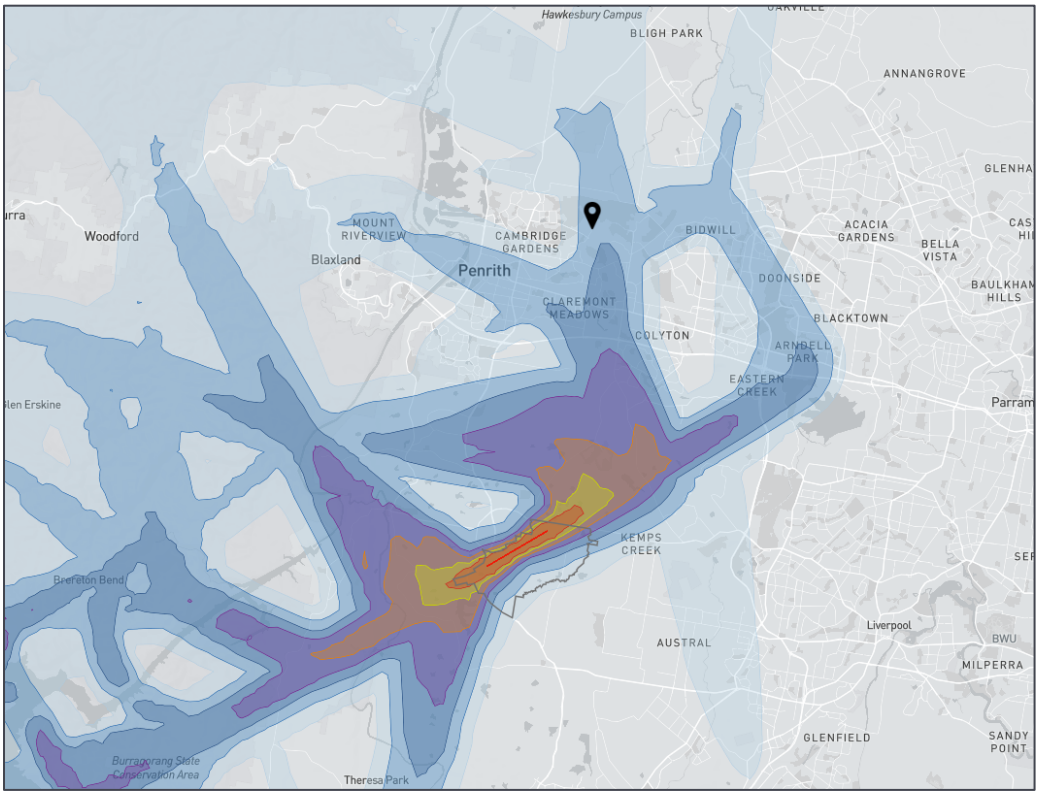
It is considered reasonable to expect that the short-term increases in noise levels due to increased traffic flows associated with school arrivals and departures would not adversely impact upon the surrounding residential community given the context of the school in terms of social benefit.

13.0 AIRCRAFT NOISE

According to the WSI *Airport Aircraft Overflight Noise Tool* (Department of Infrastructure, Transport, Regional Development, Communications and the Arts) the future high school site lies below the flight path for departures from Runway 05, and in close proximity to the flight path for arrivals on Runway 23.

Figure 6 shows the predicted single event noise level (L_{Amax}) of the proposed airport operations according to the WSI *Airport Aircraft Overflight Noise Tool*. According to the tool, the highest predicted single event noise level at the site location is 65 dB L_{Amax} during wide body jet take off (international flights).

Figure 6: WSI Predicted Noise Map – Composite L_{Amax} - All Aircraft Types (Source: WSI Aircraft Overflight Noise Tool)



Australian Standard AS 2021:2015 *Acoustics - Aircraft noise intrusion - Building siting and construction* (AS 2021) refers to Aircraft Noise Reduction (ANR) which is a calculated or measured value of sound insulation provided by a building. For design purposes, it is the arithmetic difference between the predicted external aircraft noise level at a site and the indoor design level.

Based on the external and indoor design noise levels, the calculated ANR required according to AS 2021 is shown in Table 32 for each space type.

Table 32: Required Aircraft Noise Reduction

Building Type and Activity	Aircraft Noise Level dB L_{Amax}	Indoor Design Sound Level dB L_{Amax}	ANR dB
Schools, universities			
Libraries, study areas, other noise sensitive areas	65	50	15

Building Type and Activity	Aircraft Noise Level dB L_{Amax}	Indoor Design Sound Level dB L_{Amax}	ANR dB
Teaching areas, assembly areas (less noise sensitive)	65	55	10
Workshops, gymnasia	65	75	-

For non-noise sensitive spaces such as workshops and gymnasia, no aircraft noise reduction would be required to minimise the maximum noise levels experienced at the site to achieve the indoor design sound level (75 dBA).

Typically, where external windows are open for natural ventilation, a loss of approximately 10 dBA from outside to inside can be expected (depending on the window type and area of opening).

On this basis, standard construction can be expected to allow compliance with the recommended maximum indoor design sound levels for areas that are not particularly noise sensitive. For spaces with increased ventilation requirements, the internal noise level may exceed the 55 dB L_{Amax} level during aircraft noise events with windows open.

Ventilation louvres are located at high level on the eastern elevation of the hall. When in gymnasium mode, there is no requirement for provision of increased facade sound insulation. When the hall is required to operate in assembly or event mode, the 55 dBA internal noise level target may be marginally exceeded during maximum noise level events with the louvres. Internal design levels would be achieved with the louvres closed, or with the inclusion of acoustic louvres.

For the year 2055, according to the *WSI Airport Aircraft Overflight Noise Tool*, between 50 – 99 overflight events above 60 $L_{Amax\ (slow)}$ dB can be expected from Runway 05 and between 10 – 19 overflight events above 60 dB associated with Runway 23.

Given the projected frequency of future overflight events, external windows and doors would be required to be closed to achieve an acceptable internal noise environment within sensitive spaces such as most learning and study areas, library, staff and administration offices. An alternative ventilation system (e.g. air-conditioning with suitable ducted outside air provisions) will be provided to serve these spaces. Specialist mechanical services advice will be required to determine the ventilation requirements for affected spaces. Ventilation pathways will require acoustical treatment to control aircraft noise break-in and ensure that the sound insulation performance of the building envelope is not compromised. No upgrade to the standard glazing typically installed would be required to achieve the required noise reduction (e.g. minimum 4 mm glass in well-fitted frames, no gaps, and acoustic perimeter seals).

14.0 MITIGATION MEASURES

Measures recommended in this report to mitigate noise and vibration impacts are summarised in Table 33.

Table 33: Summary of Mitigation Measures

Mitigation Number/ Name	When is Mitigation Measure to be complied with	Mitigation Measure	Reason for Mitigation Measure
CNV01	Construction Phase	Works to be carried out during standard recommended construction hours.	To minimise the impact of noise and vibration from construction works on surrounding potentially sensitive receivers
CNV02	Prior to any works outside of standard construction hours	Works proposed to be conducted outside of standard hours will require a detailed assessment of noise and vibration generated to surrounding sensitive receivers.	To minimise the impact of noise and vibration from construction works on surrounding potentially sensitive receivers
CNV03	Prior to construction works commencing	CNVMP to be prepared by Head Contractor.	To minimise the impact of noise and vibration from construction works on surrounding potentially sensitive receivers
CNV04	Prior to construction works commencing	Detailed CTMP to be prepared by Head Contractor. A Traffic Guidance Scheme is to be includedin accordance with TfNSW *Traffic Control at Work Site*s manual	To minimise the impact of noise from construction traffic on surrounding potentially sensitive receivers
OP01	Construction Certificate submission Occupation Certificate	Detailed assessment of environmental noise emissions from mechanical services and control in accordance with conditions of consent.	To ensure environmental noise emissions from mechanical services achieve acceptable environmental limits at surrounding receivers
OP02	Construction Certificate submission	Hall wall and roof construction minimum R_w 37. Hall glazing minimum R_w 30.	To ensure environmental noise emissions from high noise events achieve acceptable environmental limits at surrounding receivers

Mitigation Number/ Name	When is Mitigation Measure to be complied with	Mitigation Measure	Reason for Mitigation Measure
OP03	Construction Certificate submission Ongoing	Glazing to the Performing Arts rooms may be required to be closed during periods of high noise level activities.	To ensure environmental noise emissions from high noise events achieve acceptable environmental limits at surrounding receivers
OP04	Construction Certificate submission Ongoing	Glazing and roller shutter doors to metal workshops and wood workshops may be required to be closed during periods of high noise level activities.	To ensure environmental noise emissions from high noise events achieve acceptable environmental limits at surrounding receivers
OP04	Construction Certificate submission Ongoing	External openings to the hall may be required to be closed during periods of high noise level activities.	To ensure environmental noise emissions from high noise events achieve acceptable environmental limits at surrounding receivers
OP05	Construction Certificate submission	Glazing to sensitive spaces (classrooms offices, etc) R_w 30.	To ensure noise ingress from high noise events achieve recommended internal design levels
OP06	Construction Certificate submission Ongoing	Staggered recess and lunch breaks recommended.	To minimise noise from outdoor play to surrounding receivers
OP07	Construction Certificate submission Occupation Certificate Ongoing	Mechanical services plant to be designed to achieve the environmental noise limits included in Table 12. The contributions of other continuous operational noise sources to be included to avoid cumulative level exceeding project limit.	
OP08	Construction Certificate submission Occupation Certificate Ongoing	The PA system should initially be designed and set so that maximum noise levels at surrounding residences do not exceed the ambient noise level by more than 5dBA.	To minimise noise from outdoor play to surrounding receivers

Mitigation Number/ Name	When is Mitigation Measure to be complied with	Mitigation Measure	Reason for Mitigation Measure
OP09	Construction Certificate submission Occupation Certificate	The PA system bell should be set so that it only occurs on school days.	To minimise noise from outdoor play to surrounding receivers
OP10	Construction Certificate submission Occupation Certificate Ongoing	Outdoor maintenance works to be undertaken during daytime hours between 7.00 am and 6.00 pm Monday – Friday.	To minimise noise from outdoor play to surrounding receivers

15.0 EVALUATION OF ENVIRONMENTAL NOISE & VIBRATION IMPACTS

Assessment of noise impacts associated with a new high school at Jordan Springs has been conducted.

The scope of the assessment involved a survey of the existing noise environment, derivation and establishment of assessment criteria for noise emissions, a noise impact assessment relative to appropriate criteria and recommendations for measures to minimise the potential for disturbance to existing and future surrounding the project site residents. The findings are as follows:

15.1 Construction noise and vibration impacts

Noise objectives for construction have been established based on EPA guidelines. The noise management levels should be adopted as objectives to work towards minimising noise emissions to surrounding residences and operational areas within the school.

Construction activities associated with the proposed works are expected to generate noise levels that will potentially exceed established construction noise management levels, during standard hours. No exceedance of the High Noise Level is expected. Planning and management of construction activities shall be undertaken to minimise noise impact at surrounding receivers and within the school itself. The control of construction noise and vibration should be addressed in a detailed Noise and Vibration Management Plan developed when the successful contractor has been appointed for the project.

15.2 Operational noise impacts

Details of mechanical plant are unavailable at this stage. Acceptable noise levels due to plant operation are likely to be achieved with consideration given to low-noise plant selection, plant location that is remote from site boundaries and implementation of engineering noise control measures where required. Further assessment will be required when detailed mechanical services design becomes available.

The noise level emissions from assumed worst-case operational scenarios of the future potentially noise-generating teaching spaces and the school hall have been predicted to existing and future surrounding residential properties.

The results of calculations of continuous operational noise sources, including the carpark, were compared with the project specific trigger limits, determined in accordance with the EPA *Noise Policy for* Industry, with compliance generally able to be demonstrated .

The noise emissions associated with outdoor sport and informal activities are expected to be generally within the emission guideline of background L_{A90} + 10 dBA and less than the recommended Acceptable Noise Level (ANL) for 'Suburban' acoustic amenity at existing residential receivers. During informal outdoor play may result in marginal to moderate exceedances of the emission guideline at exposed residential properties along Armoury Road and at future residential development sites to the north (Lasetter Street) and south (Infantry Street) that have a direct line of site to the outdoor space.

The levels of noise generated during outdoor play do not exceed the amenity criterion at any of the surrounding residential receivers.

15.3 Aircraft noise impacts

The potential L_{Amax} levels generated by aircraft operations have been established in consultation with the *WSI Airport Aircraft Overflight Noise Tool* (Department of Infrastructure, Transport, Regional Development, Communications and the Arts). Following comparison of the maximum noise levels predicted at the site with internal design noise limits recommended by AS 2021:2015 and the EFSG 2.0, standard building construction was determined to adequately reduce aircraft noise within sensitive spaces to acceptable levels. External window and door openings may be required to be closed to achieve the recommended design levels during noisy events. Provision of an alternative method of ventilation will allow design requirements for airflow to be met within acoustically sensitive spaces will be required when external openings are closed.

Ventilation louvres are proposed at high level on the hall's eastern elevation. Acceptable internal design levels will be achieved for sports mode use under the current design. When assembly or event mode is required, the 55 dBA internal noise level target may be marginally exceeded during maximum noise level events with the louvres open. Internal design levels would be achieved with the louvres closed, or with the inclusion of acoustic louvres.

15.4 Impacts from additional noise from school-generated traffic

The design strategy for the preferred option has located the main drop off zones along the new Park Edge Road to minimise exposure of residential properties to student arrivals and departures. The school carpark is also accessed from this road. The bus bay has been located on Armoury Road boundary, the main access corridor road through the Jordan Springs northern extent and the future new land release area of East Llandilo.

For the Interim Solution, a temporary 7-space drop off zone would be established along the Amoury Road site boundary. The school carpark, located in the northwest corner would also be accessed from Armoury Road. This arrangement would only remain in place until the required external works are completed by others.

Noise levels potentially generated during peak arrival periods in the morning and afternoon are expected to exceed the recommended guidelines of the NSW *Road Noise Policy* at residences adjacent to the future school traffic route.

It is assumed that short term increases in traffic flows and increased noise levels associated with school arrivals and departures would be considered acceptable given the broader community benefit as a result of the new high school.

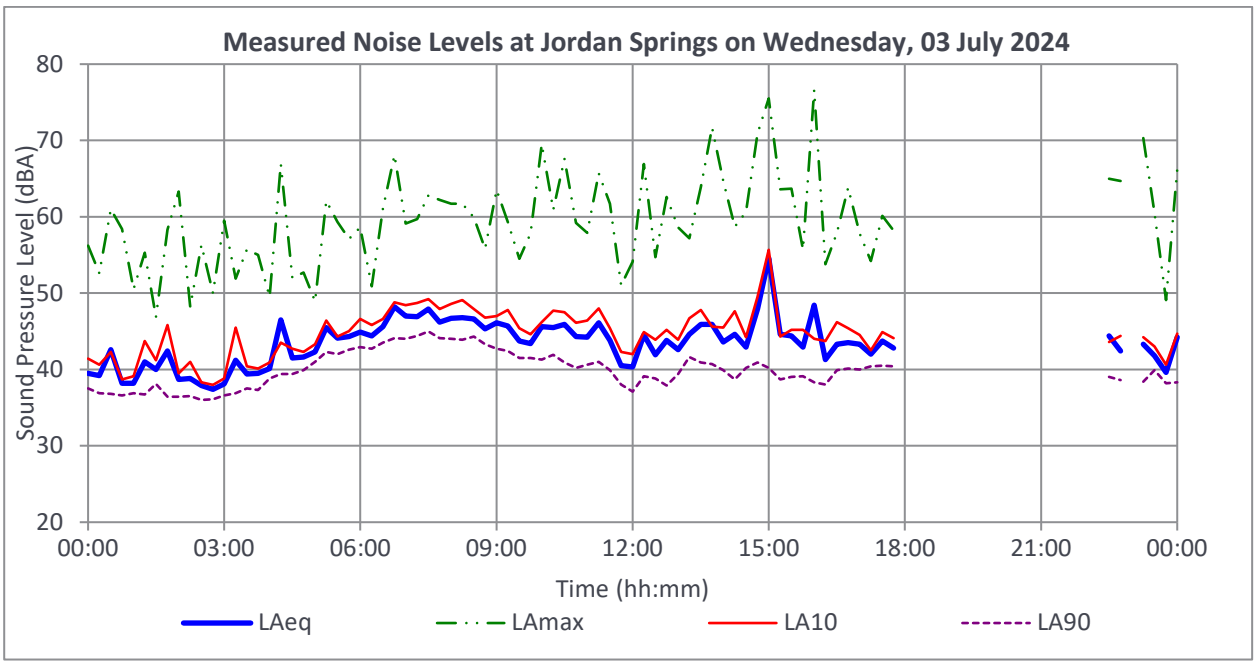
15.5 Environmental noise and vibration assessment

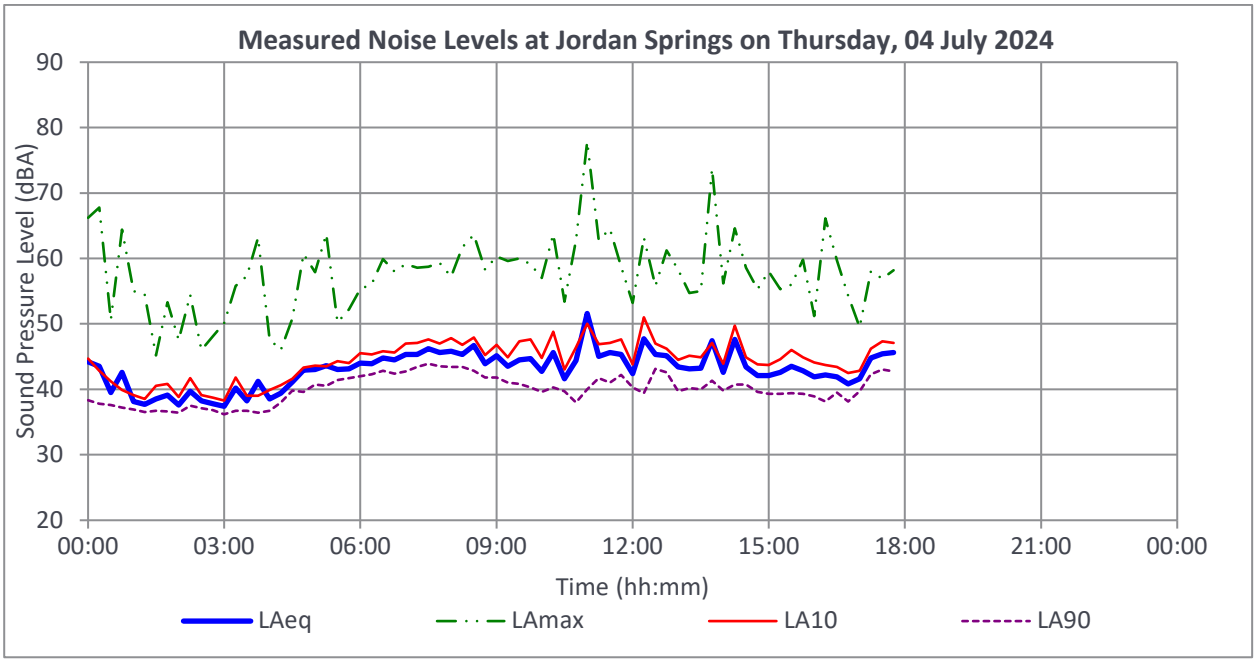
The new school for Jordan Springs is not likely to significantly affect the environment. The proposed activity can be supported on the basis of environmental noise and vibration.

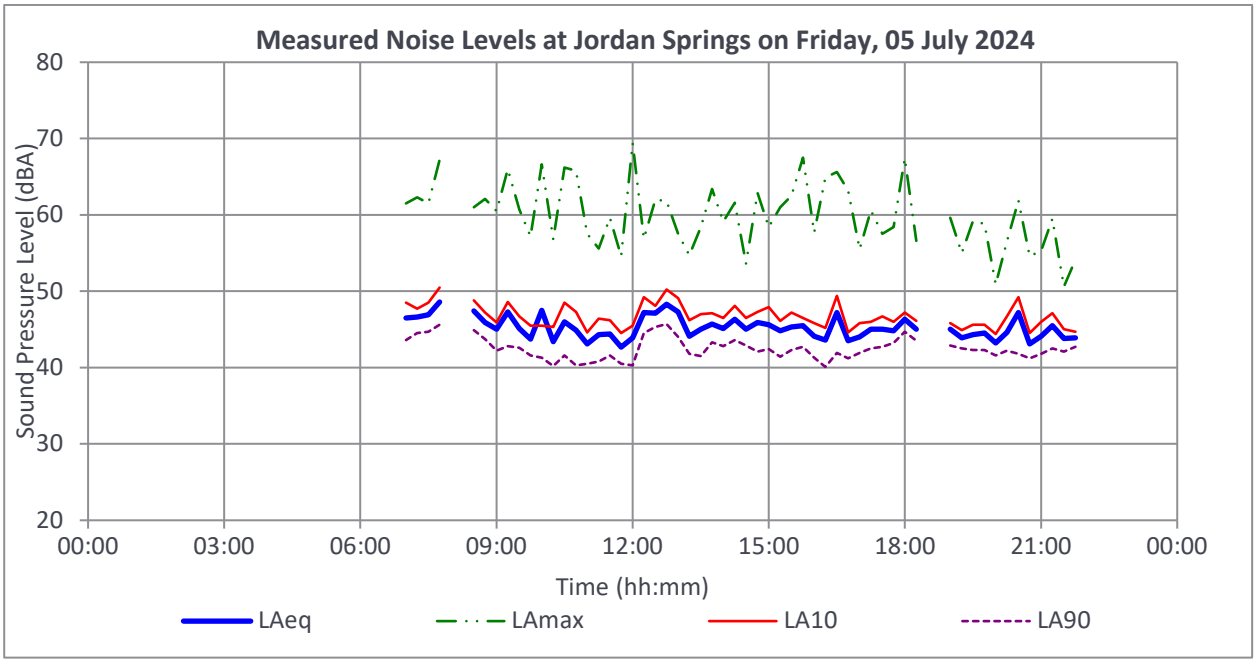
APPENDIX A GLOSSARY OF TERMINOLOGY

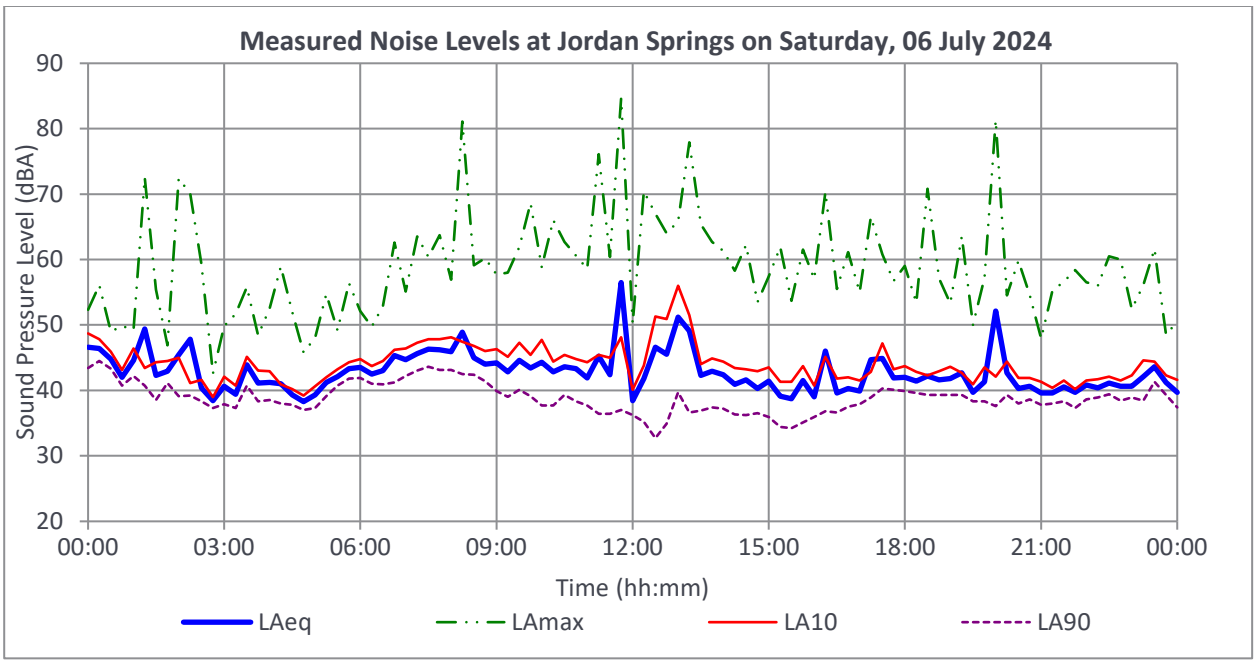
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
dB	Decibel The unit of sound level.
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
Frequency	The number of pressure fluctuation cycles per second of a sound wave. Measured in units of Hertz (Hz).
Hertz (Hz)	Hertz is the unit of frequency. One hertz is one cycle per second. One thousand hertz is a kilohertz (kHz).
L_{A90}	The noise level exceeded for 90 per cent of the measurement period, measured in dB. This is commonly referred to as the background noise level.
L_{Aeq}	The equivalent continuous sound level. This is commonly referred to as the average noise level and is measured in dB.
L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
L_{A10}	The A-weighted noise level equalled or exceeded for 10 per cent of the measurement period. This is commonly referred to as the average maximum noise level.
L_w (or SWL)	Sound Power Level. The level of total sound power radiated by a sound source.
Octave Band	A range of frequencies where the highest frequency included is twice the lowest frequency. Octave bands are referred to by their logarithmic centre frequencies, these being 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, and 16 kHz for the audible range of sound.
Rating background level (RBL)	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24-hr period used for the assessment background level). This level is used for assessment purposes. It is defined as the median value of all the assessment background levels over the monitoring period for the day, evening and night.

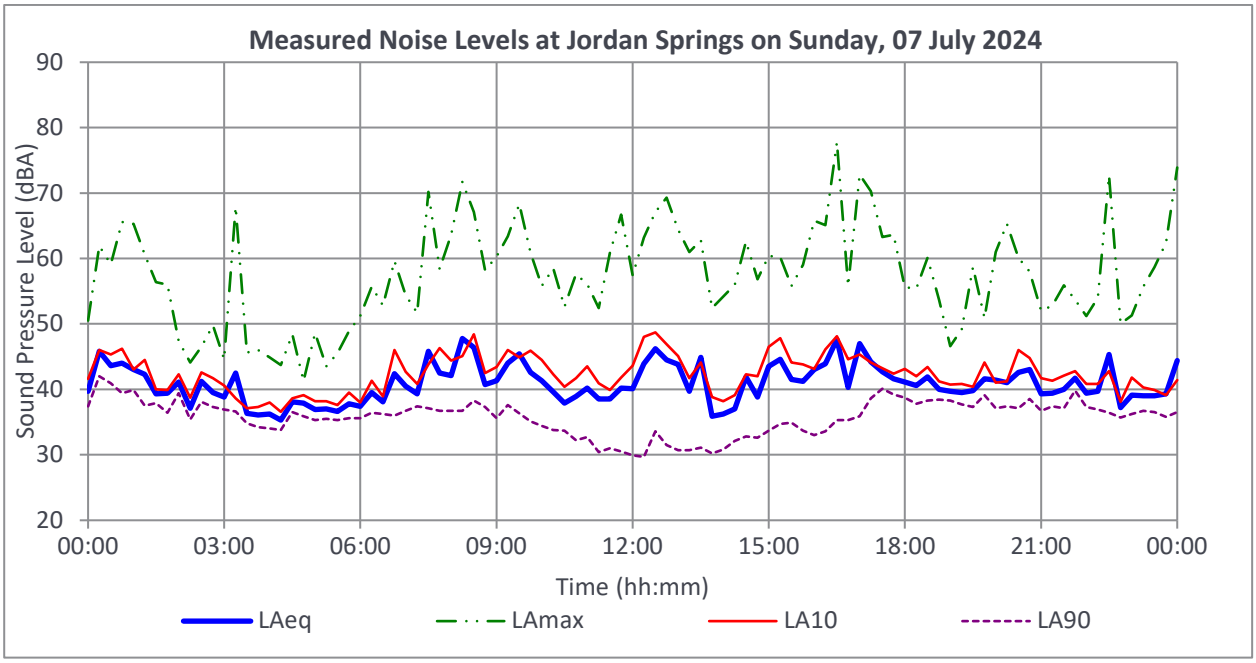
APPENDIX B AMBIENT NOISE SURVEY RESULTS

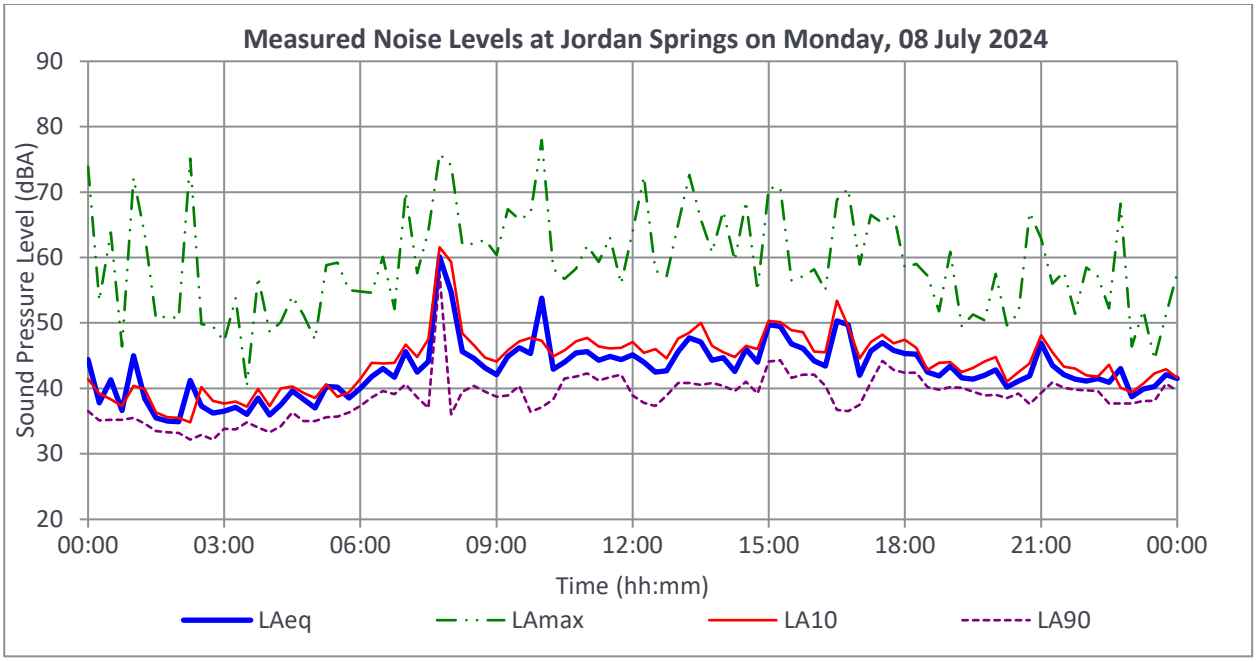


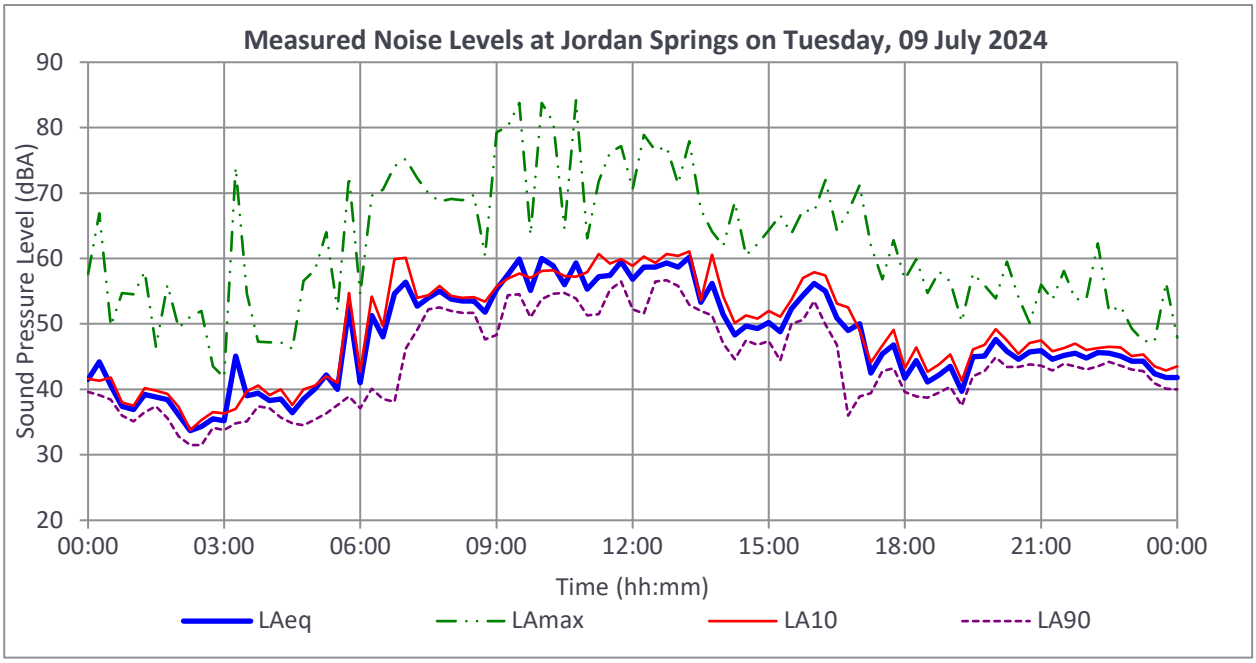


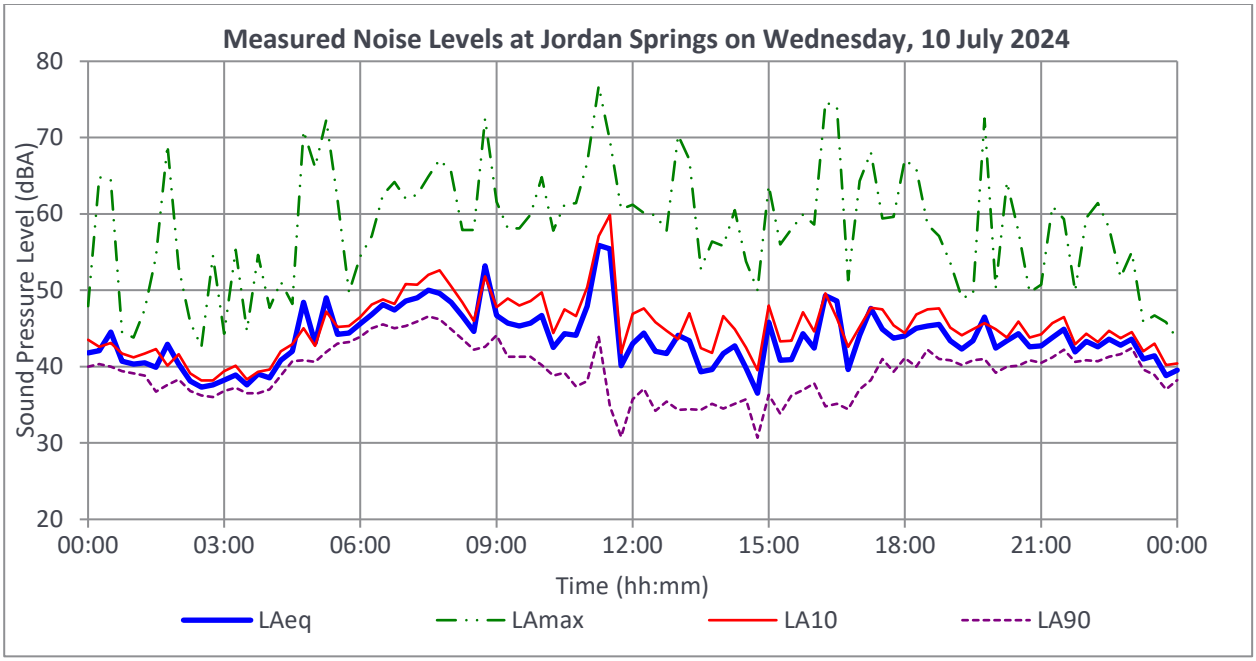

Measured Noise Levels at Jordan Springs on Friday, 05 July 2024
Sound Pressure Level (dBA)
80
70
60
50
40
30
20
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time (hh:mm)
LAeq
LAmax
LA10
LA90

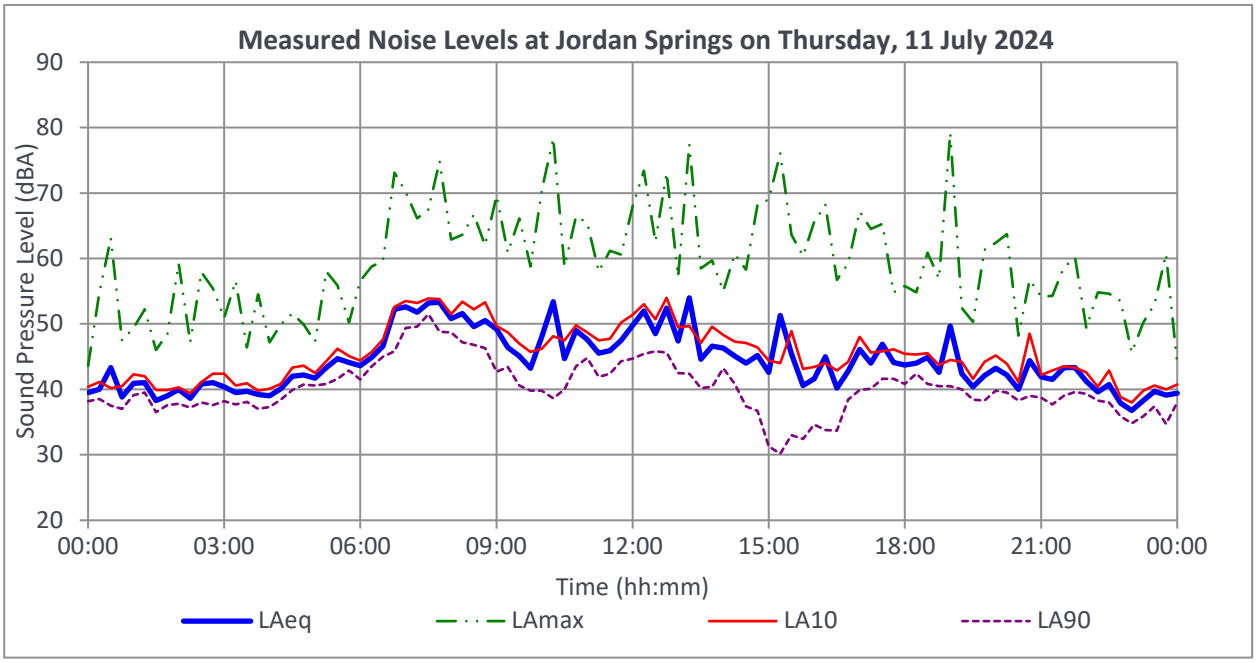

Measured Noise Levels at Jordan Springs on Saturday, 06 July 2024
Sound Pressure Level (dBA)
90
80
70
60
50
40
30
20
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time (hh:mm)
LAeq
LAmax
LA10
LA90

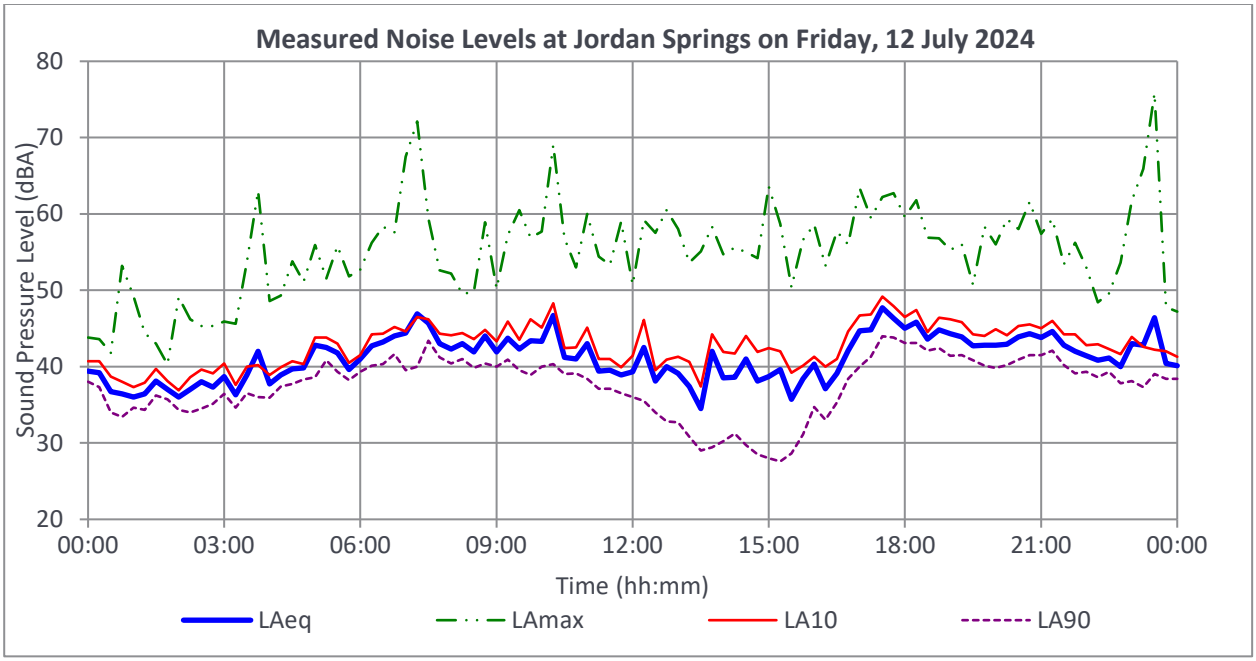

Measured Noise Levels at Jordan Springs on Sunday, 07 July 2024
Sound Pressure Level (dBA)
90
80
70
60
50
40
30
20
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time (hh:mm)
LAeq
LAmax
LA10
LA90

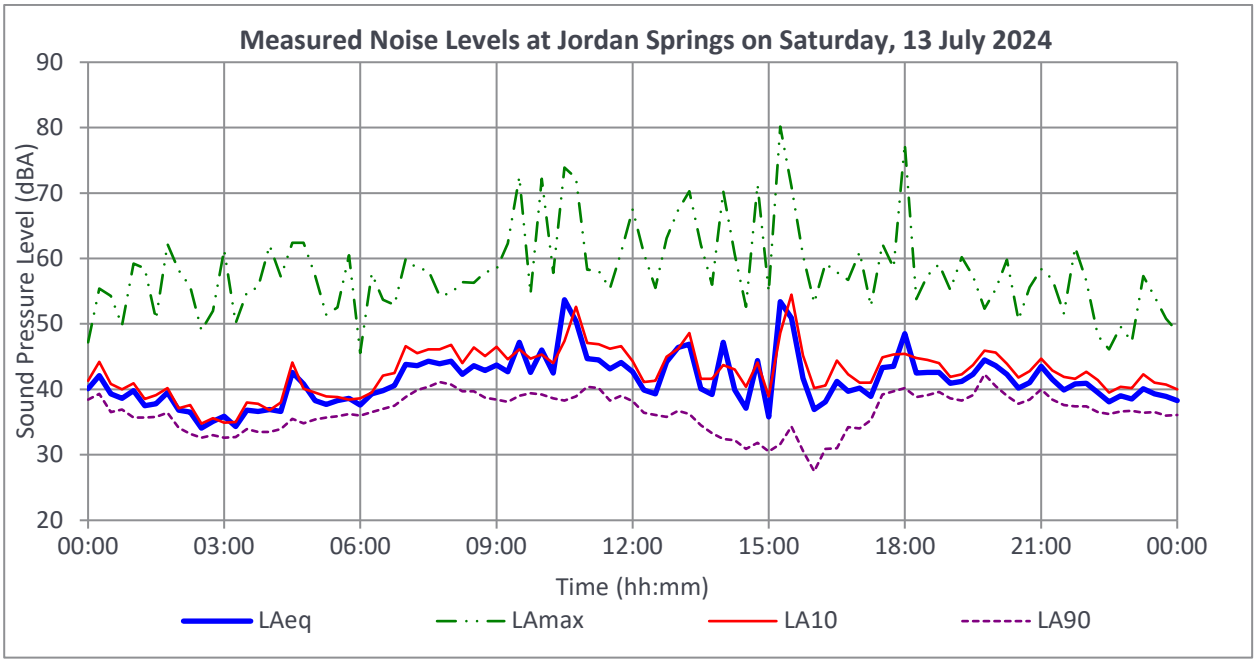

Measured Noise Levels at Jordan Springs on Monday, 08 July 2024
Sound Pressure Level (dBA)
90
80
70
60
50
40
30
20
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time (hh:mm)
LAeq
LAmax
LA10
LA90

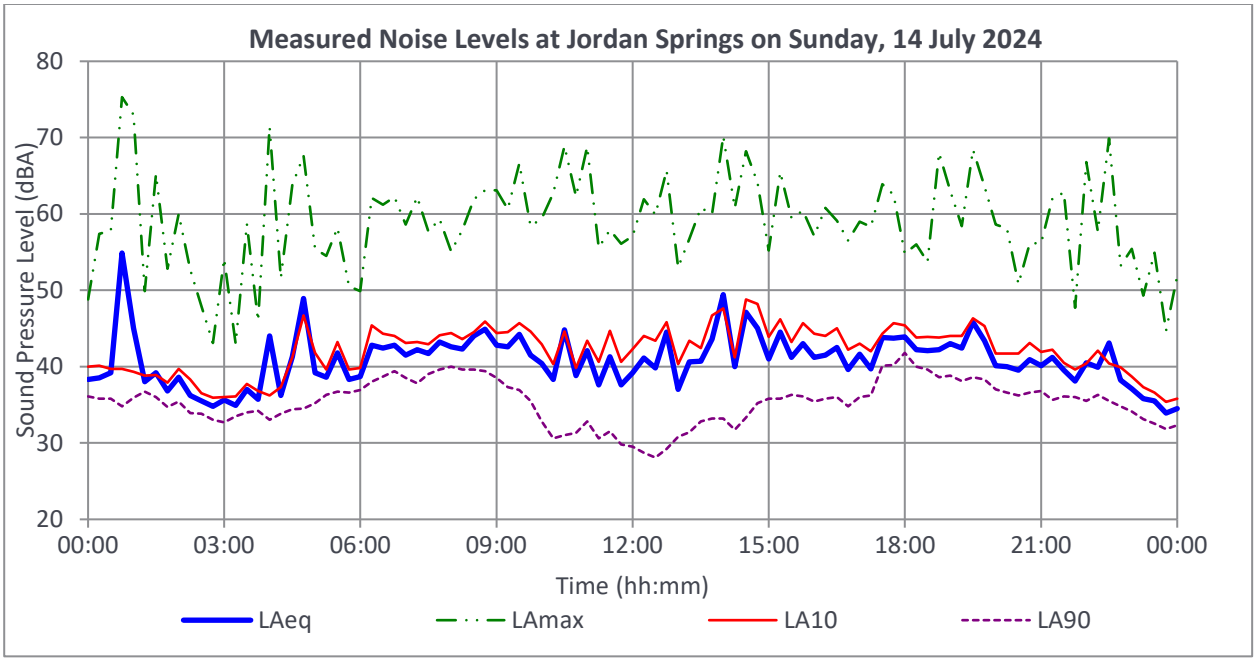

Measured Noise Levels at Jordan Springs on Tuesday, 09 July 2024
Sound Pressure Level (dBA)
90
80
70
60
50
40
30
20
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time (hh:mm)
LAeq
LAmax
LA10
LA90

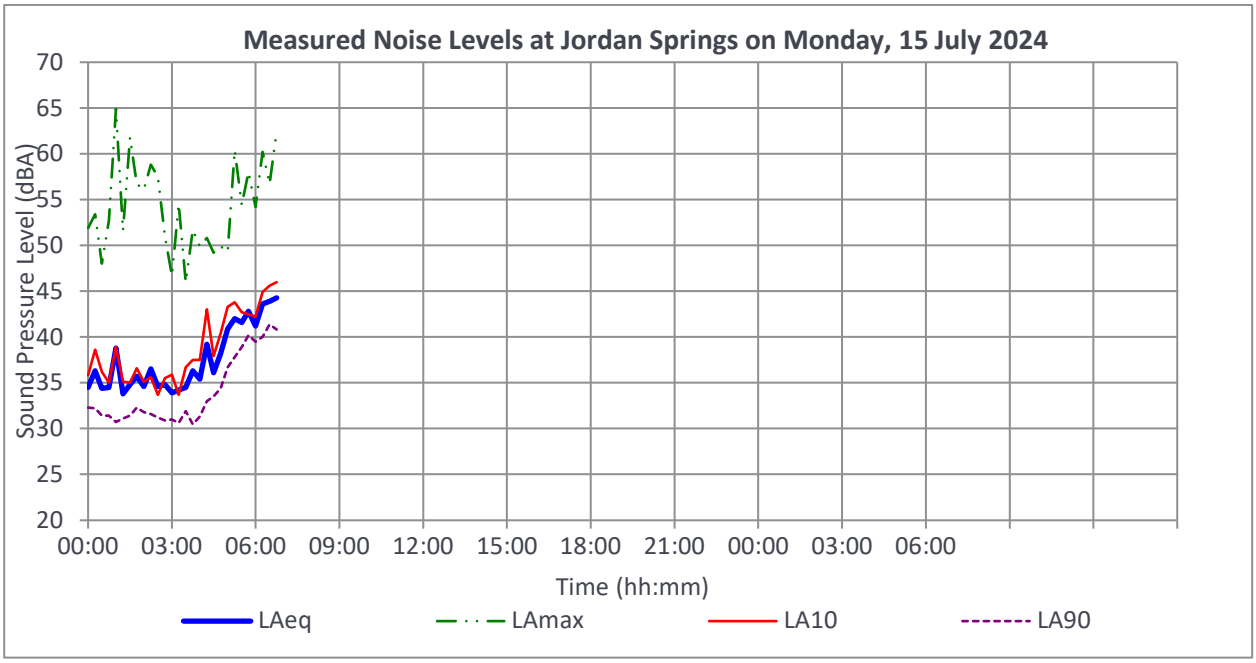

Measured Noise Levels at Jordan Springs on Wednesday, 10 July 2024
Sound Pressure Level (dBA)
80
70
60
50
40
30
20
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time (hh:mm)
LAeq
LAmax
LA10
LA90


Measured Noise Levels at Jordan Springs on Thursday, 11 July 2024
Sound Pressure Level (dBA)
90
80
70
60
50
40
30
20
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time (hh:mm)
LAeq
LAmax
LA10
LA90


Measured Noise Levels at Jordan Springs on Friday, 12 July 2024
Sound Pressure Level (dBA)
80
70
60
50
40
30
20
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time (hh:mm)
LAeq
LAmax
LA10
LA90


Measured Noise Levels at Jordan Springs on Saturday, 13 July 2024
Sound Pressure Level (dBA)
90
80
70
60
50
40
30
20
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time (hh:mm)
LAeq
LAmax
LA10
LA90


Measured Noise Levels at Jordan Springs on Sunday, 14 July 2024
Sound Pressure Level (dBA)
80
70
60
50
40
30
20
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time (hh:mm)
LAeq
LAmax
LA10
LA90


Measured Noise Levels at Jordan Springs on Monday, 15 July 2024
Sound Pressure Level (dBA)
70
65
60
55
50
45
40
35
30
25
20
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
03:00
06:00
Time (hh:mm)
LAeq
LAmax
LA10
LA90