Resonate

Scots College
Bellevue Hill

Major Alterations and Additions to the Stevenson Library

S171074RP1 Revision A

Tuesday, 17 April 2018

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Document Information

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Revision Table

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Glossary

A-weighting	A spectrum adaption that is applied to measured noise levels to represent human hearing. A-weighted levels are used as human hearing does not respond equally at all frequencies.
Daytime	Between 7 am and 6 pm as defined in the NPI.
dB	Decibel—a unit of measurement used to express sound level. It is based on a logarithmic scale which means a sound that is 3 dB higher has twice as much energy. We typically perceive a 10 dB increase in sound as a doubling of that sound level.
dB(A)	'A' Weighted sound level in dB.
Evening	Between 6 pm and 10 pm as defined in the NPI.
Frequency (Hz)	The number of times a vibrating object oscillates (moves back and forth) in one second. Fast movements produce high frequency sound (high pitch/tone), but slow movements mean the frequency (pitch/tone) is low. 1 Hz is equal to 1 cycle per second. The human ear responds to sound in the frequency range of 20 to 20,000 Hz.
NPI	New South Wales *Noise Policy for Industry*, 2017.
Intrusive Noise	Noise emission that when assessed at a noise-sensitive receiver (principally a residential premises boundary) is greater than 5 dB(A) above the background noise level.
L_{10}	Noise level exceeded for 10% of the measurement time. The L_{10} level is commonly referred to as the average maximum noise level.
L_{90}	Noise level exceeded for 90% of the measurement time. The L90 level is commonly referred to as the background noise level.
L_{eq}	Equivalent Noise Level—Energy averaged noise level over the measurement time.
L_{max}	Maximum measured sound pressure level in the time period.
mm/s	Millimetres per second—units of vibration velocity.
Night-time	Between 10 pm on one day and 7 am on the following day as defined in the NPI.
Rating Background Level (RBL)	Overall single-figure A-weighted background level representing an assessment period (Day/Evening/Night). For the short-term method, the RBL is simply the measured $L_{90,15min}$ noise level. For the long-term method, it is the median value of all measured background levels during the relevant assessment period.

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1 Introduction

Resonate Consultants has been commissioned by Impact Group to provide an acoustic assessment of construction and operational noise of the new Stevenson Library for The Scots College, located at 53 Victoria Road, Bellevue Hill.

As part of an Environmental Impact Statement (EIS), The Department of Planning & Environment (DPE) requires a Secretary's Environmental Assessment Requirements (SEARs) report to address potential noise and vibration concerns to nearby commercial and residential receivers. The SEARs relating to noise and vibration is reproduced below:

> *'Identify and provide a quantitative assessment of the main noise and vibration generating sources during construction and operation. Outline measures to minimise and mitigate the potential noise impacts on surrounding sensitive receivers.'*
>
> *Relevant Policies and Guidelines:*
> - *Noise Policy for Industry 2017 (EPA)*
> - *Interim Construction Noise Guideline (DECC)*
> - *Assessing Vibration: A Technical Guideline 2006*

This report has been prepared to address the SEARs and:

- Defines noise and vibration assessment criteria for the construction and operation of the new library.
- Identifies likely construction phase noise and vibration impacts and recommends management procedures to be implemented during construction.
- Provides an assessment of operational noise from the development.

2 Project description

Scots College is located at 53 Victoria Rd, Bellevue Hill. The site is bounded by residential receivers in all directions and the school's own buildings to the north and south, including as part of the same building. Figure 1 shows the site location with all identified potentially affected receivers.

Figure 1 - Site location

The development will include a partial demolition of an existing building and the construction of a new library. Works will include the demolition and construction of a five-level education building that will provide a range of teaching and support spaces. The library will be constructed adjoining an existing building at the school.

A number of noise and vibration-sensitive land uses are located in the immediate vicinity of the proposed site as shown on Figure 1, with the most significant being the school buildings on campus. The closest residential building being 40 Victoria Rd.

The sensitive land uses are summarised in Table 1 alongside a description of the land use.

Table 1 - Noise and vibration sensitive land uses

Reference (See Figure 1)	Description
Residential buildings	
R1 – 40 Victoria Rd	Residential properties located around the site with direct line of sight to the proposed construction. R1 being the closest, approximately 60m to the west of the site, and other residential sites approximately 125m to the east.
R2 – 27 Cranbrook Ln	
R3 – 55 Cranbrook Rd	
R4 – 57 Cranbrook Rd	Student accommodation located 150m to the south east of the site
Education Buildings	
R5 – Scots College Senior School	The site is bound by education buildings to the north, west and south, including direct connection to the dining hall
R6 – Scots College Ginagulla Campus	
Recreation land uses	
R7 – The Scots College Oval	Active recreation land use. Scots College oval is adjoining to the site.

3 Existing environment

3.1 Unattended noise monitoring

An unattended noise survey was conducted during the period Tuesday, 3 April 2018 to Wednesday to 11 April 2018 in accordance with the Noise Policy for Industry (NPI). Noise logging was conducted at 40 Victoria Rd and at the east boundary of 55 Cranbrook Rd, as shown in Figure 1 above.

Table 2 below presents the Rating Background Level (RBL) and average ambient noise level for the surrounding environment. Appendix A provides a detailed summary of the noise survey conducted for this reporting procedure.

Table 2 Existing ambient noise levels

Location	Rating Background Level, dB(A) L_{90}[1]			Ambient Noise Level, dB(A) L_{eq}		
	Daytime (7am – 6pm)	Evening (6pm – 10pm)	Night-time (10pm – 7am)	Daytime (7am – 6pm)	Evening (6pm – 10pm)	Night-time (10pm – 7am)
L1 – 40 Victoria Rd	48	36	31	60	58	53
L2 – 55 Cranbrook Rd	43	38	31	57	49	47

3.2 Attended noise monitoring

Attended noise level measurements were also conducted at locations around the site on Wednesday 11 April 2018. The monitoring was conducted during the school's class times in order to minimise the influence of student activity on the measurements.

The measured noise levels over 15-minute periods at each location are shown in Table 3, with the measurement locations shown on Figure 1. The measurements indicate that there is a moderate level of existing noise in the environment during the daytime period, due to local and distant traffic, as well as different school related activities during the day, especially on Victoria Rd.

Table 3 - Attended noise level measurement results on Wednesday, 11 April 2018

Location	Measured noise level, dB(A)				Description
	L_{max}	L_{10}	L_{eq}	L_{90}	
R1 – 40 Victoria Rd	81	65	63	53	Measurement at 11:40am. Influenced by local and distant traffic and student activities.
R3 – 55 Cranbrook Rd	74	65	60	45	Measurement at 12:00pm. Influenced by local traffic and student activities with mechanical services running consistently during measurement.

4 Assessment criteria

4.1 Construction noise criteria

Construction noise in New South Wales is assessed using the Department of Environment & Climate Change (now Environment Protection Authority) *Interim Construction Noise Guideline* (ICNG). The ICNG is also defined as the relevant guideline for construction noise by the SEARs issued by DPE.

The ICNG aims to manage noise from construction works regulated by the EPA. It is also intended to provide guidance to other interested parties in the management of construction noise, and has therefore been adopted for this construction noise assessment.

The ICNG prescribes $L_{eq,15min}$ Noise Management Levels (NML) for sensitive receivers as part of a quantitative construction noise assessment. Where the predicted or measured construction noise level exceeds these management levels, then all feasible and reasonable work practices should be implemented to reduce construction noise, and community consultation regarding construction noise is required to be undertaken.

4.1.1 Standard working hours

The ICNG recommends standard working hours for construction as follows:

- Monday to Friday, 7 am to 6 pm
- Saturday, 8 am to 1 pm
- No work on Sundays or Public Holidays

To encourage work during the Standard Working Hours, and to reflect the lower impact of work at these times, the ICNG prescribes less stringent Standard Working Hours NMLs. More stringent NMLs are prescribed for work outside of these times, as well as more onerous management requirements.

It should be noted that the Standard Working Hours are only applicable to residential (or similar) land uses. At educational or commercial land uses, where evening amenity and sleeping is not a concern, the impact of construction noise is assessed based on the times that the land use operates.

Working hours will be determined by the conditions as received from the Department of Planning. No work is proposed to occur outside of standard construction hours as part of the development.

4.1.2 Residential land uses

The NMLs prescribed for residential land uses by the ICNG are presented in Table 4. The levels apply at the most exposed property boundary of the noise sensitive receiver at a height of 1.5 metres above ground level.

Table 4 Noise management levels for residential land uses

Time of day	NML, $L_{eq,15min}$	Application notes
Recommended Standard Working Hours	Noise affected: RBL + 10 dB(A)	May be some community reaction to noise. • Where the predicted or measured construction noise level exceeds the noise affected level, all feasible and reasonable work practices should be applied to meet the noise affected level. • All residents potentially impacted by the works should be informed of the nature of the works, the expected noise levels and duration, and provided with site contact details.
	Highly noise affected: 75 dB(A)	May be strong community reaction to noise. • Where construction noise is predicted or measured to be above this level, the relevant authority may require respite periods that restrict the hours that the very noisy activities can occur. • Respite activities would be determined taking into account times identified by the community when they are less sensitive to noise, and if the community is prepared to accept a longer period of construction to accommodate respite periods.
Outside recommended Standard Working Hours	Noise affected: RBL + 5 dB(A)	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the affected noise level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the affected noise level, the proponent should negotiate with the affected community.

4.1.3 Other sensitive land uses

The ICNG also prescribes NMLs for other sensitive land uses, including educational buildings and offices. The NMLs for relevant land uses are summarised in Table 5 and apply only when those land uses are in use.

Table 5 ICNG noise management levels for other sensitive land uses

Land use	NML $L_{eq,15min}$ (applies when property in use)
Classrooms at schools and other educational institutions	Internal noise level of 45 dB(A)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion).	External noise level of 65 dB(A)
Offices, retail outlets	External noise level of 70 dB(A)

4.1.4 Project specific noise management levels

Table 6 summarises the NMLs applicable to sensitive land uses around the site during the construction phase. The NMLs are based on the background noise level measured during the attended monitoring conducted around the site during the daytime period noting that construction work will only be conducted during normal daytime construction hours. A daytime RBL of 48 dB(A) at Location 1 and 43 dB(A) at Location 2 was measured.

Table 6 Project Specific Noise Management Levels

Land use	NML for time period, dB(A)	
	Standard Working Hours	Outside of Standard Working Hours
Residential land uses	58 (NML for western receivers) 53 (NML for eastern receivers) 75 (Highly noise affected)	N/A
Education land uses	45 (Internal) when in use	N/A
Recreation land uses	65	N/A

4.2 Construction vibration criteria

Ground vibration generated by construction can have a range of effects on buildings and building occupants. The main effects are generally classified as:

- human disturbance – disturbance to building occupants: vibration which inconveniences or interferes with the activities of the occupants or users of the building
- effects on building structures – vibration which may compromise the condition of the building structure itself.

In general, vibration criteria for human disturbance are more stringent than vibration criteria for effects on buildings. Building occupants will normally feel vibration readily at levels well below those which may cause a risk of cosmetic or structural damage to a structure. However, it may not always be practical to achieve the human comfort criteria. Furthermore, unnecessary restriction of construction activities can prolong construction works longer than necessary, potentially resulting in other undesirable effects for the local community.

Construction vibration criteria have been adopted from the following sources:

- Cosmetic and structural damage to buildings: German Standard DIN 4150-3[1]
- Human comfort: Assessing Vibration – A Technical Guideline (the Vibration Guideline)

4.2.1 Cosmetic and structural damage

DIN 4150-3 summarises structural and cosmetic damage assessment criteria for different types of buildings, which are presented in Table 7, which are widely used for the assessment of construction vibration effects on buildings in Australia. The criteria are specified as Peak Particle Velocity (PPV) levels measured in any direction at or adjacent to the building foundation.

Table 7 DIN 4150-3 vibration cosmetic and structural damage criteria

Structure type	Peak Particle Velocity (PPV), mm/s			
	Foundation of structure			Vibration at horizontal plane of highest floor at all frequencies
	<10 Hz	10-50 Hz	50-100 Hz	
Buildings used for commercial, industrial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwelling and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their particular sensitivity to vibration, do not correspond to those listed in rows 1 and 2, and are of great intrinsic value (e.g. heritage-listed buildings)	3	3 to 8	8 to 10	8

DIN 4150-3 states that exposing buildings to vibration levels higher than that recommended would not necessarily result in damage. Rather, it recommends these values as maximum levels of short-term construction vibration at which experience has shown damage reducing the serviceability of structures will not occur due to vibration effects.

DIN 4150-3 is considered to be suitable for the assessment of both structural and cosmetic damage as it considers a reduction in serviceability of the structure is deemed to have occurred if:

- cracks form in plastered surfaces of walls
- existing cracks in the building are enlarged

[1] German Standard DIN 4150-3, 1999, *Structural Vibration – Part 3: Effects of vibration on structures*.

- partitions become detached from loadbearing walls or floors.

4.2.2 Human comfort

The ICNG recommends that vibration from construction works be assessed under *Assessing Vibration – a technical guideline* (the Vibration Guideline), consistent with the SEARs issued by DPE.

The vibration assessment criteria defined in the Vibration Guideline are for human comfort and represent goals that, where predicted or measured to be exceeded, require the application of all feasible and reasonable mitigation measures. Where the maximum value cannot be feasibly and reasonably achieved, the operator would need to negotiate directly with the affected community.

The Vibration Guideline defines vibration assessment criteria for continuous, impulsive and intermittent vibration. Vibration can be classified according to the following definitions:

- Continuous vibration: continues uninterrupted for a defined period. Applies to continuous construction activity such as tunnel boring machinery.
- Impulsive vibration: rapid build-up to a vibration peak followed by a damped decay or the sudden application of several cycles of vibration at approximately the same magnitude providing that the duration is short. Applies to very occasional construction activities that create distinct events such as the occasional dropping of heavy equipment.
- Intermittent vibration: interrupted periods of continuous vibration (such as a drill) or repeated periods of impulsive vibration (such as a jack hammer).

The majority of construction activities as part of the proposed works would be expected to be continuous or intermittent in nature.

Table 8 presents the management levels for continuous and impulsive vibration at different land uses. The management levels specified are as overall unweighted RMS vibration velocity levels. The Vibration Guideline specifies the management levels as suitable for vibration sources predominantly in the frequency range 8-80 Hz as would be expected for construction vibration.

For intermittent vibration, the Vibration Dose Value (VDV) is used as the metric for assessment as it accounts for the duration of the source, which will occur intermittently over the assessment period. The VDV management levels at different land uses for intermittent vibration sources are presented in Table 9.

Table 8 RMS vibration velocity management levels for continuous and impulsive vibration

Land use	Continuous vibration – RMS vibration velocity, mm/s		Impulsive vibration – RMS vibration velocity, mm/s	
	Preferred	Maximum	Preferred	Maximum
Critical areas[1]	0.1	0.2	0.1	0.2
Residences and hospital wards – daytime[2]	0.2	0.4	6.0	12.0
Residences and hospital wards – night time[3]	0.14	0.28	2.0	4.0
Offices, schools	0.4	0.8	13.0	26.0
Workshops	0.8	1.6	13.0	26.0

(1) Critical operating areas include hospital operating theatres and precision laboratories where sensitive operations are occurring.

(2) Daytime is defined by the Vibration Guideline to be 7 am to 10 pm.

(3) Night time is defined by the Vibration Guideline to be 10 pm to 7 am.

Table 9 VDV management levels for intermittent vibration

Land use	VDV – intermittent vibration, $m/s^{1.75}$	
	Preferred	Maximum
Critical areas[1]	0.1	0.2
Residences and hospital wards – daytime[2]	0.2	0.4
Residences and hospital wards – night time[3]	0.13	0.26
Offices, schools	0.4	0.8
Workshops	0.8	1.6

(1) Critical operating areas include precision laboratories where sensitive operations are occurring.

(2) Daytime is defined by the Vibration Guideline to be 7 am to 10 pm.

(3) Night time is defined by the Vibration Guideline to be 10 pm to 7 am.

4.3 Operational noise criteria

Noise emissions from the site when operational should comply with the requirements of the NSW *Noise Policy for Industry* (NPI). This is in accordance with NSW EPA recommendations where existing conditions reference the older document.

The NPI sets two separate noise criteria to meet desirable environmental outcomes:

- Intrusiveness – steady-state noise from the site should be controlled to no more than 5 dB(A) above the background noise level in the area. In this case, the steady-state L_{eq} noise level should not exceed the background noise level measured for different time periods in the environment.
- Amenity – amenity criteria are set based on the land use of an area. It requires noise levels from new industrial noise sources to consider the existing industrial noise level such that the cumulative effect of multiple sources does not produce noise levels that would significant exceed the amenity criteria.

The NPI applies to noise emissions from rooftop plant at the development. It sets noise emission criteria for the Daytime, Evening and Night-time periods. We have been advised that the mechanical plant will operate during the daytime period only (i.e. 7 am to 6 pm) and therefore only daytime criteria are considered in this assessment.

Table 10 presents the NPI noise emission criteria for residential land uses for the daytime period. Table 11 presents the NPI noise emission criteria for other sensitive land uses.

Table 10 NPI noise emission criteria for residential land uses

Receiver				**NPI Noise Criteria**		
Receiver	**Period**	**Ambient Noise Level**	**RBL**	**Project Amenity $L_{Aeq\ (15\ minute)}$**	**Intrusiveness $L_{Aeq\ (15minute)}$**	**Project trigger level**
Residential (west)	Day	60	48	50	53	**50**
Residential (east)	Day	57	43	50	48	**48**

Table 11 NPI noise emission criteria for other sensitive land uses

Land use	**Time of day**	**Noise emission criteria, dB(A)**	
		Recommended amenity noise level	**Project amenity noise level**
Classroom	Noisiest one-hour period when in use	Internal 35[1]	Internal 35[1]
Active recreation area	When in use	External 55	External 50

(1) Internal noise levels refer to the centre of a habitable room most exposed to the noise source and are to apply with windows open sufficiently to allow for natural ventilation. Where gaining access for monitoring purposes is difficult, external noise levels 10 dB above the internal levels apply.

5 Construction Assessment

5.1 Construction noise

5.1.1 Construction noise sources

Table 12 summarises the assumed sound power levels (L_W) for the major construction noise sources which we expect would be on site during each phase of construction. The sound power levels have been based on data obtained from previous measurements conducted by Resonate and those within the UK Department for Environment, Food and Rural Affairs (DEFRA) *Update of noise database for prediction of noise on construction and open sites*. An overall sound power level for each phase has also been assumed based on the loudest typical source(s) operating for each works phase.

Table 12 Construction noise source sound power levels

Stage	Typical plant items	Assumed sound power level, dB(A)
Demolition Stage	Large excavator	111
	Vibratory roller	107
	Large truck	108
	Pneumatic jackhammer	109
	Typical overall sound power level	**115**
External Construction Stage	Crane	106
	Concrete truck	109
	Concrete pump	107
	Large truck	108
	General hand tools	98
	Typical overall sound power level	**114**
Internal works and fitout	General hand tools	98
	Compressor	94
	Portable generator	95
	Typical overall sound power level	**99**

5.1.2 Typical construction noise levels

Typical worst-case predicted noise levels are shown in Table 13 for each sensitive-receiver location and each phase of works. Predicted noise levels that exceed the relevant Standard Work Hours NML are highlighted in **bold** type. Predictions were calculated using distance attenuation while accounting for shielding provided by intervening buildings and barriers.

Table 13 Typical worst-case external construction noise levels for each phase

Receiver	Typical worst-case external construction noise level for phase, dB(A) L_{eq}		
	Demolition	External construction	Internal works and fit out
R1 – 40 Victoria Rd	**68**	**67**	54
R2 – 27 Cranbrook Ln	**64**	**63**	**50**
R3 – 55 Cranbrook Rd	**59**	**58**	45
R4 – 57 Cranbrook Rd	**59**	**58**	45
R5 – Scots College Senior School*	**58**	**57**	44
R6 – Scots College Ginagulla Campus*	41	40	27
R7 – The Scots College Oval	**78**	**77**	64

* Education building land criteria requires an internal noise level to be met. A 15 dB(A) reduction has been assumed for R5 and R6 to account for noise attenuation through an open window.

Based on the predictions, it can be seen that construction noise from the site is predicted to exceed the relevant NMLs at all locations. Recommendations for construction noise management are provided in Section 0.

It is important to note that these predictions are typical worst-case predictions as they assume that:

- The construction works are occurring at the nearest point to each receiver and that the receiver is located at the most exposed position.
- The noisiest construction sources are operating continuously for the entire 15-minute period. This will not occur at all times as equipment will regularly be stood down or idled while other activities are undertaken.

Potential noise impacts within the adjoining buildings

The existing site comprises a number of buildings located directly adjacent to each other. The use of jackhammers and excavators are likely to cause the building to vibrate and regenerate as audible noise within the adjacent spaces. This may result in exceedances of the noise criteria and would require careful construction management to control noise emissions within adjacent spaces of the building. Recommendations for construction noise management are provided in Section 0.

5.2 Construction vibration

Table 14 summarises recommended safe working distances for key vibration-generating activities that would be expected during the construction phase, based on prior measurements conducted by Resonate.

Table 14 Recommended safe working distances for key vibration generating activities

Plant	Rating	Typical safe working distance for occupant comfort, m		Typical safe working distance for building damage, m	
		Preferred vibration target	Maximum vibration target	Heritage structure	Commercial building
Vibratory roller	< 7t	≥ 35	≥ 20	≥ 10	≥ 2
	7t – 12t	≥ 50	≥ 30	≥ 15	≥ 5
	≥ 13t	≥ 75	≥ 40	≥ 20	≥ 10
Excavator	Large excavator digging	≥ 25	≥ 15	≥ 5	≥ 1
Bored piling	≤ 800mm	≥ 20	≥ 10	≥ 2	≥ 1
Jackhammer	Handheld	–[1]	–[1]	≥ 3	≥ 1

Recommendations are provided in Section 5.3. for the management of construction vibration from the works.

5.3 Recommendations

To manage the potential impact of noise and vibration during construction, reasonable and feasible management measures and work practices should be implemented as detailed below.

5.3.1 Construction Noise and Vibration Management Plan

Prior to the commencement of major construction works the contractor should develop a Construction Noise and Vibration Management Plan (CNVMP). The CNVMP should:

- identify relevant construction noise and vibration criteria as detailed in this report
- identify neighbouring sensitive land uses for noise and vibration
- summarise key noise- and vibration-generating construction activities and the associated predicted levels at neighbouring land uses
- identify reasonable and feasible work practices to be implemented during the works
- summarise stakeholder consultation and complaints handling procedures for noise and vibration.

5.3.2 Stakeholder consultation

Nearby stakeholders should be consulted prior to the works and kept regularly informed of potential noise and vibration impacts from the works.

Specifically, this would involve consultation with nearby residential receivers to inform them of the works. A noise and vibration complaints handling procedure and register should be developed and implemented during construction.

Consultation with potentially impacted Scots College usages would be managed by the school itself.

5.3.3 Work programming

Work should be programmed such that works, and particularly noisy works, occur during standard working hours wherever feasible, namely:

- Monday to Friday 7 am to 6 pm
- Saturday 8 am to 1 pm
- No work on Sundays or public holidays.

While it is not expected to occur, if any works are to occur outside of the working hours nominated above, then justification would need to be provided and appropriate mitigation measures applied. The CNVMP should define an approval process for work undertaken outside of approved hours and for identifying reasonable and feasible mitigation measures to be implemented in accordance with the ICNG.

5.3.4 Truck movements and site access

Truck movements during long term construction projects have the potential to cause annoyance for sensitive receivers, even where trucks may be travelling on sealed roads. The design and selection of site access routes shall consider the potential disturbance to residents. In particular:

- site access and delivery points shall be located as far away from residences as possible
- truck movements shall use arterial roads and be diverted away from residential streets where feasible
- deliveries to/from site shall not occur during the night time period where possible.

5.3.5 Site management

Site management procedures should include the following:

- processes that generate lower noise levels should be selected where feasible
- the simultaneous operation of noisy plant or equipment close together and near residences should be avoided
- noisy plant should be located as far away from residences as is practical to allow efficient and safe completion of the task
- the potential shielding provided by site topography and intervening buildings should be taken into account in locating equipment
- site compounds should be located as far away as possible from residences

- equipment that is used intermittently should be shut down or throttled down to a minimum during periods where it is not in use
- works should be planned to minimise the reduce the noise from reversing signals
- warning horns should not be used as signalling devices
- two way radios should be set to the minimum effective volume
- noise associated with packing up plant and equipment at the end of works should be minimised.

5.3.6 Equipment management

Equipment management should include the following:

- selection of low-noise plant and equipment where possible
- equipment should be well maintained
- equipment should have quality mufflers and silencers installed where relevant
- equipment not in use on site should be shut down
- tasks should be completed using the minimum feasible power and equipment.

6 Operational assessment

Due to the early stage of the project, details on the precise nature of mechanical plant at the site are not available. However, it is understood that the development will include roof top mechanical plant such as AHUs and rooftop fans. As the equipment will be located on the rooftop, there will be little or no direct line-of-sight between the rooftop plant and the neighbouring noise-sensitive land uses.

Noise mitigation techniques that will need to be considered for rooftop plant include as the design progresses include:

- Selection of lower noise plant and equipment.
- Screening of external plant using solid barriers or acoustic louvres.
- Appropriate construction of a rooftop plant room to reduce noise emissions to neighbouring land uses.

The noise levels from mechanical plant, and other noise sources, will be assessed as the design progresses to ensure that compliance with the NPI noise emission criteria can be achieved. An acoustic consultant should be engaged during the design process to ensure that this is achieved.

7 Conclusion

This report presents a construction and operational noise and vibration assessment for the proposed construction works of the Stevenson Library at the Scots College, Bellevue. Works involves the demolition and construction of a five-level education/library building that will provide a range of teaching and support spaces. The library will be constructed adjoining an existing building at the school.

Construction noise and vibration criteria have been determined in accordance with relevant guidance such as the ICNG and Vibration Guideline. It is likely that construction works may have some noise and vibration impact on the nearby residential receivers and the surrounding classrooms. It is anticipated that these impacts will be able to be managed through works being carried out during standard working hours and with the implementation of reasonable and feasible work practices.

Operational noise emission criteria have been set in accordance with the NSW NPI and apply predominantly to mechanical plant noise emissions from the site. As the design progresses, noise mitigation measures will need to be incorporated into the design of the building to ensure that noise from rooftop plant in particular can comply with the NPI noise emission criteria at neighbouring noise-sensitive land uses.

Appendix A – Unattended Noise Monitoring

Unattended noise logging

An unattended environmental noise survey was conducted during the period Tuesday, 3 April to Wednesday to Wednesday 11 April 2018 in accordance with the Noise Policy for Industry 2017 (EPA). The equipment used were Rion NL-42 sound level meters, serial numbers 00946977 and 00946980. Field calibration was conducted at the commencement and conclusion of the logging period and no significant calibration drift was observed.

The noise logger was configured to record all relevant noise indices, including background noise level (L_{A90}) and equivalent continuous noise levels (L_{Aeq}). Samples were accumulated at 15-minute intervals. The time response of the logger was set to 'fast'.

Weather conditions

In order to provide an indication that noise data was obtained during suitable meteorological conditions, half-hourly weather data was obtained from the Bureau of Meteorology (BOM).

Measured noise levels

Noise data has been excluded from the processed results if:

- Rain was observed during a measurement period, and/or
- Wind speed exceeded 5 m/s (18 km/h) at the measurement height of 1.5 m above ground.

For reference, weekly charts showing the graphed noise logging results are shown below.

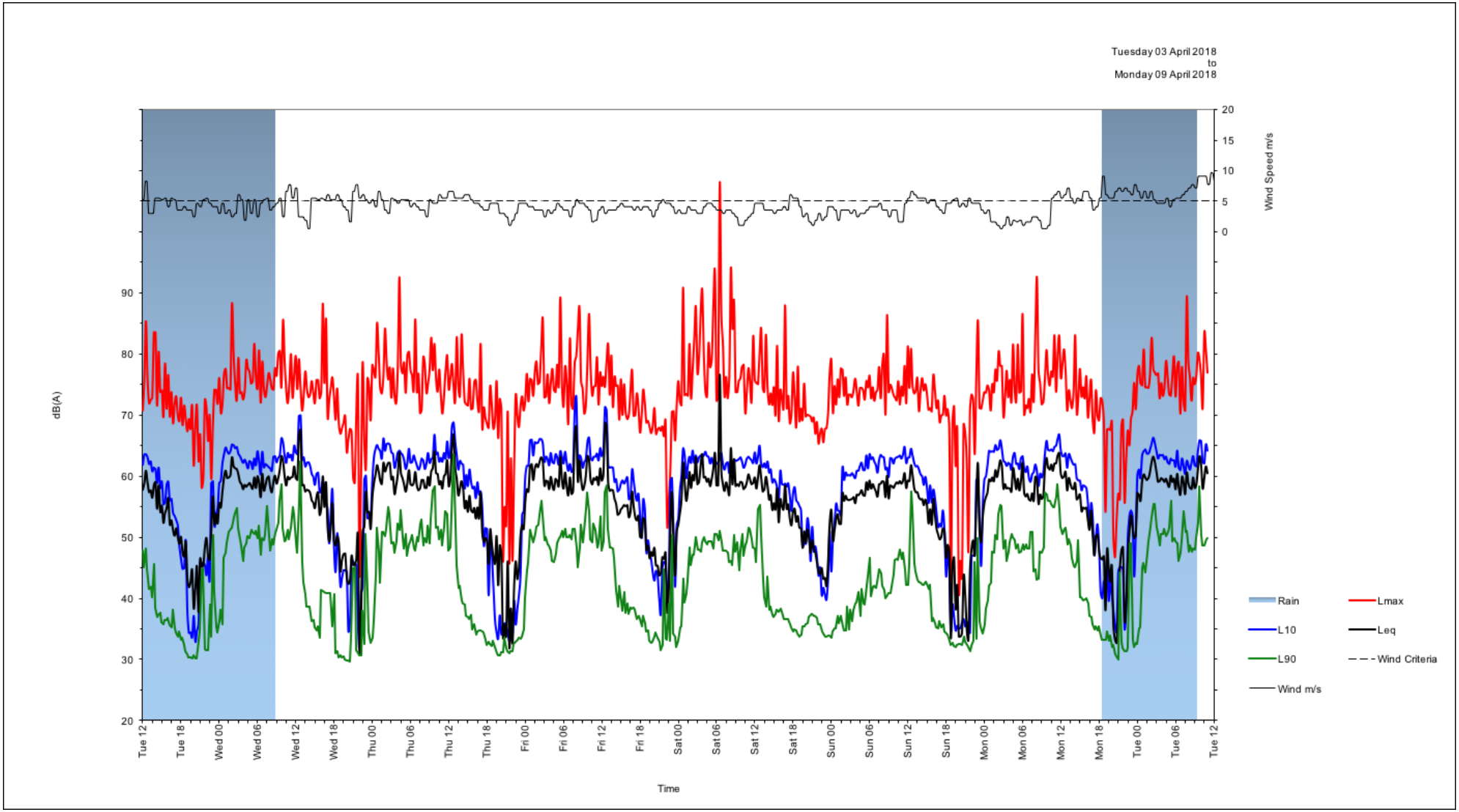

Figure 2 Unattended noise monitoring at Location 01 – 40 Victoria Rd

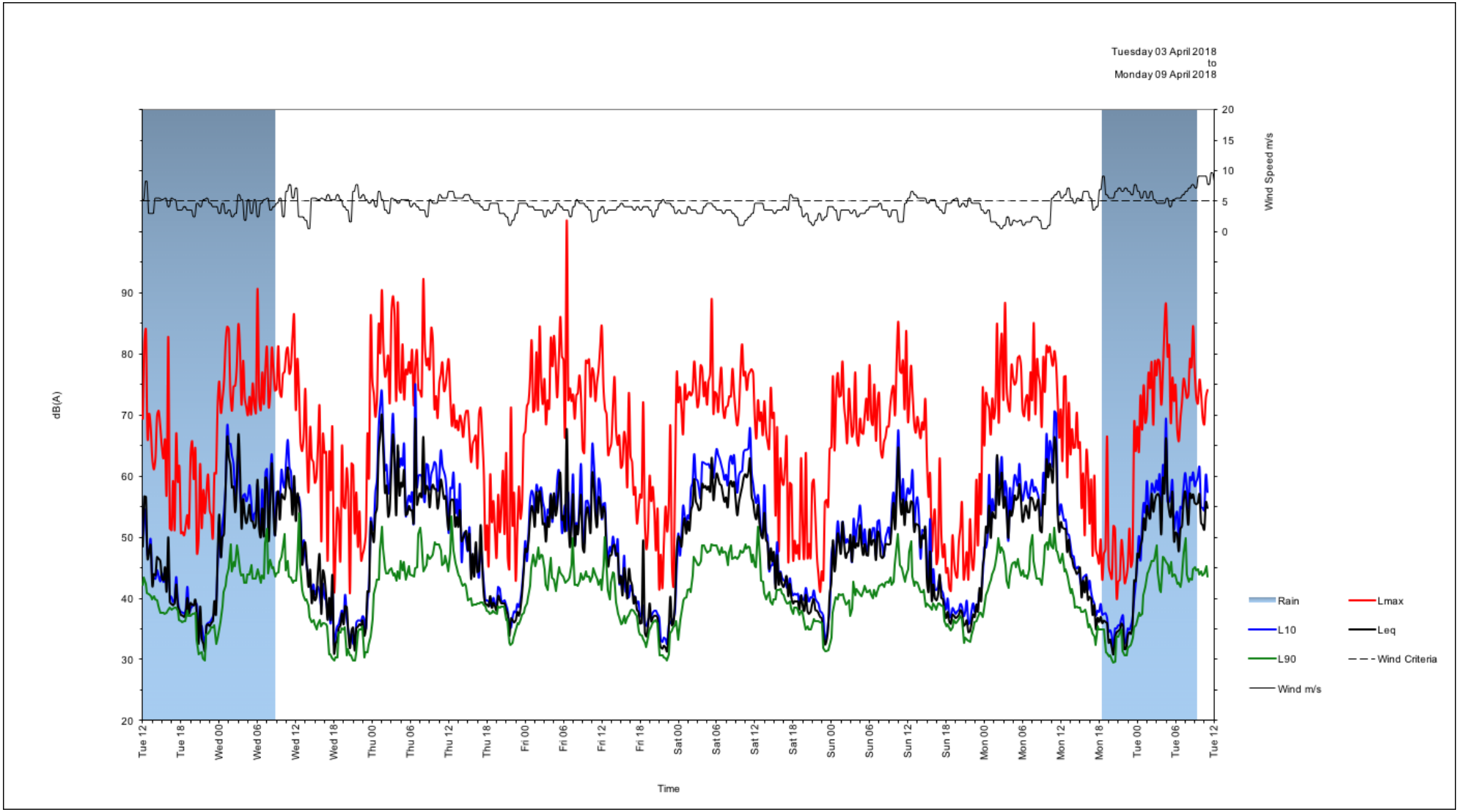

Figure 3 Unattended noise monitoring at Location 02 – 55 Cranbrook Rd