MARSHALL DAY Acoustics

CENTRE OF EXCELLENCE IN AGRICULTURAL EDUCATION
NOISE AND VIBRATION ASSESSMENT

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Project: **CENTRE OF EXCELLENCE IN AGRICULTURAL EDUCATION**

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EXECUTIVE SUMMARY

Marshall Day Acoustics (MDA) has been commissioned by School Infrastructure NSW to conduct an assessment of noise and vibration relating to the construction and operation of the proposed Centre of Excellence in Agricultural Education) located in Richmond NSW. Assessment of the school has considered the following:

- Planning Secretary's Environmental Assessment Requirements (SEARs) (Application Number: SSD 15001460) issued 19th March 2021
- *NSW Noise Policy for Industry 2017 (NSW Environment Protection Authority (EPA).*
- *Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009).*
- *Assessing Vibration: A Technical Guideline 2006 (Department of Environment and Conservation, 2006).*
- *Australian Standard 2363 Acoustics - Measurement of noise from helicopter operations (AS 2363).*

Additional standard and guidelines are referenced, comprising

- *Protection of the Environment Operations Act 1997, NSW Environment Protection Authority (POEO)*
- *Noise Guideline for Local Government, NSW Environment Protection Authority 2013 (NGLG)*
- *Road Noise Policy, NSW Department of Environment, Climate Change and Water 2011 (RNP)*
- *AS 2021:2015 Acoustics - Aircraft Noise Intrusion - Building Siting and Construction*

Noise from construction activities have been assessed based on assumed plant equipment likely to be used during the three stages of construction (Site Preparation, Bulk Excavation and Construction). Noise at five primary receivers has been considered:

- UWS Student Accommodation located immediately west of the proposed site
- UWS biology labs to the north east of the proposed site
- UWS microbiology labs to the east of the proposed site
- A residential care building located to west of the proposed site
- A residential area located further north west of the proposed site.

Noise from construction is expected to be below the derived "Highly Noise Affected" management goals for all the surrounding receivers for both "Worst-Case" and "Average" scenarios during all stages of construction.

For the most noise affected receiver surrounding the site, noise from typical Site Preparation, Bulk Excavation and Construction activities may exceed the ''Noise Affected'' goals from the EPA criteria for both "Worst-Case" and "Average" scenarios by up to 23 dB and 20 dB respectively for sensitive residential receivers, whilst remaining below the "Highly Noise Affected" management levels.

As predicted construction noise levels are expected to be above the "Noise Affected" management goals, MDA has provided a schedule of appropriate noise control recommendations and proposed inclusions for Construction Noise and Vibration Management Plan (CNVMP), to assist in controlling noise impacts from construction stages. All feasible noise controls and management practises detailed in this report should be adopted as a matter of course. A full, detailed and specific CNVMP must be prepared at a later once a builder is appointed and detailed construction methodology is known.

Assessment of human responses to vibration levels is considered in this report and recommendation are provided.

With respect to operational noise, noise emissions from the following sources have been considered:

- Public Address System
- School Bell
- Mechanical Services
- Outdoor Activities
- Traffic movements and carpark use
- Use of dining hall and presentation space
- Aircraft Noise
- Limited reviews of agricultural equipment

At this early point in the development of the project design, the specification of the public address system, school bell and mechanical services is not sufficiently progressed such that noise emissions can be evaluated in detail. General comments and derived maximum noise levels have, however, been provided in order to assist the ongoing design and ensure noise emissions from these sources can be properly controlled.

Noise generated within most of the school's internal spaces will be typically low and can be controlled with standard building constructions in most instances. Therefore, noise from the school's internal spaces is not generally not assessed in detail in this report.

Noise from use of school dining hall and presentation space (Block E), during school time and out of hours evening time, has been quantitatively evaluated based on assumed maximum internal sound levels for expected activities. This has informed preliminary performance requirements for building enclosure elements including external walls, roofs, glazing and door systems. Based on the anticipated use, standard building envelope construction types will provide adequate acoustic containment of the anticipated activities.

Outdoor activity noise has been qualitatively assessed based on the subjective assessment guidance described in the Protection of the Environment Operations Act 1997, and the EPA Noise Guideline for Local Government. Noise from general outdoor activities has been clearly established as not qualifying for description as offensive noise, although some restrictions may apply to the use of the COLA area.

An assessment based on the TTW traffic report projections has been included in this report. Noise increases (ie over and above that generated by existing traffic flow levels) due to additional traffic on public roads generated by the operational use of the site is expected to be within acceptable limits. Noise generated by the use of the carparks, drop off and service deliveries is expected to be within acceptable limits.

Details on possible farming plant and equipment is not known at this stage. It would however be necessary to develop an operational noise management plant to limit noise impacts from equipment associated with the agricultural plots, orchards and dams.

Traffic noise intrusion across the site is low, with standard building construction sufficient to control noise from traffic. There may be a minor exceedance of the criteria with windows open however.

The site lies outside the ANEF 20 Zone associated with the Richmond RAAF base. As such, the site is defined as "acceptable" within table 2.1 of AS 2021 and a formal assessment of aircraft noise is not required. This does not mean that there are no aircraft noise impacts, only that the numbers of movements nearby the site and the associated noise is sufficiently low as to be considered as "Acceptable" within AS 2021.

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1.0 INTRODUCTION

Marshall Day Acoustics (MDA) have been commissioned by Schools Infrastructure NSW to conduct an assessment of noise and vibration relating to the construction and operation of the proposed Centre of Excellence in Agricultural Education located in Richmond, NSW.

It is proposed to develop the site to form a new, Centre of Excellence (CoE) in Agricultural Education), on a leased land parcel of area 11.37 Hectares within the Western Sydney University (Hawkesbury Campus) site, Richmond NSW.

This assessment is to satisfy the requirements of the Planning Secretary's Environmental Assessment Requirements (SEARs) (Application Number: SSD-15001460) issued 19th March 2021, with respect to Noise and Vibration. These requirements are described in detail in section 3.0.

The report includes assessments of the following key items :

- General project and site descriptions including nearby noise sensitive receivers
- Derivation of criteria applicable to the Project based on advice provided in the SEARs documentation with additional reference made to other guidance applied outside of the SEARs requirements
- Qualitative assessment of activities
- Quantitative assessment of noise emissions from building E dining hall and presentation space
- Quantitative assessment of noise generated by vehicle movements and carparking associated with the site.
- Quantitative assessment of construction noise with additional comments with respect to construction vibration
- Qualitative assessment of noise from aircraft events to the proposed site
- Comments regarding noise from mechanical services
- Provision of discussion on school Bell and PA operation
- Provision of measures to mitigate and minimise noise impacts where required

Acoustic advice provided in this report is based on the following documentation:

- Draft Schematic Drawings - prepared by NBRS Architects (ref. 20417, Issued: 23 March 2021)
- Project Description Prepared by NBRS Architects
- Traffic Report prepared by Taylor Thompson Whitting (TTW): *Transport and Accessibility Impact Assessment Hawkesbury Centre of Excellence* Revision 2 dated 03 June 2021.

Note: Noise generated within the school's internal spaces will typically be low and can be controlled with the proposed building construction in this report. Therefore, noise from the school's internal spaces is not assessed in detail in this report, apart from a review of building E.

Technical terms used throughout this report are described in Appendix A.

2.0 SITE AND PROJECT DESCRIPTION

2.1 Site Location

The site (Part 1 Lot 2 DP 1051798) comprises a parcel of land of area 11.37 Hectares leased from Western Sydney University (WSU Hawkesbury Campus), located adjacent the south western end of the campus, separated by Vines Drive.

The WSU Campus includes a number of potential noise receptors, including student accommodation immediately adjacent the north western boundary and educational buildings to the north and east. Beyond the Western Sydney University properties are more distant residential properties comprising Anglicare Nursing Home at the far north western corner of the site (at Londonderry Road) and a residentially zoned area, the closest point of which is at the corner of Southee Road and Londonderry Road, Hobartville.

The proposed site and the intervening property to the receptor zone is essentially flat land. The nearest noise sensitive receivers surrounding the proposed site are listed in Table 1. A site plan is provided in Appendix B with aerial imagery depicting nearby receivers detailed in Appendix C. The distances shown in the table below at those between the receptor and the closest boundary of the site (or part of the site subject to development in the case of the farming area)

Table 1: Noise sensitive receivers selected for assessment

Receiver ID	Location	Receiver Type	Description
R1	North of the proposed development approximately 549 m	Residential	Single lot residential housing area to the north of the proposed development corner Southee Road and Londonderry Road. It includes two level dwellings.
R2	North West of the proposed site 118m	Residential Care	Multistorey residential care building nearby the proposed development. This residential receiver represents the closest sensitive residential type receivers located adjacent the western extremities of the subject site.
R3	North West of the proposed site 52m	Student Accommodation	Single-storey residential buildings nearby the proposed development. This group of residential receivers represents the closest sensitive residential type receivers located north west of the subject site.
E1	North of the proposed site 17m	Educational	WSU Forensic and Biology Labs (K16) to the north of the proposed development, separated by Vines Drive.
E2	East of the proposed site 21m	Educational	WSU Microbiology (J4) Labs Building with a common boundary with the proposed development. This receiver is identified as the closest educational to the subject site.

2.2 Project overview

The proposed development involves the construction and operation of a new Centre of Excellence (CoE) in Agricultural Education on a leased land parcel of area 11.37 Hectares within the Western Sydney University Hawkesbury Campus) site, Richmond NSW.

The CoE will provide new agricultural / STEM teaching facilities with general learning and administration spaces to be utilised by rural, regional, metropolitan and international school students. The CoE will accommodate up to 325 students and up to 20 full time employees consisting of farm assistants, administration staff and teachers and up to five itinerant staff members. The CoE will also include short-term on-site accommodation facilities for up to 62 visiting students and teaching professionals from regional and rural NSW.

The CoE will include five science laboratories, ten general learning spaces, practical activity teaching areas, seminar, botany room, administration block and accommodation facilities. It will also include covered outdoor learning areas, dining / recreation hall, canteen and kitchen, agricultural plots, significant landscaping spaces, car parking and provision of necessary infrastructure.

The proposed development has been designed to be well integrated into the Western Sydney University site, having due regard for scale, bulk and orientation of existing buildings. The educational facilities will display linear open building forms in single story design with open spaces and lightweight construction techniques. The site is benefitted by views Blue Mountains to the west and the building and landscape plans have incorporated viewing opportunities into the design.

The EIS seeks development consent for the following works.

- Three academic blocks (Block B, C and D).
- Short-term, dormitory site accommodation with capacity for 62 patrons (Block F).
- Dining hall, Conference space and canteen (Block E).
- Administrative building (Block A).
- Support facilities for management and maintenance of site.
- External works to accommodate circulation and covered walkways between buildings.
- Pedestrian walkways.
- Student and staff amenities.
- Covered Outdoor Learning Areas.
- Staff car parking area and bus drop off and pick up area at the eastern side of the site, near Block F.
- Visitor parking located in front of Block A.
- Short-term accommodation car parking area.
- Green house.
- Various agricultural and animal plots and associated agricultural workshop.
- Provision of waste facility area.
- Installation of all essential services including stormwater management devices where required.
- Operation of the CoE site.

2.3 School population and hours of use

We are advised by SINSW the following population and hours of use can be expected:

2.3.1 Students

At full capacity 90- students per cohort

Equating to 540 AgSTEM students attending 0.6 of their timetable = FTE: 325 AgSTEM RAC students

Plus: state programs : up to visitors 60 residential capacity plus day visits.

2.3.2 Staff

20 fulltime including farm, admin and teaching plus up to 5 itinerant staff between campuses

2.3.3 Total Maximum Population

Monday to Friday

325 students

25 staff

100 visitors (includes 62 accommodation)

450 maximum

Saturday/Sunday

150 persons conference (includes accommodation noting tote dining / conference hall is used by the accommodation people for breakfast, lunch and dinner)

2.3.4 Hours

Core Hours 8.25am – 2.45 pm

Extended day for senior students 7.45am – 4.30pm to facilitate school curriculum opportunities and spread travel arrival/departure load

On site day trips generally operate 9am – 2.15 pm

Residential arrivals generally from 9am – back on campus in evening by 6pm.

The dining hall and conference block E may be used by the community in the evening times. Block F comprises student accommodation and would be expected to be in use during the night-time hours given its intended function.

2.4 Proposed built form

The proposed CoE buildings are sited to the south of Vines Road with the primary access from a private road. The proposed development includes new educational buildings, open spaces and parking facilities as per below.

2.4.1 New educational buildings

Six (6) main educational buildings and two (2) farm buildings are proposed as part of the development.

- Block A Administration: One (1) single- storey building on the site will accommodate the administrative activities, shared office space and staff located at the main entrance from Vines Drive.
- Block B Learning: One (1) single storey building provides a central practical activities/ seminar room and four general learning areas (two on the northeast elevation and two on the southwest elevation) to be used as teaching areas. Oriented generally north to south.

- Block C Learning: One (1) single storey building offers two (2) areas for practical activities, one (1) seminar, one (1) semi commercial food tech with kitchen prep and six (6) general learning areas. Generally oriented east to west.
- Block D Learning: One (1) single storey building to provide five (5) labs, one (1) botany/ zoology room two (2) practical spaces and one preparation area. Oriented east to west.
- Block E Hall/Dining: One (1) Single story building containing the dining hall and conference area with canteen and kitchen. Oriented north to south.
- Block F Accommodation: One (1) Single storey building to accommodate short term accommodation, dormitory style bedrooms with a wellbeing area extending to the northeast.
- Block H Farming: One (1) Single storey Agricultural workshop.
- Block G Farming: One (1) Single storey green house.

Buildings have been oriented on the site in linear open building forms utilising a 7.5m x 9m DfMA grid for a lightweight steel structure and portal frame structures. The buildings are connected by Covered Outdoor Learning Areas, facilitating pedestrian activity. Agricultural plots are sited to the west of the buildings and accessed by internal circulation path. The arrangement of the outdoor learning spaces and buildings create a comprehensive site wayfinding strategy with landscaping utilised to reinforce the site plan.

2.4.2 Site and parking facilities

The site planning focuses on separate private and public vehicular access with minibus/ student drop off and pickup occurring at the north from Vines Road. Five car parking spaces are provided in this location. A further thirty-four car parking spaces for staff and short-term accommodation is provided in an area is located to the eastern side of the site, along with loading, waste removal and maintenance area.

2.5 Mechanical services

The objective of this assessment is to review externally located equipment with respect to noise emissions to the environment. As equipment selections have not yet been finalised, conceptual advice and performance targets are provided to inform the ongoing design.

3.0 PLANNING SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

Key issue requirements applicable to the Project are detailed in the Planning Secretary's Environmental Assessment Requirements (SEARs) (Application Number: SSD 15001460) issued 19 March 2021. The SEARs provide the following requirements for Noise and Vibration:

9. Noise and Vibration

• Provide a noise and vibration impact assessment that:

- *o includes a quantitative assessment of the main noise and vibration generating sources during demolition, site preparation, bulk excavation and construction.*
- *o details the proposed construction hours and provide details of, and justification for, instances where it is expected that works would be carried out outside standard construction hours.*
- *o includes a quantitative assessment of the main sources of operational noise, including consideration of any public-address system, school bell, mechanical services (e.g. air conditioning plant), use of any school hall for concerts etc. (both during and outside school hours) and any out of hours community use of school facilities.*
- *o outlines measures to minimise and mitigate the potential noise impacts on nearby sensitive receivers.*

- *considers sources of external noise intrusion in proximity to the site (including, road rail and aviation operations) and identifies building performance requirements for the proposed development to achieve appropriate internal amenity standards.*
- *demonstrates that the assessment has been prepared in accordance with polices and guidelines relevant to the context of the site and the nature of the proposed development.*

Relevant Policies and Guidelines:

- *NSW Noise Policy for Industry 2017 (NSW Environment Protection Authority (EPA).*
- *Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009).*
- *Assessing Vibration: A Technical Guideline 2006 (Department of Environment and Conservation, 2006).*
- *Australian Standard 2363 Acoustics - Measurement of noise from helicopter operations (AS 2363).*

3.1 Noise and Vibration Sources

Based on the above, Table 2 shows the expected noise and vibration sources associated with the development of the Project and the documents referred for assessment. Note that vibration has been considered for the construction sources only as no operation sources are expected to give rise to perceptible vibration levels at residential receivers.

Table 2: Project noise and vibration sources and assessment references

Noise/Vibration Source	Assessment Reference
Construction	
- Site Preparation	'Interim Construction Noise Guideline' 'Assessing Vibration: A Technical Guideline'
- Bulk Excavation	'Interim Construction Noise Guideline' 'Assessing Vibration: A Technical Guideline'
- Construction	'Interim Construction Noise Guideline' 'Assessing Vibration: A Technical Guideline'
Operation	
- Public Address System	'NSW EPA Noise Policy for Industry' 'Educational Establishments and Child Care Facilities SEPP 2017'
- School Bell	'NSW EPA Noise Policy for Industry' 'Educational Establishments and Child Care Facilities SEPP 2017'
- Mechanical Services	'NSW EPA Noise Policy for Industry'
- Outdoor Activities	'Noise Guideline for Local Government' 'Protection of the Environment Operations Act'
- Aircraft Noise	'AS 2021:2015 Acoustics - Aircraft Noise Intrusion - Building Siting and Construction'
- Traffic Noise	'Road Noise Policy'
- Car park noise	'NSW Noise Policy for Industry'

4.0 BACKGROUND NOISE SURVEY

A long-term unattended survey of background noise levels was conducted at a location close to the site boundary from 3 March 2021 to 8 April 2021, using a 01dB noise logger (S/N: DUO 10419). The selected location provided a good representation of noise levels in the local environment and nearby noise sensitive receivers. Additionally, attended measurement has been carried out near the university student accommodation on 3 March 2021 using a B&K 2250 Sound Level Meter (S/N:3010249). Measurement locations are shown in Appendix C.

The measurement equipment was calibrated before and after the survey with no significant drift observed.

Average L_{A90} and L_{Aeq} noise levels measured during the long-term noise survey are shown in Table 3 and have been derived in accordance with the data exclusion rules described in the NPfI. Graphs of the measured noise levels during the measurement period are provided in at the end of this report.

Primary use of the school will be during the Daytime period (0700-1800 hrs) Additionally, the dining and multipurpose space may be used by in the evening period (1800-2200 hrs).

Table 3: Measured average background and ambient noise levels – Long-term

Period	Time of day	RBL L_{A90} dB	L_{Aeq} dB
Day	0700-1800 hrs	35	48
Evening	1800-2200 hrs	45	52
Night	2200-0700 hrs	38	47

Average L_{A90} and L_{Aeq} noise levels measured during the short-term noise survey are shown in **Table 4**.

Table 4: Measured average background and ambient noise levels – Short-term

Period	RBL L_{A90} dB	L_{Aeq} dB
1728hr-1743hr	52	54

During the attended measurement, it was noted that the ambient noise of the environment was controlled by noise from nature (insects and frogs) as well as distant traffic noise from Londonderry Road.

It is noted that the RBL during the Evening and Night periods were higher than the Day period. Examination of recorded spectra and listening to audio recordings from the noise logger revealed that seasonal insect and frog activity significantly impacted on the Evening and Night RBLs.

Extensive noise monitoring had already been carried out on site previously as part of assessment of an earlier development. Noise monitoring data was sourced from a Resonate Acoustics report HASH-00-SD-AS-RP-0001-C for a previous development proposal associated with the site. The monitoring locations for both the MDA and Resonate surveys were similar.

We note however that the Resonate Survey recorded lower RBL data during the Evening and Night-time period. Table 4 of the Resonate report is reproduced below:

Table 4 Unattended monitoring results

Location	Rating Background Level, dB(A) L_{90}[1]			Ambient noise level, dB(A) L_{eq}		
	Day 7 am—6 pm	Evening 6 pm—10 pm	Night 10 pm—7 am	Day 7 am—6 pm	Evening 6 pm—10 pm	Night 10 pm—7 am
U1 – WSU Village	37	37	32	47	44	44

(1) The Rating Background Level is a measure of the typical minimum steady background noise level for each time of day.

As a conservative approach we have adopted the lowest RBL from both the MDA and Resonate data sets. The MDA measured Day RBL has been applied for Day and has also been applied for the Evening (in accordance with Section 2.3 of EPA NPfI, noting Resonate Evening level was higher). The Resonate measured Night RBL has been applied for for Night-time periods.

Table 5: RBL used for assessment

Period	Rating Background Level, $L_{A90, 15min}$ dB
Day	35
Evening	35
Night	31

5.0 CONSTRUCTION NOISE AND VIBRATION

In this section construction noise impact assessments associated with the proposed works are provided. Construction noise targets have been established and the prediction results are based on the assumptions detailed in this report.

Ground-borne noise associated with the expected activities from the transmission of vibration through the ground is expected to be negligible compared to the direct transmission of noise through the air. Therefore, ground-borne construction noise has not been assessed further in this report.

5.1 Construction Hours

It is anticipated that all works will be completed during Standard daytime construction hours. The works during the following periods are anticipated:

Standard hours: Monday to Friday from 7 am to 6 pm, Saturday 8 am to 1 pm. No work on Sundays or public holidays.

5.2 Construction Noise and Vibration Criteria

Noise and vibration criteria applicable to the project site with respect to construction activities have been derived considering the references detailed in Table 2, and are summarised in the following sections.

5.2.1 Construction noise management levels

Noise criteria applicable to the project site with respect to construction activities have been derived considering the '*Interim Construction Noise Guideline*' (ICNG) and are summarised in Table 6. These criteria apply to airborne noise emissions related to construction activity during the recommended standard hours only. The full derivation of criteria is provided in Appendix D.

Table 6: 'Interim Construction Noise Guideline' airborne noise criteria

Receiver Type	Management Level, $L_{Aeq\,(15\,min)}$	
	Noise Affected	Highly Noise Affected
Residential	45	75
Classrooms at schools and other educational institutions	45 (Internal noise level) 55 (External noise level)	

The "Noise Affected" level is the point above which there may be some community reaction to noise. The "Highly Noise Affected" level represents the point above which there may be a strong community reaction to noise. Where the "Noise Affected" management level is predicted to be exceeded, the ICNG requires that all feasible and reasonable work practices be employed. Where it is predicted that the "Highly Noise Affected" management level will be exceeded, respite periods may need to be considered.

5.2.2 Construction traffic noise criteria

In accordance with ICNG, potential road traffic noise impact from construction traffic on public roads to and from the subject site should be assessed under the *Environmental Criteria for Road Traffic Noise* (EPA 1999). This policy, however, has been superseded by the *NSW Road Noise Policy* (EPA 2011).

The *NSW Road Noise Policy* (RNP) provides noise level criteria for increased traffic flow as a result of land-use Development with the potential to create additional traffic. Table 7 presents the traffic noise criteria applicable to this project.

Table 7: Road Traffic Noise Criteria

Type of Development	Criteria	
	Day 0700-2200hrs	Night 2200-0700hrs
Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{eq(1hr)}$ 55 dBA (external)	$L_{eq(1hr)}$ 50 dBA (external)

Source: Table3 EPA – RNP

Additionally, the RNP states that 'for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the Development should be limited to 2 dB above that of the noise level without the Development. This limit applies wherever the noise level without the Development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.'

5.2.3 Human comfort vibration targets

Humans can detect vibration levels which are well below those causing any risk of damage to a building or its contents. Human comfort due to vibration from construction works is assessed under the NSW EPA document *Assessing Vibration – a technical guideline* (DEC 2006).

The vibration characteristics of most construction activities (e.g. excavation and rock breaking) are considered to be intermittent. Vibration criteria applicable to the site for intermittent vibration sources, are summarised in Table 8. Only Day time criterion is provided as no out of hours construction activities are expected.

Table 8: Vibration limits according to 'Assessing Vibration: A Technical Guideline', (m/s$^{1.75}$)

Location	Daytime (0600-2200hrs)[1]	
	Preferred Value, VDV	Maximum Value, VDV
Critical areas[2]	0.1	0.2
Residences	0.2	0.4
Offices, schools, educational institutions and places of worship	0.4	0.8
Workshops	0.8	1.6

Note: 1 - Daytime is 7.00 am to 10.00 pm and Night-time is 10.00 pm to 7.00 am.
2 - Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas. Source: BS 6472–1992

5.3 Construction Airborne Noise Prediction Methodology

5.3.1 Assessment scenarios

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. Based on the proposed construction locations and methodology, the following construction phases were developed to represent the works at various construction sites within the project.

- Site Preparation
- Bulk Excavation
- Construction

For each construction phase, two scenarios were developed to represent the works potentially having the greatest noise impact on the surrounding receivers. Noise levels for these works in this assessment have been calculated for the following scenarios:

"Typical Average Case" (TA): it is assumed that all the proposed plant items nominated by the client will be working concurrently towards the centre of the relevant construction site for between 25% to 100% of the time over a 15-minute period.

"Typical Worst Case" (TW): it is assumed that two of the nosiest proposed plant items will be working concurrently simultaneously near the boundary of the relevant construction site for between 25 to 100% of the time over a 15-minute period.

Situations, where noise sources would be located towards the centre of the site, are likely to be representative of the longer-term average noise emissions.

5.3.2 Assumed construction plant items and sound power

At this early planning stage, potential plant items are proposed by the client. These assumptions must be reviewed in the detailed design phase when more information is available on the schedule for the works and the equipment to be used. If the plant items to be used differ from that assumed in this report, further assessment of construction noise and vibration will be required. A summary of equipment assumed to be operating and the assumed operating duty (percentage of time operating per 15-minute period) for each phase of construction work, is provided in Appendix E. The relevant sound power data for these plant items is provided in Appendix F.

5.3.3 Modelling assumptions

Noise levels have been calculated at 1.5m above ground level in accordance with the requirements of the ICNG and at various distances from the boundary of the site. Calculated noise levels include the effects of the noise control recommendations specific to each construction phase detailed in this report.

5.4 Noise Control Recommendations

Based on the assumed construction plant items, MDA recommends that the noise control measures detailed in Table 9 are implemented on-site. Predicted construction noise levels in this assessment, include the effect of these recommendations.

Table 9: Noise control recommendations for site

Phase	Equipment/Location	Recommendation
Site preparation	Generator Air compressor	- Localised noise barriers should be utilised when this equipment is in use. - Barriers should be mobile and extend to a height 1 m above noise source. - Barrier should envelop the work location to ensure no direct line of sight to nearby receivers. - Practical and feasible measures should be taken to allow the noise barrier to be located within 4 m of the noise source.
Bulk Excavation	Jack hammer & breaker Concrete saw Generator Air compressor De-watering plant	- Localised noise barriers should be utilised when this equipment is in use. - Barriers should be mobile and extend to a height 1 m above noise source. - Barrier should envelop the work location to ensure no direct line of sight to nearby receivers. - Practical and feasible measures should be taken to allow the noise barrier to be located within 4 m of the noise source.
Construction	Brick saw Concrete saw/ring saw Generator Air compressor De-watering plant	- Localised noise barriers should be utilised when this equipment is in use. - Barriers should be mobile and extend to a height 1 m above noise source. - Barrier should envelop the work location to ensure no direct line of sight to nearby receivers. - Practical and feasible measures should be taken to allow the noise barrier to be located within 4 m of the noise source.

The above noise control recommendations are provided in the absence of a detailed construction methodology. A full CNVMP will be required later to be prepared by the builder once appointed and detailed construction methodology is available.

5.5 Summary of Construction Noise Assessment

Predicted noise levels from construction activities have been calculated, a detailed assessment, including predicted noise levels, are provided in Appendix G.

It is noted that situations, where noise sources would be located towards the centre of the site, are likely to be representative of the longer-term average noise emissions. Within standard hours (Monday – Friday: 0700-1700 hrs, Saturday 0800-1300 hrs) the "Average" noise levels from typical operations at the most noise affected receivers are probable to be;

- Site Preparation activities are calculated to be:
  - Up to 8 dB above the "Noise Affected" goals and below the "Highly Noise Affected" project-specific management levels.
- Bulk Excavation activities are calculated to be:
  - Up to 21 dB above the "Noise Affected" goals and below the "Highly Noise Affected" project-specific management levels.
- Construction activities are calculated to be:
  - Up to 27 dB above the "Noise Affected" goals and below the "Highly Noise Affected" project-specific management levels.

Exceedances of "Noise Affected" goals are typical of construction sites in suburban areas as background noise levels tend to be relatively low. Further, since all construction works are restricted to take place only during the daytime, noise impacts will not be experienced during the most sensitive time period i.e. night-time. The ICNG recommends that for situations in which the "Noise Affected" management levels are exceeded; all feasible and reasonable work practises should be adopted. As such the works at this site will need to be considered during the preparation of the CNVMP such that all feasible and reasonable noise management practices are adopted, including consultation with the community. Inclusions for construction noise and vibration management plan are proposed in Appendix H.

5.6 Summary of Construction Vibration Assessment

Based on the assumed plant and equipment summarised in Appendix E, some vibration intensive activities may potentially exceed the applicable human comfort criteria in Section 5.2.3 at distances of up to around 100 meters. Table 10 shows a "Safe Working Distance" from vibration intensive plant indicating the minimum distance at which vibration levels from intensive vibration activities are not expected to exceed the human comfort targets. Where vibration intensive activities are proposed close to sensitive receivers, site measurements and alternative equipment or methodologies should be employed. A detailed vibration impacts assessment as part of the full CNVMP will be required later to be prepared in the detailed design phase once detailed construction methodology is available.

Table 10: Safe working distance – Human comfort

Plant Items	Safe working distance, (m)
18-34 t extractor with hydraulic hammer	75
12 t vibratory roller	100
Jackhammer	1 (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. However, vibration monitoring is recommended to confirm minimum working distances for more sensitive receivers e.g. precision laboratories where sensitive operations are occurring.

6.0 OPERATIONAL NOISE

6.1 Operational Noise Criteria

Noise criteria applicable to the project site with respect to operational activities have been developed considering the references detailed in Table 2 and are summarised in the following sections. The full derivation of criteria is provided in Appendix D.

6.1.1 'Noise Policy for Industry'

Airborne noise criteria applicable to the site derived in accordance with the NPfI are summarised in Table 11. These criteria apply (in accordance with the SEARs) to airborne noise emission related to the PA system, school bell and mechanical services.

Table 11: NPfI Project Noise Trigger Levels

Receiver	Period	Project Noise Trigger Level, $L_{Aeq,15min}$, dB
Residential	Day	40
	Evening	40
	Night	36
School classroom (Internal)	When in use	33 (internal)

6.1.2 'Noise Guideline for Local Government'

The NGLG is designed to assist local government officers in assessing noise impacts and associated decision making. In determining whether a source of noise may be offensive, the following checklist is considered:

Q1: Is the noise loud in an absolute sense? Is it loud relative to other noise in the area?

Q2: Does the noise include characteristics that make it particularly irritating?

Q3: Does the noise occur at times when people expect to enjoy peace and quiet?

Q4: Is the noise atypical for the area?

Q5: Does the noise occur often?

Q6: Are a number of people affected by the noise?

Above assessment checklist has been considered in assessing noise from outdoor activities.

6.1.3 'Protection of the Environment Operations Act 1997'

The PoEO provides a qualitative basis on which to assess impacts from noise sources and outlines assessment considerations designed to establish whether noise can be objectively considered offensive. Offensive noise is defined in the PoEO act as being noise:

(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:

(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or

(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations.

The PoEO subjective assessment has been considered in evaluating noise from outdoor activities.

6.1.4 'Road Noise Policy'

The Road Noise Policy provides a noise criterion for existing residences affected by additional traffic on existing local and arterial roads generated by land-use developments. This is specified as $L_{Aeq\ (15\ hr)}$ 60 dBA assessed at the boundary of a residence along arterial roads; and $L_{Aeq\ (1\ hr)}$ 55 dBA assessed at the boundary of a residence along local roads.

Additionally, the RNP notes that in assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person. An increase of 2 dB equates to an approximate increase in traffic volume in the order of 60%.

6.2 Operational Noise Emissions

6.2.1 PA System and School Bell

At this early stage, no detailed information has been provided with respect to the PA system or school bell. It is not known whether bell or PA functions occur externally or are limited to internal spaces.

Noise from internal speakers will be well controlled by the building façade. Noise emissions from outdoor sources will need to be reviewed in more detail at a later stage once the number and location of bells and speakers are known. Noise from new PA or school bell noise sources must be designed such that the criteria shown in Table 11 are achieved when assessed cumulatively with all site-related operational noise emissions.

Additionally;

- Speakers should be positioned to minimise noise spill
- Consider the use of highly directional speaker units
- A distributed system of smaller, lower output speakers rather than a system of fewer, higher output speakers allows better control of noise spill and lower noise levels
- External speaker use should be limited to the provision of short PA announcements and bell functions only and should not be used for playing music, radio or other continuous noise sources.

6.2.2 Noise Emissions from Use of the Dining Hall Presentation Space

Noise generated within the school's internal spaces will typically be low, with noise within the Dining Hall (block E) expected to be potentially higher than in other spaces. Noise emissions from the hall have been assessed based on the assumed internal reverberant sound levels shown in Table 12. These activities are expected to occur anytime during the Day time period for school-based activities, or the Evening period for community-based activities.

Any assumptions regarding frequency of these activities should be verified by others.

Table 12: Assumed internal reverberant sound pressure levels, dB

Use	Internal reverberant sound pressure level, L_{Aeq} dB	Comments
Presentations (with amplified speech)	75	To occur on a weekly or daily basis
Dining	65-70	To occur on a weekly or daily basis

Based on noise emissions from the above activities, in addition to other considerations such as rain noise control, the external wall, roof, glazing and door acoustic performance requirements detailed in Table 13 have been derived.

Table 13: Performance requirements for external building elements, R_w

Building Element/Applicable Block	Performance requirement, R_w
Roof/ceiling	35 (higher rating required for rain noise control)
External walls	35
Glazing	25
Doors and sliding glazed partitions	25

Predicted noise levels at both the educational receptors (building J4 and K16) and the nearest residential receiver (WSU student accommodation) have been calculated and are presented in Table 14.

Table 14: Predicted noise levels from School Dining Hall Building E

Receiver/Period	NPfI Criteria, $L_{Aeq\ (15\ min)}$, dB	Façade Elements Closed		Façade Elements Open	
		Predicted Level $L_{Aeq\ (15\ min)}$, dB	Compliance?	Predicted Level $L_{Aeq\ (15\ min)}$, dB	Compliance?
WSU Student Accommodation – Residential -dining activities					
Day/Evening[1] (Dining)	40	<30	✓	33	✓
Day/Evening[1] (Dining)	40	<30	✓	38	✓
Microbiology J4					
When In Use	53	<30	✓	35	✓

[1] Day: 0700-1800hrs, Evening: 1800-2200hrs

The proposed acoustic performance of the façade elements is predicted to allow sufficient noise control of school and community use activities such that NPfI (and EECF SEPP) noise criteria can be achieved at the residential receivers during both Day and Evening time periods. With façade elements open, noise levels at receivers would increase but would still be compliant with criteria for the Day and Evening periods.

Noise emissions from other sources must be designed such that cumulative noise levels at nearby noise sensitive receivers are capable of complying with the derived NPfI criteria when assessed cumulatively with noise from Dining Hall.

6.2.3 Mechanical services

The mechanical services design finalised equipment selections have not yet been made. As such, a quantitative assessment of mechanical services noise emissions cannot be conducted. The mechanical services are expected to comprise a fully ducted system with various external plant items likely to give rise to noise emissions from the school.

Any noise emissions related to the Project from external mechanical services items must be designed and selected such that the applicable NPfI noise criteria are achieved at the residential receivers when assessed cumulatively with all other noise emissions from the school as a whole.

Noise control measures that may be required to control noise emissions from external plant could include:

- Noise control barriers
- Selection of low-noise equipment
- Vibration isolation of items
- Attenuators to ducting

It is expected that noise emissions from the plant will be reviewed in detail as part of the ongoing mechanical services design.

6.2.4 Outdoor activities

Noise from children outside engaging in sports activities has been assessed. No information has been provided with respect to proposed numbers, positioning or scheduling of outdoor activities. In order to conduct an assessment of noise impacts, MDA has made assumptions regarding the nature of the outdoor activities and provides comments below.

It should be noted that no specific quantitative criteria for the assessment of outdoor activities associated with schools are available. NSW EPA indicates consideration of the Noise Guideline for Local Government and the Protection of the Environment Operations Act for the assessment of such sources. These sources provide qualitative guidance for assessment only, however approximate predicted noise levels have been developed to aid in understanding the nature of any noise impacts on nearby receivers.

Outdoor Activities Areas

For outdoor recreation activities, it is assumed that up to 100 students may be engaging in active activities within the recreational green fields located adjacent building D and E. It is assumed that students will be dispersed over the entire recreation field area. It is also assumed that students may be vocalising on a 1 in 2 basis and a raised voice basis, with a nominal sound power of 83 L_{WA} each.

Noise levels from activities of this nature are predicted to be in the order of 52 dB L_{Aeq} at the WSU student accommodation receiver, and 39 dB L_{Aeq} at the Residential Care Building to the west.

Noise levels at the WSU buildings J4 (microbiology) and K16 (biology labs) are likely to be of the order of 45-50 dB L_{Aeq} at the façade. This will result in levels less than 33 dB L_{Aeq} allowing for the existing window and façade systems being closed.

Based on a subjective assessment under the NGLG our assessment has established that noise from outdoor activities at the school is unlikely to be considered offensive on the basis shown in Table 15.

There is a COLA located along the north western boundary of the site, approximately, approximately 50 metres from the WSU student accommodation. Noise impacts from this zone will depend on the type of use of the COLA, however a teaching activity with one or two raised voices is expected to be limited impacts to an acceptable level during the daytime hours. Some events or activities, particularly where music is played may being to generate adverse noise impacts at the WSU student accommodation.

Table 15: NGLG Subjective Assessment

NGLG Subjective Assessment of Outdoor Activity Noise
Q1: Is the noise loud in an absolute sense? Is it loud relative to other noise in the area?
Noise levels from outdoor activities are predicted to be likely above background noise levels, however, unlikely to be significantly above noise from typical traffic noise along Londonderry Road when the absolute level is considered.
Q2: Does the noise include characteristics that make it particularly irritating?

NGLG Subjective Assessment of Outdoor Activity Noise
Court judgements about intrusive noise from schools have indicated that noise from student activities may be considered more acceptable and less irritating than the noise of an equivalent level from industrial, commercial or other noise sources **Q3: Does the noise occur at times when people expect to enjoy peace and quiet?** Outdoor activities are expected to occur during the Daytime period 0700-1800hrs during which residents are generally expecting to be impacted by community noise sources. **Q4: Is the noise atypical for the area?** The proposed site is currently adjacent (and is part of) an existing WSU education precinct which permits the use of land for educational establishments with the relevant consents. Therefore noise from student outdoors is not out of character for the intended land use. **Q5: Does the noise occur often?** Noise from students utilising the outdoor areas of the school is expected to occur in varying numbers throughout the day. The worst-case scenario of all students outside simultaneously is likely to occur for one of two periods of less than an hour on weekday only. **Q6: Are a number of people affected by the noise?** The number of receivers affected by the noise is likely to be in the order of 10-12 WSU student accommodation buildings. We note that the noise from outdoor activities would only occur during the daytime hours, when it is less likely that WSU students are sleeping.

With regards to assessment under the PoEO Act, noise from outdoor activities is not considered to be offensive. A summary of our subjective assessment is described in Table 16.

Table 16: PoEO Act Subjective Assessment

PoEO Act Subjective Assessment of Outdoor Activity Noise
(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances: **(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted,** Noise from outdoor activities is not excessive in level, has acceptable character and occurs during the Daytime period. On this basis, outdoor activity noise is unlikely to be harmful to a receiver outside of the school. **(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or** Outdoor activities will occur during the Daytime period (0700-1800hrs). Receivers are generally less noise-sensitive during this period due to increase in other noise-generating activities not related to the school, reduced likelihood of residents sleeping, increased likelihood of residents being away from the premises and increase in general activities in the community. **(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations.** The proposed site is currently adjacent (and is part of) an existing WSU education precinct which permits the use of land for educational establishments with the relevant consents. Therefore noise from student outdoors is not out of character for the intended land use.

6.2.5 Traffic Movement on Public Roads

Information on existing and projected traffic flow movements can be found within a report prepared by Taylor Thompson Whitting Pty Ltd *Transport and Accessibility Impact Assessment Hawkesbury Centre of Excellence* Revision 2 dated 03 June 2021. Modelled data in the report can be found within Appendix D – Intersection Modelling Results. The data provides information for 2021 without development, 2021 with development and 2031 with development for each of the following intersections:

1 Londonderry x Vines

2 Londonderry x Southee Road

3 Paget x Lennox

4 Blacktown x Bourke

5 Blacktown x Campus

We have summarised the total hourly traffic modelled by TTW for each intersection in Table 17

Table 17: Summarised hourly traffic movements per TTW modelling

Site	2021am WOD	2021pm WOD	2021am WD	2021pm WD	2031am WD	2031pm WD
1	925	903	921	873	1009	960
2	878	951	854	895	945	985
3	1546	1720	1565	1756	1728	1938
4	1652	1705	1669	1740	1843	1904
5	1340	1318	1367	1353	1353	1494

MDA has conducted a review of these traffic volumes. Based on the predicted traffic volume increases, MDA has determined that associated traffic noise level changes will remain below 2 dB. The RNP indicates that an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person. On this basis, no noise control design or mitigation measures are required with respect to future traffic on public roads.

6.2.6 Traffic movements at Site Carparks

A noise assessment has been carried out for the car park to be located north of the subject site. Traffic data in the report *'Transport and Accessibility Impact Assessment Hawkesbury Centre of Excellence*, dated 3rd June 2021, is used to carry out an assessment of the expected noise levels at the nearest sensitive receivers from the car park operations.

The traffic report notes that the main car park of Maintenance Lane will comprise 34 parking spaces, with an additional 5 visitor spaces outside the main administration block. Pickup and drop off will be near the visitor carpark with up to 10 vehicle cycles per peak period (15 minutes)

As such, for a conservative assessment in this report, the following vehicle movements during morning and afternoon peak hour are assumed in this report:

- Pick-up and Drop-off Provision: 10 vehicles will visit the pick-up and drop-off space during the peak period (15 minutes)

- Car Parking: all the 39 spaces are assumed to occupied during the peak hour (1 hr). Over a fifteen-minute period we have allowed for 3 out 5 spaces in the small carpark and 17 out of 34 spaces to be filled.
- Deliveries: The traffic report recommends a maximum of 1 vehicle per fifteen-minute period, and this has been allowed for in the calculation

Noise levels have been predicted using the data in Table 18 impacts to the identified nearest receivers are presented in Table 4.

Table 18: Assumed Sound Power Levels, L_{WAeq}

Description	Overall L_{WAeq}, dB
Minibuses[1]	90
Cars[1]	88
Light rigid truck[2]	93
Door slam and Engine start[2]	90

Note: 1 – Based on AAAC "Guideline for Child Care Centre Acoustic Assessment"
2 – Based on measurements conducted by MDA on previous projects

Based on anticipated vehicle movements, noise levels from the operation of the proposed car park are predicted and detailed in Table 19, as calculated to the nearest sensitive properties, that of WSU the student accommodation.

Table 19: Car Park Assessment - NPfI Compliance

Receiver	Time Period	Project Noise Trigger Level, $L_{Aeq, 15min}$, dB	Calculated noise level, $L_{Aeq, 15min}$, dB	Compliance
R4	Day	40	38	✓

Based on the predicted noise levels presented in the above table; operations of car parks and delivery truck movements are capable of complying with the noise criteria set out in this report during the primary use of the school (Day period).

6.2.7 Farming Equipment

The proposed agricultural nature of the facility means that it is reasonable to expect farming plant and equipment could be expected at various areas across the site. The site plan shows agricultural plot, orchards and dams along the south western extent of the site. In formation on plant and equipment and operational requirements is not available at this stage. Possible plant items include tractors and associated attachments such as ploughs, seeders and spreaders. Other items could include pumps, small utility ATVs, mowers and irrigation systems

The proposed location of the plots, orchards and dams is optimal, at the furthest extent from the WSU Student accommodation and the Residential Care Facility. It will be necessary to develop an operational noise management plan for the of the agricultural equipment. In particular the plan would require that:

- Mobile activities such as ploughing only be carried out during the daytime hours
- Mobile equipment be selected on the basis of its low operational noise, to the extent possible
- Where necessary, topographical land forms and features be provided between the activities and any residential or accommodation zone.

- Any stationary equipment be selected on the basis of low operating noise, or alternatively provided with an enclosure to achieve any necessary noise reduction.

7.0 ROAD TRAFFIC NOISE INGRESS TO SCHOOL SPACES

7.1 Noise Targets

In order to establish likely noise targets for school receivers NSW EPA Road Noise Policy have been considered. School receivers considered for assessment are detailed in Table 20 alongside expected noise targets and reference guidelines.

Table 20: Receiver locations and expected noise targets

Receiver	Recommended noise target	Reference Guideline
Internal spaces (school classroom etc.)	$L_{Aeq\ 1\ hr}$ 40	Road Noise Policy
External – Active Use	$L_{Aeq\ 15\ hr}$ 60	Road Noise Policy
External – Passive Use	$L_{Aeq\ 15\ hr}$ 55	Road Noise Policy

NSW EPA Road Noise Policy (RNP) recognises 'Open space (active use)' and 'Open space (passive use)' as sensitive land uses and sets criteria for these land uses. In this report, both uses of the outdoor activity areas are considered.

7.2 Assessment Results

Traffic noise levels have been measured as part of the long term noise logging detailed in Section 4.0. Ambient noise levels across the site due to traffic are low, with typical noise levels of the order of 48 – 52 $L_{Aeq(day)}$ to 54 dB $L_{Aeq(15\ minutes)}$

7.2.1 Traffic noise ingress to outdoor activity areas

MDA have carried out distance attenuation calculations between the traffic noise measurement location and the proposed outdoor activity area locations. Table 21 shows the calculated traffic noise levels at the proposed outdoor activity areas.

Table 21: Calculated traffic noise levels at outdoor activity areas

Receiver area	Expected noise level	Recommended noise target
Outdoor activity areas	$L_{Aeq\ 15\ hr}$ < 52	$L_{Aeq\ 15\ hr}$ 55 (External – Passive Use) $L_{Aeq\ 15\ hr}$ 60 (External – Active Use)

Analysis of the measurement results, shown in Table 21, indicate that the recommended traffic noise targets within the school outdoor areas are expected to be achieved. Therefore, no further mitigation measures are required.

7.2.2 Traffic noise ingress upon internal areas

Table 22 shows the estimate traffic noise levels at various locations within the site representing the future building façade locations. These figures do not include façade reflections. Allowance is made for opening windows and doors. The expected noise levels are expected to be 52 $L_{Aeq(1hr)}$ or less based on the attended location measurements of 54 $L_{Aeq(15\ minutes)}$ closer to Londonderry Road.

Table 22: Calculated traffic noise levels at various locations

Receiver building	Façade direction[1]	Expected noise level, $L_{Aeq\ 1\ hr}$	Recommended noise target, $L_{Aeq\ 1\ hr}$	Comply
Blocks A-F	West	<52 (External)	40 (Internal) 50 (External)[2]	Less than 2dB above target with windows open. Fully compliant with windows closed.
	Other	< 49 (External)		Yes

[1] the western façade is the façade facing Londonderry Road

[2] a minimum of 10 dB(A) reduction from external noise levels to internal noise levels has been adopted assuming open windows

7.3 Noise Mitigation Requirements

7.3.1 Architectural treatments

Results shown in Table 22 indicate that traffic noise levels within internal spaces of Blocks A to F are predicted to be marginally above the recommended target noise levels during the day with windows open.

With windows doors and louvres closed, traffic noise levels will be fully controlled by the building façade allowing for standard external façade constructions. Where windows are required to be closed to control traffic noise alternative ventilation (to provide adequate fresh air indoors) may be necessary.

Blocks A-D and F are to be air conditioned. In those instances, the systems should be configured to maintain any necessary outside air requirements.

Block F will include opening for natural ventilation. These openings would be satisfactory when the use is considered as a dining hall. There is potential exceedance of the internal noise criteria anticipated for the hall when used for assemblies or speech, with ventilation elements open. In those instances, an acoustic rating (such as from acoustic louvres) may be required for natural ventilation openings.

Where alternative ventilation is required, this should be considered during the design of the building. Consideration should be given (by others) to the ventilation requirements of the internal spaces with respect to AS 1668 and the Building Code of Australia.

Any mechanical plant should be designed to comply with Council's internal and external limits for mechanical plant noise.

8.0 AIRCRAFT NOISE

The SEARs requires and assessment of the impact of external noise sources on the site, including but not limited to, aviation operations. The SEARs references Australian Standard 2363 Acoustics – Measurement of Noise from helicopter operations (AS 2363). To our knowledge, the site is not impacted by noise from helicopter operations. Noise impacts from helicopter operations have not been identified during our site investigations.

The site is however in distant proximity to the Richmond RAAF air base, and subject to occasional noise from distant aircraft.

The relevant planning instrument is the RAAF Base Richmond, NSW 2014 ANEF Summary Report available from the Australian Government Department of Defence. This appears to be the current issue with the comment on the site noting that *Although an ANEF is developed for a future year, the forecast does not expire when that year has been reached.*

The approximate location of the Hawkesbury CoE sites is shown on the Richmond Airbase 2014 ANEF diagram appended to this report.

A review of ANEF contours indicates that the Hawkesbury CoE site is located well outside the ANEF 20 contour. Reference to Table 2.1 within AS 2021:2015 *Acoustics-Aircraft noise intrusion – Building siting and construction* notes that:

- A school or university siting is acceptable in a zone of ANEF 20 or less (educational component)
- a hotel, motel or hostel siting is acceptable in an ANEF zone ANEF 25 or less (accommodation component).

The noting of the development type as 'acceptable', rather than 'conditionally acceptable', indicates further assessment or application of noise controls is not required in accordance with the Standard.

The NSW Department of Education Educational Facilities Standard and Guidelines (EFSG) requires assessment of aircraft noise impacts on the site in certain circumstances as follows:

Aircraft Noise for general learning areas, music, drama, movement studios and hall is 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.

As the site is located outside the ANEF 25 (and outside the ANEF 20 contour) zone, an aircraft acoustic assessment would not be required by the EFSG or AS2021.

9.0 INDUSTRIAL NOISE INGRESS TO SCHOOL SPACES

There are no industrial noise sources in proximity to the site which require assessment with regards to noise impacts upon the proposed CoE facility.

APPENDIX A GLOSSARY OF TERMINOLOGY

SPL or L_P	Sound Pressure Level A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 μPa RMS) and expressed in decibels.
SWL or L_W	Sound Power Level A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
dB	Decibel The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μPa i.e. dB = 20 x log(P/Pr)
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.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
$L_{Aeq\,(t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
$L_{A90\,(t)}$	The A-weighted noise level equalled or exceeded for 90% of the measurement period. This is commonly referred to as the background noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
SEL or L_{AE}	Sound Exposure Level The sound level of one second duration which has the same amount of energy as the actual noise event measured. Usually used to measure the sound energy of a particular event, such as a train pass-by or an aircraft flyover
R_w	Weighted Sound Reduction Index A single number rating of the sound insulation performance of a specific building element. Rw is measured in a laboratory. Rw is commonly used by manufacturers to describe the sound insulation performance of building elements such as plasterboard and concrete.
Vibration	When an object vibrates, it moves rapidly up and down or from side to side. The magnitude of the sensation when feeling a vibrating object is related to the vibration velocity.

Vibration can occur in any direction. When vibration velocities are described, it can be either the total vibration velocity, which includes all directions, or it can be separated into the vertical direction (up and down vibration), the horizontal transverse direction (side to side) and the horizontal longitudinal direction (front to back).

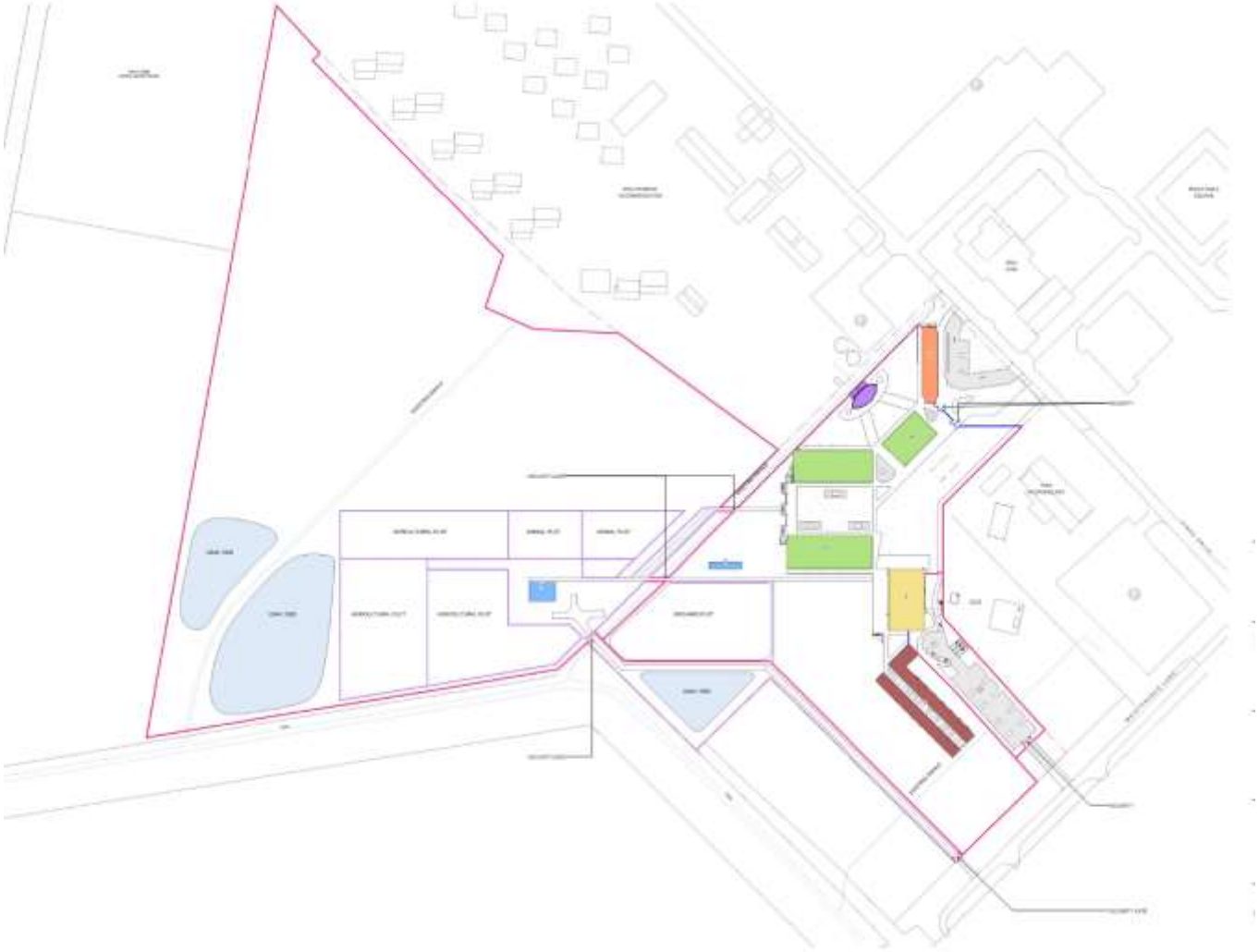
VDV

Vibration Dose Value

Vibration Dose Value is based on British Standard BS 6472:1992 Guide to Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz) and provides guidelines for the evaluation of whole body exposure to intermittent vibration.

VDV can be used to take into account the weighted measured RMS vibration from many vibration sources including rail vehicles, construction equipment such as jackhammers and industry. VDV takes into account the duration of each event and the number of events per day, either at present or in the foreseeable future and calculates a single value index.

APPENDIX B SITE PLAN



APPENDIX C AERIAL IMAGE OF SITE WITH RECEIVERS

APPENDIX D PROJECT SPECIFIC CRITERIA

D1 'Interim Construction Noise Guideline'

The 'Interim Construction Noise Guideline' (ICNG) aims to provide a clear understanding of ways to identify and minimise noise from construction works through applying all 'feasible' and 'reasonable' work practises to control noise impacts. The guideline identifies sensitive land uses and recommends construction hours, provides quantitative and qualitative assessment methods and subsequently advises on appropriate work practises.

For the project site, sensitive receivers and land uses have been identified. It is understood that construction activities on-site will not extend outside of the recommended standard hours detailed in Table D1.

Table D1: ICNG recommended standard ours of work

Work Type	Recommended standard hours of work
Normal Construction	Monday to Friday 0700 to 1800 hrs Saturdays 0800 to 1300 hrs No work on Sundays or public holidays

Based on the recommended standard hours, the guideline provides airborne noise criteria for residential receivers as detailed in Table B2. The "Noise Affected" management level is derived on a Rating Background Level (RBL) + 10 dB basis during Standard hours and RBL + 5 dB during periods Outside Standard hours, with RBL values taken from the measured average background noise levels shown in Table E2. The "Highly Noise Affected" management level is prescriptively set at $L_{Aeq\ (15\ min)}$ 75 dB. The management level for microbiology laboratory receiver is not distinguished as either "Noise Affected" or "Highly Noise Affected" but is set as a single criterion of $L_{Aeq\ (15\ min)}$ 45 dB (internal noise level).

Table D2: Noise Management levels for Residential receivers, dB $L_{Aeq(15minute)}$

Receiver Type	Management Level, $L_{Aeq\ (15\ min)}$	
	Noise Affected	Highly Noise Affected
Residential	45	75

Note: 1- NML applies when properties are being used
2- Internal noise levels are to be assessed at the centre of the occupied room
3- Where internal noise levels cannot be measured, external noise levels may be used. A conservative estimate of the difference between internal and external noise levels is 10 dB for buildings other than residences.
4- External noise levels are to be assessed at the most affected point within 50 m of the area boundary
5- Assessed at the most affected occupied point of the premises.

Table D3: Noise Management levels for Residential receivers, dB $L_{Aeq(15minute)}$

Receiver Type	Management Level, $L_{Aeq\ (15\ min)}$
Microbiology laboratory (Classrooms at schools and other educational institutions)	45 dB (internal noise level)

Note: 1- NML applies when properties are being used
2- Internal noise levels are to be assessed at the centre of the occupied room
3- Where internal noise levels cannot be measured, external noise levels may be used. A conservative estimate of the difference between internal and external noise levels is 10 dB for buildings other than residences.
4- External noise levels are to be assessed at the most affected point within 50 m of the area boundary

5- Assessed at the most affected occupied point of the premises.

Where noise from construction works is above the "Noise Affected" level, all feasible and reasonable work practises should be applied. Where the noise from construction works is above "Highly Affected management level, restrictions to the hours of construction may be required.

D2 'Noise Policy for Industry'

In NSW, the NPfI is the guideline used for assessing noise from large industrial premises scheduled by the EPA. However, some Councils also apply the NPfI to the assessment of noise emissions from other developments with noise sources that may be considered to be industrial in nature. Whilst the EPA has indicated that the NPfI is inappropriate for the assessment of educational facilities, specifically with regard to noise from children, the NPfI can be used as guidance to inform project-specific criteria that may be developed for a school development from industrial type noise sources such as mechanical plant.

The NPfI sets out a procedure where a noise source can be evaluated against a series of noise assessment levels. In the NPfI, these project-specific noise levels are derived from an analysis of the ambient noise environment and zoning information.

The ambient noise levels for this project are summarised in Table D1. In the NPfI, the background noise level is called the Rating Background Level (RBL). As the primary use of the facility will only occur during the Daytime and Evening periods (0700-1800 hrs and 1800-2200 hrs), the Night-time period is not required for assessment and has been omitted.

Table D1: NPfI periods and measured background noise levels

Period	Time of day	RBL $L_{A90,\ 15min}$ dB
Day	0700-1800 hrs	35
Evening	1800-2200 hrs	45
Night	2200-0700 hrs	38

During the attended measurement, it was noted that the ambient noise of the environment was controlled by noise from nature (insects and frogs) as well as distant traffic noise from Londonderry Road.

It is noted that the RBL during the Evening and Night periods were higher than the Day period. Examination of recorded spectra and listening to audio recordings from the noise logger revealed that seasonal insect and frog activity significantly impacted on the Evening and Night RBLs.

Extensive noise monitoring had already been carried out on site previously as part of assessment of an earlier development. Noise monitoring data was sourced from a Resonate Acoustics report HASH-00-SD-AS-RP-0001-C for a previous development proposal associated with the site. The monitoring locations for both the MDA and Resonate surveys were similar.

We note however that the Resonate Survey recorded lower RBL data during the Evening and Night-time period.

Table 4 of the Resonate report is reproduced below:

Table 4 Unattended monitoring results

Location	Rating Background Level, dB(A) L_{90}[1]			Ambient noise level, dB(A) L_{eq}		
	Day 7 am—6 pm	Evening 6 pm—10 pm	Night 10 pm—7 am	Day 7 am—6 pm	Evening 6 pm—10 pm	Night 10 pm—7 am
U1 – WSU Village	37	37	32	47	44	44

(1) The Rating Background Level is a measure of the typical minimum steady background noise level for each time of day.

Intrusiveness noise levels

The intrusiveness noise assessment is applicable to residential receivers and is based on knowledge of the background noise level at the receiver location. The intrusiveness level is the background noise level at the nearest noise-sensitive location plus 5 dB. Therefore, the noise emissions from the premises are considered to be intrusive if the A-weighted source noise level ($L_{Aeq,\ 15min}$) is greater than the background noise level (L_{A90}) plus 5 dB.

Based upon the background noise data summarised in Table D1, noise limits for Intrusiveness have been calculated in accordance with the NPfI and are presented in Table D2.

Table D2: Derived Intrusiveness noise levels

Period	Rating Background Level, $L_{A90,\ 15min}$ dB	Intrusiveness Noise Level (RBL + 5 dB), $L_{Aeq,\ 15\ min}$ dB
Day	35	40
Evening	35	40
Night	31	36

Amenity noise levels

The project amenity noise levels are designed to prevent industrial noise continually increasing above an acceptable level. The initial stage in determining the project amenity level is to determine the recommended amenity noise levels for the appropriate amenity area and time of day.

A review of the noise levels measured indicates that the residential noise environment is typical of a Suburban area with intermittent traffic-related noise source during the Day and Evening ambient noise levels defined by the natural environment and human activity. As such, the recommended amenity noise levels for a Suburban residential receiver as described in Table 2.2 of the NPfI have been selected. The appropriate recommended amenity noise levels are then modified to convert an $L_{Aeq\ period}$ time descriptor to an $L_{Aeq\ 15\ min}$ descriptor, with further modification available to allow for existing industrial and commercial premises (as detailed in Section 2.4 of the NPfI).

Given the above, and considering the various receivers identified in Section 2.0, the NPfI project amenity noise levels applicable to the development are detailed in Table D3.

Table D3: Derived project amenity noise levels

Receiver	Period	Recommended Amenity Noise Level $L_{Aeq,\ period}$ dB	Project Amenity Noise Level $L_{Aeq,\ 15min}$ dB
Residential (Suburban)	Day	55	53

Receiver	Period	Recommended Amenity Noise Level $L_{Aeq, period}$ dB	Project Amenity Noise Level $L_{Aeq, 15min}$ dB
	Evening	45	43
	Night	40	38
School classroom (Internal)	When in use	35 (Noisiest 1-hour period when in use)	33 (internal)

Source: Table 2.2 NSW Noise Policy for Industry

Determination of Project Noise Trigger Levels

The final process in determining the operational noise limits according to the NPfI is to derive the Project Noise Trigger Levels. The Project Noise Trigger Levels are levels that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response; for example, further investigation of mitigation measures.

The Project Noise Trigger Levels are derived by selecting the more stringent of either the intrusiveness or project amenity noise levels. For residential receivers, each assessment time period is evaluated individually. For non-residential receivers, only the Amenity noise level applies. The NPfI Project Noise Trigger Levels applicable to the site are shown in Table D4.

Table D4: NPfI Project Noise Trigger Levels

Receiver	Period	Project Noise Trigger Level, $L_{Aeq,15min,}$ dB
	Day	40
Residential	Evening	40
	Night	36
School classroom (Internal)	When in use	33 (internal)

APPENDIX E ASSUMED CONSTRUCTION PLANT ITEMS

A summary of equipment and the assumed duty (percentage of operation per 15-minute period) of equipment to be operating simultaneously in a 15-minute period for each construction work, is provided in Table F1.

Table D5: Assumed duration (% of 15-minute) of equipment to be operating simultaneously in a 15-minute period at construction sites

Construction Equipment	Site Preparation		Bulk Excavation		Construction	
	TW	TA	TW	TA	TW	TA
tracked 35t excavator (35 t)	75	75	-	-	-	-
Bogie truck & trailer	25	25	-	-	-	-
Generator	-	100	-	100	-	-
Air compressor & lines	-	50	-	50	-	75
2 x excavators (35 tonne, 27 tonne) with a hydraulic hammer	-	-	75	75	-	-
12t vibratory roller	-	-	25	25	-	-
Jack hammer & breaker	-	-	-	25	-	-
Concrete saw - road	-	-	-	25	-	25
Flatbed truck	-	-	-	25	-	-
Bogie truck	-	-	-	25	-	-
De-watering plant	-	-	-	100	-	100
Concrete pump	-	-	-	-	75	75
Brick saw	-	-	-	-	-	25
Concrete vibrator	-	-	-	-	75	75
Concrete floats	-	-	-	-	75	75
Diamond core drill	-	-	-	-	-	25
Nail guns	-	-	-	-	-	50
Hydraulic bar cutter	-	-	-	-	-	25
Concrete truck	-	-	-	-	-	25
Bogie truck	-	-	-	-	-	25
Generator	-	-	-	-	-	100
Electric winch & materials hoist	-	-	-	-	-	50
Mobile Crane	-	-	-	-	-	25
3.5t telehandler	-	-	-	-	-	25
rough terrain scissor lift	-	-	-	-	-	25

Note: Assessment Scenarios are described in Section 5.3.1. **TA** = 'Typical Average', **TW** = 'Typical Worst'

APPENDIX F CONSTRUCTION NOISE SOURCES

A variety of excavation and construction equipment will be used for this project. At this early stage, a comprehensive plan of staging and equipment selection is not known. Table C1 provides a schedule of construction equipment that is anticipated to be used on this site and their noise levels as taken from:

- AS2436-2010: *Guide to noise and vibration control on construction, demolition and maintenance sites*
- AS2436-1981: *Guide to noise and vibration control on construction, demolition and maintenance sites*
- BS5228-1-2009: *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*

Table C1: Construction noise source sound power levels, dB L_{Aeq}

Noise source	A-weighted sound power level, L_{Aeq} dB SWL	Source
Tracked 35t excavator (35 t)	108	BS5228-1-2009
Bogie truck & trailer	107	AS2436-2010
Generator	99	AS2436-2010
Air compressor & lines	101	AS2436-2010
2 x excavators (35 tonne, 27 tonne) with a hydraulic hammer	121*	AS2436 - 1981
12t vibratory roller	108	BS5228-1-2009
Jack hammer & breaker	126*	AS2436-2010
Concrete saw - road	122*	AS2436-2010
Flatbed truck	107	AS2436-2010
De-watering plant	99	BS5228-1-2009
Concrete pump	108	AS2436-2010
Brick saw	107	BS5228-1-2009
Concrete vibrator	103	AS2436-2010
Concrete floats	100	BS5228-1-2009
Diamond core drill	113	BS5228-1-2009
Nail guns	101	BS5228-1-2009
Hydraulic bar cutter	107	BS5228-1-2009
Concrete truck	108	AS2436-2010
Electric winch & materials hoist	96	BS5228-1-2009
Mobile Crane	104	AS2436-2010
3.5t telehandler	98	BS5228-1-2009
Rough terrain scissor lift	106	BS5228-1-2009

* Includes a +5 dB factor in accordance with recommendations given in Section 4.5 of the ICNG.

APPENDIX G CONSTRUCTION NOISE IMPACT ASSESSMENT

Noise levels during the Site Preparation and Demolition, Bulk Excavation and Construction phases have been calculated at the nominated receivers. These noise levels have been predicted under guidance from *AS2436-2010 Guide to noise control on construction, maintenance and demolition sites* and utilising the information provided in *BS 5228-1-2009 Code of practise for noise and vibration control on construction and open sites*.

Levels have been calculated for "Worst-Case" situations where noise sources will either be closest to the noise-sensitive receiver and/or not screened by existing site structures. Noise levels have also been calculated for the "Average" situation, with noise sources located towards the centre of the site. The latter is likely to be representative of the longer-term noise emissions.

G1 Site Preparation Phase

Table F6 details the predicted noise levels at the nominated receivers' occupancies during the Site Preparation phase. Noise levels have been calculated at a position within the receiver that is most exposed to noise from associated activities. Calculated noise levels include the effects of the noise control recommendations detailed in Section 5.4.

The calculated levels indicate that noise from Site Preparation activities is expected to be below the "Highly Noise Affected" goals for the "Worst-Case" and "Average" assessment position for all the identified nearby receivers.

Predicted noise levels are expected to be up 1 dB above the "Noise Affected" goals for the "Average" assessment, and up to 6 dB above the "Noise Affected" goals for the "Worst-Case" assessment at some residential receivers.

For the other receiver, predicted noise levels are expected to be up to 8 dB above the "Noise Affected" goals for the "Average" assessment, and up to 20 dB above the "Noise Affected" goals for the "Worst-Case" assessment at some residential receivers.

During the Site Preparation phase, the use of 35 T excavator and truck movements have the highest potential to impact on the noise receivers.

G2 Bulk Excavation Phase

Table F7 details the predicted noise levels at the nominated receivers during the Bulk Excavation phase. Noise levels have been calculated at a position within the receiver that is most exposed to noise from Bulk Excavation activities. Calculated noise levels include the effects of the noise control recommendations detailed in Section 5.4.

The calculated levels indicate that noise from Site Preparation activities is expected to be below the "Highly Noise Affected" goals for the "Worst-Case" and "Average" assessment position for all the identified nearby receivers.

Predicted noise levels are expected to be up 14 dB above the "Noise Affected" goals for the "Average" assessment, and up to 18 dB above the "Noise Affected" goals for the "Worst-Case" assessment at some residential receivers.

For the other receiver, predicted noise levels are expected to be up to 21 dB above the "Noise Affected" goals for the "Average" assessment, and up to 32 dB above the "Noise Affected" goals for the "Worst-Case" assessment at some residential receivers.

During the Bulk Excavation phase, the use of jack hammers and excavators have the highest potential to impact on the noise receivers at the adjacent residential receivers.

G3 Construction Phase

Table F8 details the predicted noise levels at the nominated receivers during the Construction phase. Noise levels have been calculated at the position within the receiver that is most exposed to noise from

Construction activities. Calculated noise levels include the effects of the noise control recommendations detailed in Section 5.4.

The calculated levels indicate that noise from Site Preparation activities is expected to be below the “Highly Noise Affected” goals for the “Worst-Case” and “Average” assessment position for all the identified nearby receivers.

Predicted noise levels are expected to be up 20 dB above the “Noise Affected” goals for the “Average” assessment, and up to 23 dB above the “Noise Affected” goals for the “Worst-Case” assessment at some residential receivers.

For other receiver, predicted noise levels are expected to be up to 27 dB above the “Noise Affected” goals for the “Average” assessment, and up to 37 dB above the “Noise Affected” goals for the “Worst-Case” assessment at some residential receivers.

During the Bulk Excavation phase, the use of concrete vibrator and concrete floats have the highest potential to impact on the noise receivers at the adjacent residential receivers.

Table F6: Predicted noise levels during Site Preparation works

Receiver	Period	Assessment	Calculated noise level[2], dB $L_{Aeq, 15min}$[3]	"Noise Affected"		"Highly Noise Affected"	
				Management level, dB $L_{Aeq, 15min}$	Exceedance, dB	Management level, dB $L_{Aeq,15mins}$	Exceedance, dB
R1 - 126 Southee Road	Within guideline hours[2]	Worst-case	37	45	--	75	--
		Average	36		--		--
R2 - Anglicare	Within guideline hours[2]	Worst-case	41	45	--	75	--
		Average	38		--		--
R3 - Student accommodation	Within guideline hours[2]	Worst-case	51	45	6	75	--
		Average	46		1		--
E1 - Microbiology laboratory J4	Within guideline hours[2]	Worst-case	62	55	7	--	--
		Average	56		1		--
E2 - Pridham building K16	Within guideline hours[2]	Worst-case	75	55	20	--	--
		Average	63		8		--

[1] Monday – Friday: 0700-1700hrs, Saturday 0800-1300hrs

[2] Calculations included the recommended noise controls detailed in Section 5.2

[3] Unless noted otherwise, noise level calculated at 1.5m above ground level at the property boundary most exposed to construction noise in accordance with the requirements of the ICNG. Noise levels at upper floors without shielding are likely to be higher.

Table F7: Predicted noise levels during Bulk Excavation works

Receiver	Period	Assessment	Calculated noise level[2], dB $L_{Aeq, 15min}$[3]	"Noise Affected"		"Highly Noise Affected"	
				Management level, dB $L_{Aeq, 15min}$	Exceedance, dB	Management level, dB $L_{Aeq,15mins}$	Exceedance, dB
R1 - 126 Southee Road	Within guideline hours[2]	Worst-case	49	45	4	75	--
		Average	50		5		--
R2 - Anglicare	Within guideline hours[2]	Worst-case	53	45	8	75	--
		Average	52		7		--
R3 - Student accommodation	Within guideline hours[2]	Worst-case	63	45	18	75	--
		Average	59		14		--
E1 - Microbiology laboratory J4	Within guideline hours[2]	Worst-case	74	55	19	--	--
		Average	69		14		--
E2 - Pridham building K16	Within guideline hours[2]	Worst-case	87	55	32	--	--
		Average	76		21		--

[1] Monday – Friday: 0700-1700hrs, Saturday 0800-1300hrs

[2] Calculations included the recommended noise controls detailed in Section 5.4

[3] Unless noted otherwise, noise level calculated at 1.5m above ground level at the property boundary most exposed to construction noise in accordance with the requirements of the ICNG. Noise levels at upper floors without shielding are likely to be higher.

Table F8: Predicted noise levels during Construction works

Receiver	Period	Assessment	Calculated noise level[2], dB $L_{Aeq, 15min}$[3]	"Noise Affected"		"Highly Noise Affected"	
				Management level, dB $L_{Aeq, 15min}$	Exceedance, dB	Management level, dB $L_{Aeq,15mins}$	Exceedance, dB
R1 - 126 Southee Road	Within guideline hours[2]	Worst-case	56	45	11	75	--
		Average	55		10		--
R2 - Anglicare	Within guideline hours[2]	Worst-case	58	45	13	75	--
		Average	57		12		--
R3 - Student accommodation	Within guideline hours[2]	Worst-case	68	45	23	75	--
		Average	65		20		--
E1 - Microbiology laboratory J4	Within guideline hours[2]	Worst-case	79	55	24	--	--
		Average	75		20		--
E2 - Pridham building K16	Within guideline hours[2]	Worst-case	92	55	37	--	--
		Average	82		27		--

[1] Monday – Friday: 0700-1700hrs, Saturday 0800-1300hrs

[2] Calculations included the recommended noise controls detailed in Section 5.4

[3] Unless noted otherwise, noise level calculated at 1.5m above ground level at the property boundary most exposed to construction noise in accordance with the requirements of the CNG. Noise levels at upper floors without shielding are likely to be higher.

APPENDIX H PROPOSED INCLUSIONS FOR CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

As part of the detailed design phase of the project, once a contractor is appointed and proposed construction methodologies and plant and equipment are finalised a Construction Noise and Vibration Management Plan (CNVMP) will need to be prepared. The CNVMP is a documented plan that should assist the construction team in managing and mitigating noise impacts as well communicating effectively with impacted stakeholders. Whilst the details of the CNVMP are outside of the scope of this document the following is provided for the consideration of those preparing the plan.

Many complaints about construction noise are due to preventable activities during construction periods. The following should be considered for adoption on site:

- Regularly train workers and contractors (such as at 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 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

H1 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.

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

- For larger projects 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

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

H2 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.

Use quieter methods

- 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

Use quieter equipment

- 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 tractors can be less noisy than steel tracked tractors
- 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

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

H3 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.

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

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 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.

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

H4 Work scheduling

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

Provide respite periods

- Consult with affected education facilities to ensure that noise-generating construction works in the vicinity of affected education buildings are not scheduled to occur during examination periods, unless other arrangements (such as relocation to an alternative location) acceptable to the affected parties can be made.
- 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, commercial neighbours, colleges and schools may not be present outside business 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 neighbours about scheduling activities to minimise noise impacts

Organise deliveries and access

- Nominate an off-site truck parking area, 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. Truck waiting areas may require bunding or walls to minimise noise
- Schedule deliveries to nominated hours only

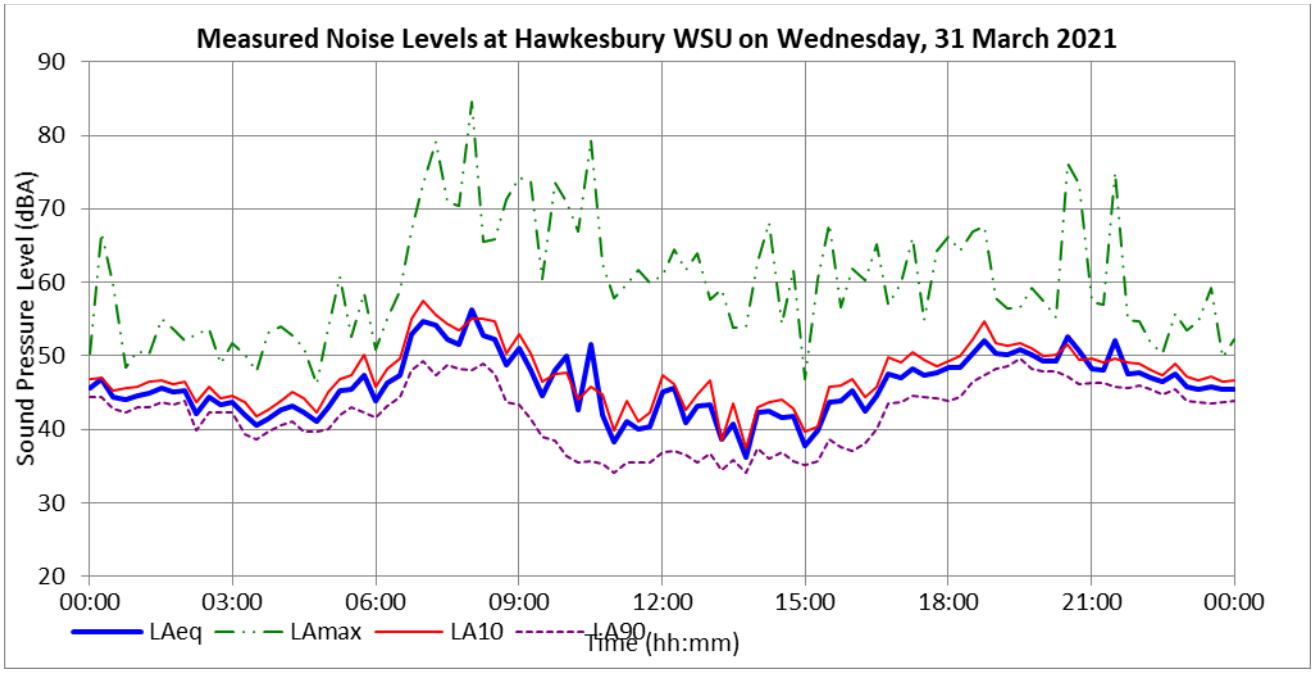
H5 Transmission path

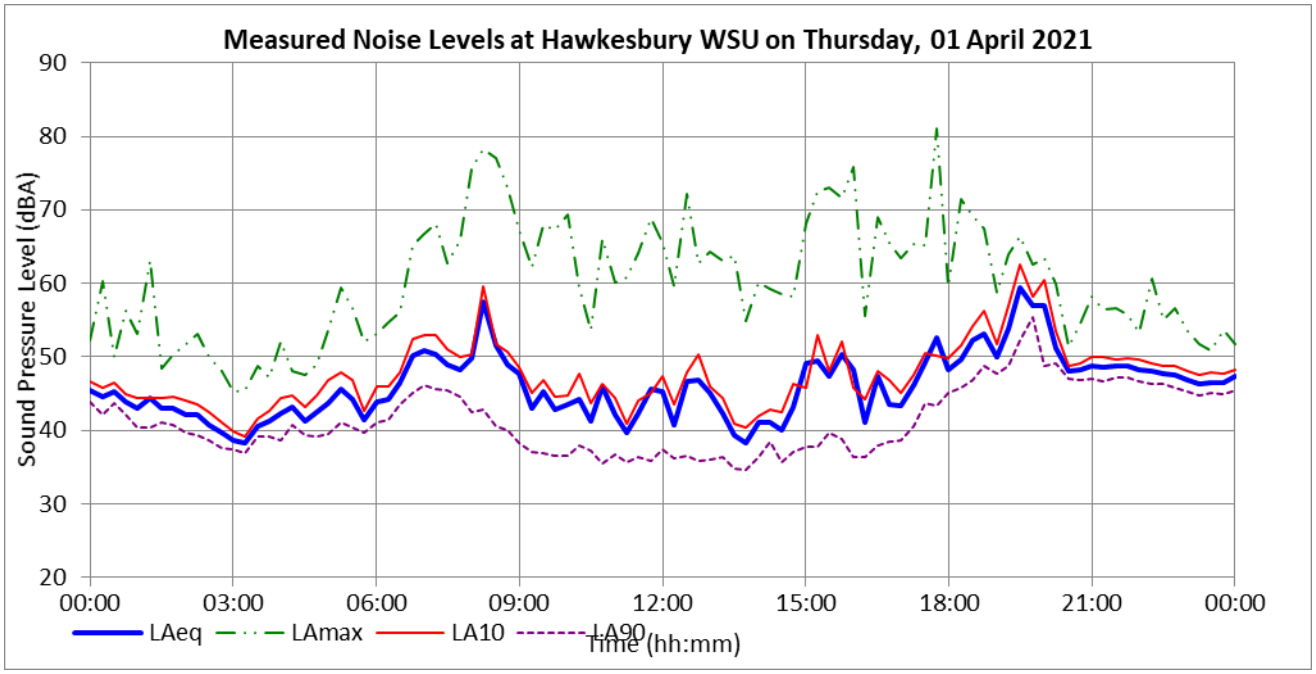
Physical methods to reduce the transmission of noise between the construction works and residences or other sensitive land uses are generally suited to works where there is longer-term exposure to the noise.

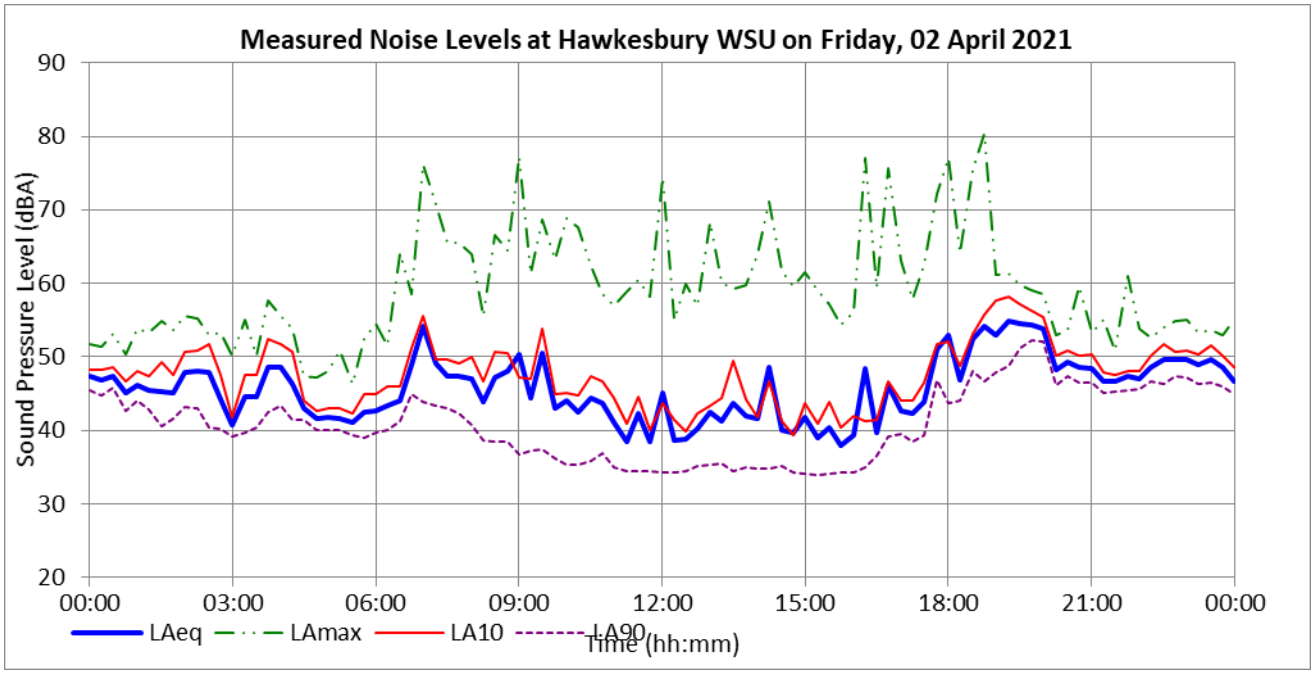
- Reduce the line-of-sight noise transmission to residences or other sensitive land uses using temporary barriers
- Temporary noise barriers can be constructed from hoarding (plywood boards, panels of steel sheeting or compressed fibre cement board) with no gaps between the panels at the site boundary. Stockpiles, shipping containers and site office transportables can be effective barriers
- Erect temporary noise barriers before work commences to reduce noise from works as soon as possible

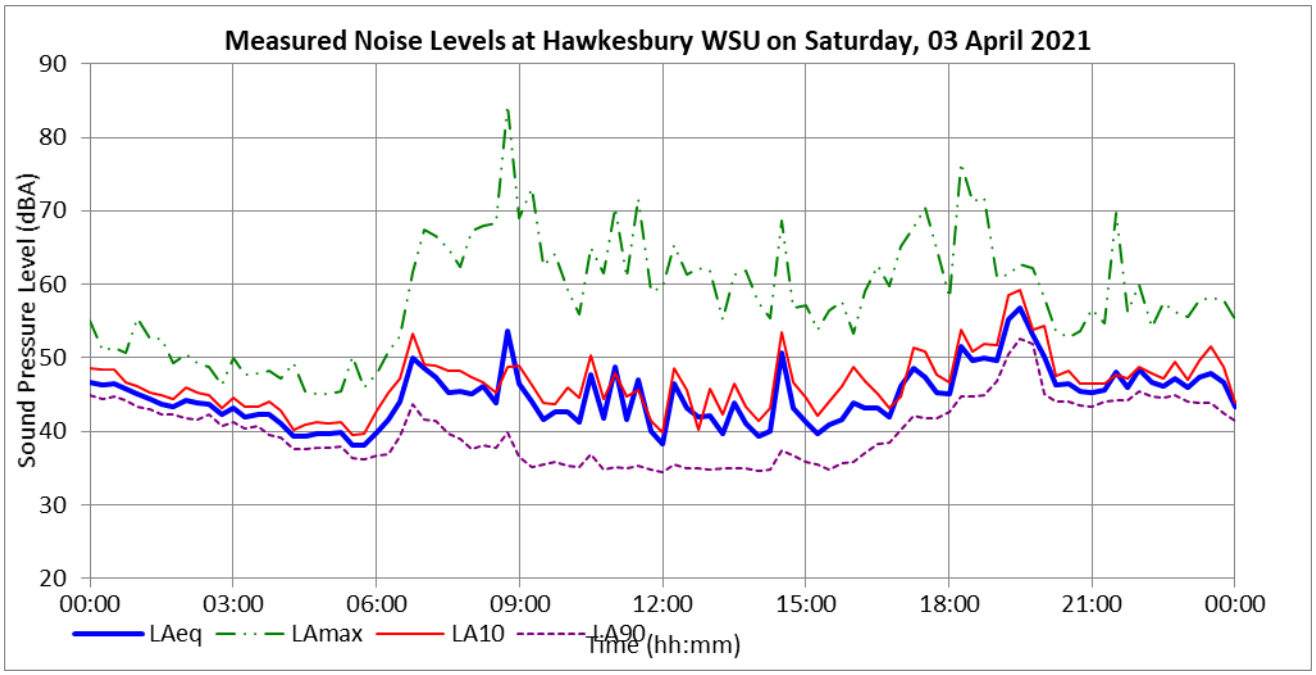
Consult with most affected neighbours about how effective the proposed noise mitigation measures will be in addressing their concerns

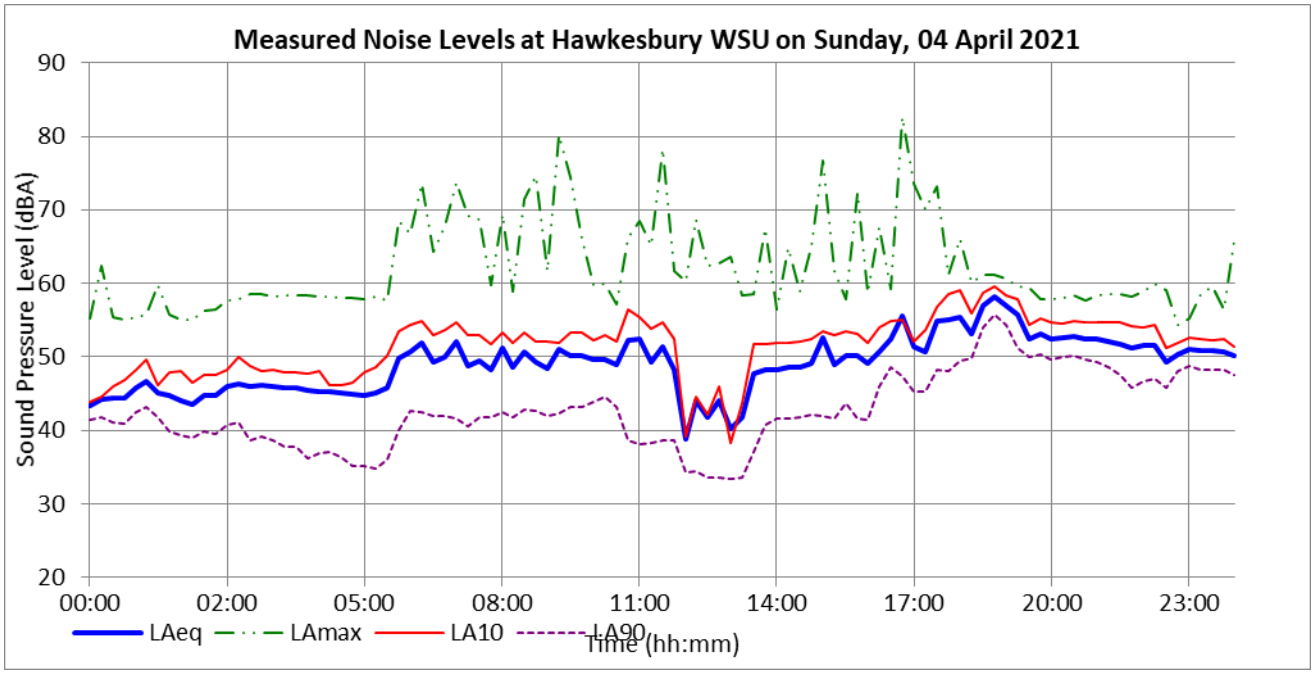
APPENDIX I MONITORING RESULTS

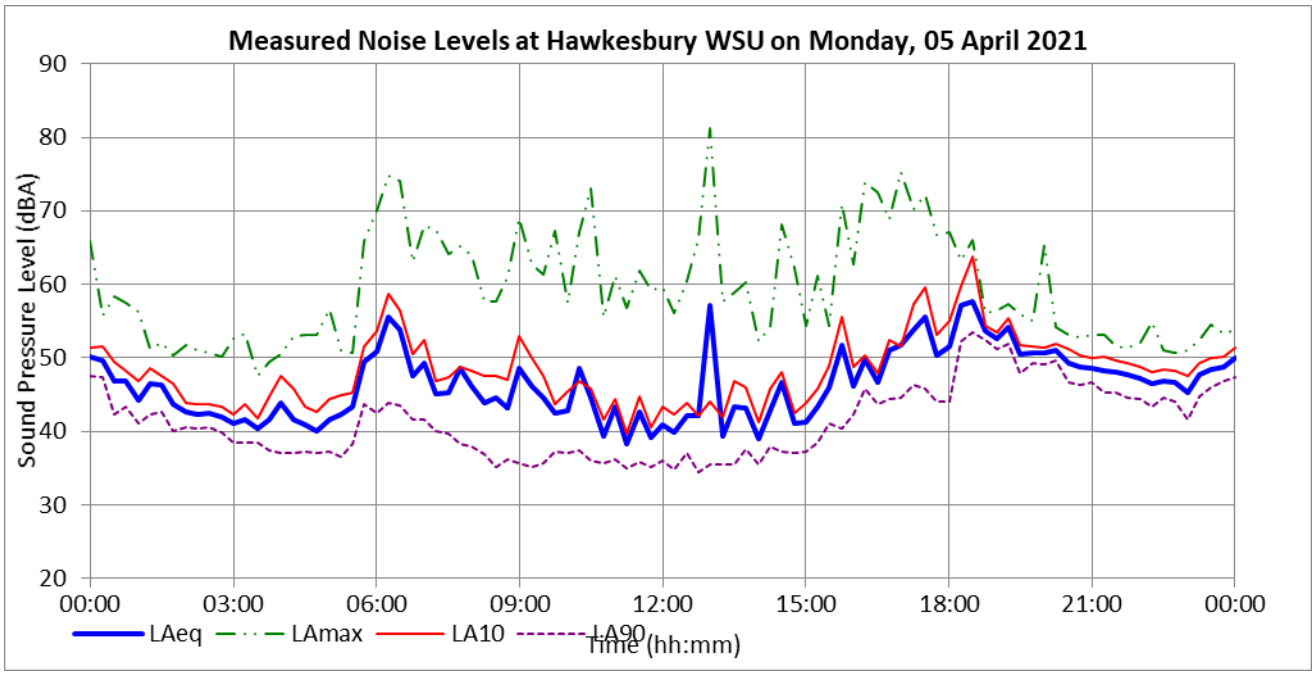


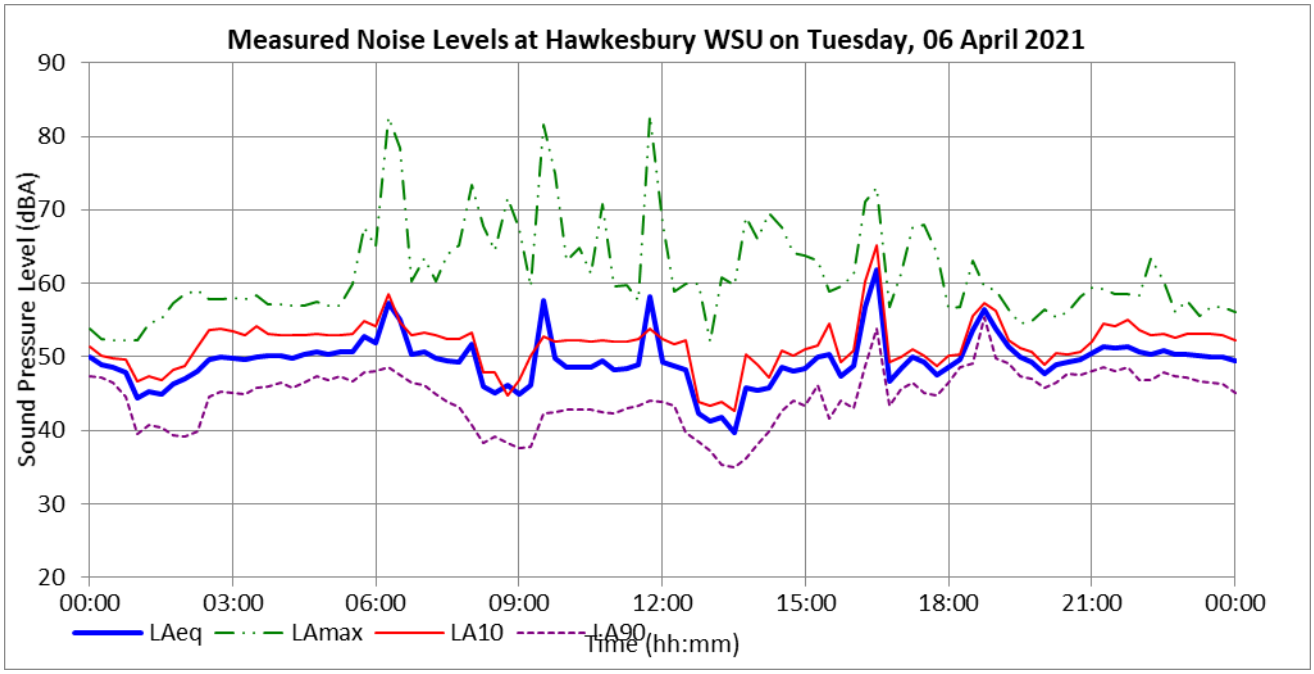


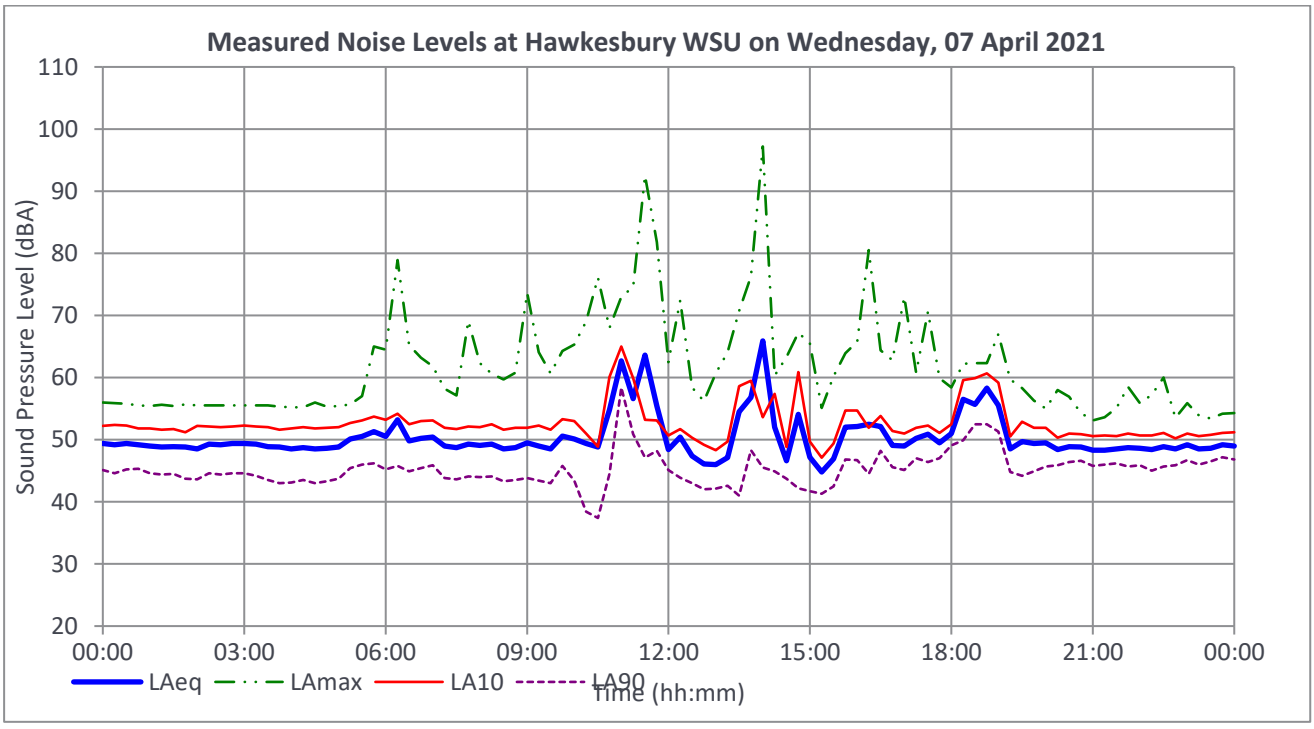

Measured Noise Levels at Hawkesbury WSU on Friday, 02 April 2021
Sound Pressure Level (dBA)
90
80
70
60
50
40
30
20
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
LAeq
LAmax
LA10
LA90
Time (hh:mm)


Measured Noise Levels at Hawkesbury WSU on Saturday, 03 April 2021
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
LAeq
LAmax
LA10
LA90
Time (hh:mm)


Measured Noise Levels at Hawkesbury WSU on Sunday, 04 April 2021
Sound Pressure Level (dBA)
90
80
70
60
50
40
30
20
00:00
02:00
05:00
08:00
11:00
14:00
17:00
20:00
23:00
LAeq
LAmax
LA10
LA90
Time (hh:mm)


Measured Noise Levels at Hawkesbury WSU on Monday, 05 April 2021
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
LAeq
LAmax
LA10
LA90
Time (hh:mm)


Measured Noise Levels at Hawkesbury WSU on Tuesday, 06 April 2021
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
LAeq
LAmax
LA10
LA90
Time (hh:mm)


Measured Noise Levels at Hawkesbury WSU on Wednesday, 07 April 2021
Sound Pressure Level (dBA)
110
100
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
LAeq
LAmax
LA10
LA90
Time (hh:mm)

APPENDIX J ANEF LOCATION DIAGRAM – RICHMOND RAAF BASE

Richmond High School

Hawkesbury CoE site approximate location

LEGEND :

20 — 25 ANEF CONTOURS SHOWING ANEF VALUES

For track, profile and aircraft movement details refer to :
1. Summary Report : RAAF Richmond Airfield, ANEF 2014, of November 2004 by GHD Pty Ltd
2. INM Input Data Report : RAAF Richmond Airfield, ANEC 2014, of November 2004 by GHD Pty Ltd

The above 2014 ANEF contour map of RAAF Base Richmond is endorsed by: *Signed by Chris Bee* Dated ..15.. December 2004.

Chris Bee
Assistant Secretary Strategic Planning
and Estate Development

SCALE IN KILOMETRES
0 1 2 3
(1 : 50,000 for A3 size)

GHD
MANAGEMENT
ENGINEERING
ENVIRONMENT
23/11047/DGN RIC/INPUT/
APP F ANEF MAP.DGN

Australian Government
Department of Defence
NOVEMBER 2004

RAAF BASE RICHMOND, NSW
2014 ANEF SUMMARY REPORT

2014 ANEF

Appendix F