TRANSPORT ACCESS PROGRAM

Canley Vale Station Upgrade
Noise and Vibration Impact Assessment

Prepared for:

Transport for NSW
Level 5, Tower A, Zenith Centre
821 Pacific Highway CHATSWOOD NSW 2067

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Transport for NSW (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.19079-R02-v1.0	24 February 2020	Jordan McMahon	Robert Hall Dominic Sburlati	Robert Hall

EXECUTIVE SUMMARY

Transport for NSW (TfNSW) proposes to upgrade Canley Vale Station to meet disability access requirements (the Proposal) as outlined in the *Disability Discrimination Act 1992* (DDA Act). The Proposal would include upgrading the station access and station facilities as well as installing two lifts to the existing footbridge.

This report presents an assessment of construction and operational noise and vibration associated with the concept design and identifies feasible and reasonable noise and vibration mitigation and management measures to be incorporated in the detailed design and construction planning stage of the Proposal. This assessment forms part of the input to the Review of Environmental Factors (REF).

Construction noise impacts

Most of the Proposal's construction works are to be undertaken during standard daytime construction hours, 7am to 6pm Monday to Friday and 8am to 1pm Saturday. However, some works would need to be undertaken during scheduled Sydney Trains track work periods and would therefore need to be undertaken during the more noise sensitive night-time period.

Moderate daytime construction noise management level exceedances are predicted at surrounding residential receivers on both sides of the rail corridor for most of the Proposal's construction activities. Due to the nearby residential receivers being located close to the works, high daytime noise management level (NML) exceedances of up to 36 dB are predicted during the most noise intensive work periods. These impacts would be limited to residential receivers located directly adjacent to Canley Vale Station on Railway Parade and First Avenue which have direct line of sight to the proposed works. Receivers which are located further away from the proposed worksite would have much lower NML exceedances or no predicted noise or vibration impact.

During scheduled Sydney Trains track work periods, when works are required to be performed during evening and night-time periods, exceedances of the night-time noise management levels of up to 20 dBA are predicted for residential receivers surrounding the Proposal. High exceedances of the night-time NMLs of more than 40 dBA are predicted for residential receivers within approximately 100 metres of the works. The high magnitude of impacts at the closest receivers is a result of the highly noise intensive equipment proposed within the construction scenarios, their close proximity to the works and the low night-time NMLs in this location. It is, however, anticipated that night-time works would be limited to approximately three scheduled Sydney Trains track work periods and would therefore be limited to a relatively short portion of the construction program.

Of the potentially most affected receivers, 16 are predicted to be 'highly noise affected', as defined by the ICNG, during the worst-case works scenarios. These impacts are predominantly driven by the proposed use of highly noise intensive equipment items and parts of the works area which is close to the receivers. For instance, the wood chipper in the *Vegetation removal* scenario and the concrete saw in the *Platform resurfacing* scenario may be operated across a range of the areas, including compound areas extending to the south of the station in the case of vegetation removal. This results in a number of sensitive receivers in close proximity to the equipment at times during the works. It is noted that these high magnitude impacts would likely be limited to short periods where the proposed works are occurring directly adjacent to each receiver.

Management of potential impacts from vibration-producing construction plant is restricted to the near vicinity of Canley Vale Station.

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Specific and additional mitigation and management measures for construction noise and vibration are outlined in this report. Where vibration intensive works are required to be undertaken within the specified minimum working distances outlined in this report, or in close proximity to vibration sensitive heritage structures, vibration monitoring should be undertaken to ensure acceptable levels of vibration are satisfied.

Operational noise impacts

This assessment presents the applicable noise criteria for industrial noise sources associated with the Proposal. At this stage of the design specific mechanical systems have not been selected, which means it is too early to assess compliance with the applicable noise criteria however given this type of noise source (i.e. lift) generally has relatively low noise emissions, it an anticipated that the lift system design could be relatively easily mitigated if required during the detailed design phase of the Proposal. It is anticipated that the operational noise criteria established in this assessment would inform the detailed design process.

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GLOSSARY

Item	Description / Definition
CNS	Construction Noise Strategy
CNVS	Construction Noise and Vibration Strategy
DEC	Department of Environment and Conservation (now OEH / EPA)
DECC	Department of Environment and Climate Change (now OEH / EPA)
DECCW	Department of Environment, Climate Change and Water (now OEH / EPA)
REF	Review of Environmental Factors
EPA	Environment Protection Authority
ICNG	Interim Construction Noise Guideline
INP	Industrial Noise Policy
NPfI	Noise Policy for Industry
NML	Noise Management Level
NSW	New South Wales
RBL	Rating Background Level
RNP	Road Noise Policy
SLR	SLR Consulting Australia Pty Ltd
SWL	Sound Power Level
TfNSW	Transport for NSW

1 Introduction

Transport for New South Wales (TfNSW) is proposing to upgrade Canley Vale Station (the Proposal) to meet accessibility requirements outlined in the *Disability Discrimination Act 1992* (DD Act). The Proposal would include two lifts to the existing footbridge.

The Proposal is part of the Transport Access Program (TAP) which is an NSW Government initiative to provide a better experience for public transport customers by delivering accessible, modern, secure and integrated transport infrastructure. The Proposal would provide safe and equitable access to the surrounding pedestrian network at Canley Vale Station and would also improve customer facilities and amenity.

1.1 Report objectives

SLR Consulting Australia Pty Ltd (SLR) has been engaged by TfNSW to prepare a construction and operational noise and vibration assessment for the proposed station upgrade at Canley Vale.

The aims of this assessment are to:

- summarise the construction and operational noise and vibration assessment of the concept design for the Proposal
- identify feasible and reasonable noise and vibration mitigation and management measures to be incorporated in the detailed design and construction planning stage of the Proposal.

This assessment forms part of the input to the Review of Environmental Factors (REF).

1.2 Relevant guidelines

The noise and vibration guidelines for construction and operations are based on publications managed by the NSW Environment Protection Authority (EPA). The EPA guidelines applicable to this assessment include:

- operational noise – *Noise Policy for Industry* (NPfI, EPA 2017)
- construction noise – *Interim Construction Noise Guideline* (DECC 2009)
- construction and operational vibration (human comfort) – *Assessing Vibration – a technical guideline* (DEC 2006)
- road traffic noise on public roads – NSW *Road Noise Policy* (RNP), NSW EPA 2011).

The following additional guidelines are also referenced in this study:

- construction noise and vibration mitigation - *Construction Noise and Vibration Strategy* (CNVS, version 4.1, Transport for NSW, 2019).

1.3 Terminology

Specific acoustic terminology is used within this assessment. An explanation of common acoustic terms is included as **Appendix A**.

2 Proposal description

2.1 Proposal overview

The Proposal involves an upgrade of Canley Vale Station as part of the Transport Access Program which aims to improve accessibility and amenity for customers.

The Proposal would include the following elements.

- a new three stop lift to provide access to Railway Parade, Platform 1 and the existing footbridge
- a new two stop lift to provide access to Platform 2 and the existing footbridge
- extension of the existing footbridge to accommodate the new lifts
- replacement of existing stairs with new 3m wide entry stairs at the western station entry (Railway Parade)
- extension of the existing kerb line on Railway Parade to provide an accessible path leading to the lift
- new accessible car space to be provided within the First Avenue commuter car park
- new DDA kiss and ride to be provided on First Avenue
- improved amenities such as a new unisex ambulant toilet and family accessible toilet.
- new handrails along existing footbridge and stairs
- regrading of Platform 1 from the footbridge stairs to the family accessible toilet
- ancillary works including adjustments to lighting, Opal card readers, general service relocation, improvements to station communications systems including closed circuit TV (CCTV), cameras, hearing loops, and installation of Tactile Ground Surface Indicators (TGSIs).

2.2 Identification of sensitive receivers

The Proposal works are located as shown in **Figure 1**. Also shown are the locations of the closest representative noise sensitive receiver Noise Catchment Areas (NCA01 to NCA03) and noise monitoring locations L01 and L02.

Figure 1 Site location showing indicative works location

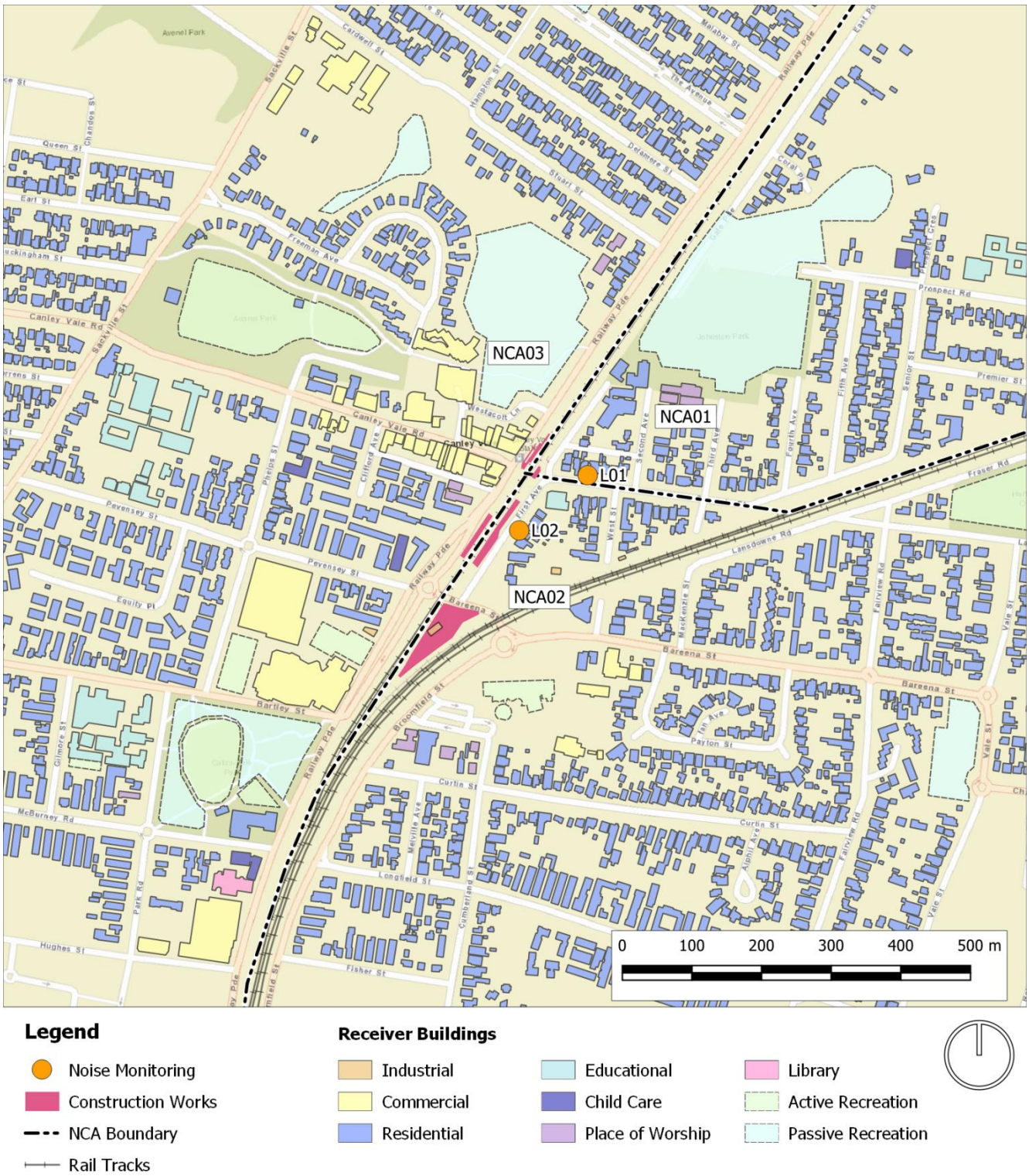


Table 1 provides a summary of the noise catchment areas shown as NCA01 through NCA03 in **Figure 1**.

Table 1 Representative noise sensitive receivers

NCA	Boundary description	Sensitive receiver descriptions
NCA01	Receivers located on the eastern side of the rail corridor north of Carcoola Street.	Mostly single storey residential buildings on Carcoola Street. Other sensitive receivers include the Australian Chinese Descendants Mutual Aged (ACDMA) Hostel association at the northern end of First Avenue and Orphan School Creek and the Kwan Yin Temple on Second Avenue. Closest receivers located approximately 20 m east of the Canley Vale Station platform.
NCA02	Receivers located on the eastern side of the rail corridor south of Carcoola Street.	Mostly single storey residential buildings. Other sensitive receivers include the Pal Buddhist School on the corner of First Avenue and Carcoola Street. Closest receivers located approximately 35 m east of the Canley Vale Station platform.
NCA03	Receivers located on the western side of the rail corridor.	Mostly multi storey residential buildings with mixed commercial units located adjacent to the station on Canley Vale Road. Closest receivers located approximately 20 m west of the Canley Vale Station platform.

3 Existing acoustic environment

3.1 Continuous unattended monitoring

3.1.1 Noise monitoring procedure

Noise monitoring locations (refer to **Figure 1**) were selected based on an inspection of the potentially affected areas, giving consideration to other noise sources which may influence the recordings, security issues for the noise monitoring device and gaining permission for access to the location from the resident or landowner. Monitoring was undertaken from 14 October to 24 October 2019. Instrument calibration was checked before and after the measurement survey, with the variation in calibrated levels not exceeding the acceptable variation of ±0.5 dB (AS 1055).

The results of the noise monitoring have been processed to exclude periods of adverse wind and/or rain so as to establish representative noise levels at the locations.

3.1.2 Noise monitoring results

A summary of the unattended continuous noise monitoring is provided in **Table 2**. A full graphical representation of the unattended noise monitoring results is provided in **Appendix B**.

Table 2 Unattended Noise Logger Results

Location	Equipment used	Address	Date	Period[1]	Measurement parameter (dBA)			
					L90	LAeq	LA10	LA1
L01	Svantek 957 (serial number 20664)	1 Carcoola Street, Canley Vale	14/10/2019 – 24/10/2019	Daytime 7am-6pm	42	58	60	67
				Evening 6pm – 10pm	43	56	59	66
				Night-time 10pm-7am	35	53	51	63
L02	Svantek 957 (serial number 23244)	20 First Avenue, Canley Vale	14/10/2019 – 24/10/2019	Daytime 7am-6pm	47	60	63	68
				Evening 6pm – 10pm	48	60	64	59
				Night-time 10pm-7am	37	56	58	67

Note 1: NPfI Governing Periods - Day: 7am to 6pm Monday to Saturday, 8am to 6pm Sundays & Public Holidays, Evening: 6pm to 10pm, Night: 10pm to 7am Monday to Saturday, 10pm to 8am Sundays & Public Holidays.

3.2 Operator attended measurements

3.2.1 Noise measurement procedure

The operator-attended noise measurements were performed on 14 October 2019 using a calibrated Brüel and Kjær 2250L, Sound Level Meter Serial No: 3004636. The acoustic instrumentation employed throughout the noise monitoring survey was designed to comply with the requirements of *AS IEC 61672.1-2004: Electroacoustics - Sound level meters - Specifications* as a type 1 precision sound level meter and has an accuracy suitable for both field and laboratory use. Both the meter and calibrator carry current NATA calibration certificates.

3.2.2 Noise measurement results

A summary of the operator-attended ambient noise survey is shown in **Table 3**.

Table 3 Operator attended ambient noise survey

Measurement Location	Measured noise levels (dBA)			Observations (dBA)
	LAmax	LAeq	LA90	
L01 - 1 Carcoola Street, Canley Vale	80	59	46	Light-vehicle passby: 58-62 Heavy-vehicle passby: 70-78 Horn: 80 Train passby: 52-53 Aircraft: 52-57 Traffic on Railway Pde: 44-46
L02 - 20 First Avenue, Canley Vale	82	59	50	Light-vehicle passby: 60-65 Heavy-vehicle passby: 72-75 Train passby: 64-65 Aircraft: 60-62 Traffic on Railway Pde: 52-55

Daytime ambient noise levels at L01 were observed to be largely controlled by traffic movements along Railway Parade, Carcoola Street and First Avenue. Daytime ambient noise levels at L02 were observed to be largely controlled by traffic movements along Railway Parade, First Avenue Street and train movements. A light aircraft flightpath was also observed to contribute to the ambient noise levels at both locations.

4 Construction noise assessment

4.1 Noise and vibration guidelines

4.1.1 Construction noise metrics

The three primary noise metrics used to describe construction noise emissions:

- **$L_{A1(1minute)}$** - the "typical maximum noise level" for an event, used in the assessment of potential sleep disturbance during night-time periods. Alternatively, assessment may be conducted using the L_{Amax} or maximum noise level
- **$L_{Aeq(15minute)}$** - the "energy average noise level" evaluated over a 15-minute period. This parameter is used to assess the potential construction noise impacts.
- **L_{A90}** - the "background noise level" in the absence of construction activities. This parameter represents the average minimum noise level during the daytime, evening and night-time periods respectively. The $L_{Aeq(15\ minute)}$ construction Noise Management Levels (NMLs) are based on the L_{A90} background noise levels.

The subscript "A" indicates that the noise levels are filtered to match normal human hearing characteristics (ie A-weighted).

4.1.2 NSW Interim Construction Noise Guideline

The *Interim Construction Noise Guideline* (ICNG) sets out ways to deal with the impacts of construction noise on residences and other sensitive land uses. It does this by presenting assessment approaches that are tailored to the scale of construction projects.

The ICNG requires proposal specific Noise Management Levels (NMLs) to be established for noise affected receivers. In the event construction noise levels are predicted to be above the NMLs, feasible and reasonable work practices are investigated to minimise noise emissions.

4.1.2.1 Residential receivers

The ICNG provides an approach for determining $L_{Aeq(15minute)}$ NMLs at residential receivers adjacent to the works by applying the measured $L_{AF90(15minute)}$ rating background noise levels (RBL), as described in **Table 4**.

Table 4 ICNG - determination of NMLs for residential receivers

Time of day	NML $L_{Aeq(15minute)}$	How to apply
Standard hours Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	RBL + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that the very noisy activities can occur, taking into account: Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools or mid-morning or mid-afternoon for works near residences. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	RBL[1] + 5 dBA	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 noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community.

Note 1: The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW *Industrial Noise Policy*.

4.1.2.2 Sleep disturbance

For the purposes of this assessment, the following night-time sleep disturbance noise goal has been used:

- night-time RBL +15 dBA "screening criterion"

4.1.2.3 Commercial receivers

The ICNG explains that due to the broad range of sensitivities that commercial or industrial land can have to noise from construction, the process of defining management levels is separated into three categories:

- industrial premises: external $L_{Aeq(15minute)}$ 75 dBA
- offices, retail outlets: external $L_{Aeq(15minute)}$ 70 dBA
- other businesses that may be very sensitive to noise, where the noise level is project specific as discussed below.

The external noise levels are assessed at the most-affected occupied point of the premises.

4.1.2.4 Other sensitive land uses

The ICNG's quantitative assessment method provides NMLs for other sensitive land uses, such as educational institutes, hospital, medical facilities, etc. These land uses are considered potentially sensitive to construction noise only when the properties are in use. The ICNG also references *AS2107:2016 – Recommended design sound levels and reverberation times for building interiors* for criteria of other sensitive receiver types that are not listed in the guideline. Neither the ICNG or AS 2107 provide criteria for childcare centres so the Association of Australian Acoustical Consultants *Guideline for Child Care Centre Acoustic Assessment* (GCCCAA) has also been referenced to adopt a noise management level for such receivers. The NMLs for the other sensitive receivers identified in the Proposal area are reproduced in **Table 5**.

Table 5 NMLs – other sensitive land uses

Use	Period	NML derived from	Noise Management Level $L_{Aeq(15minute)}$ (dBA)	
			Internal	External
Commercial	Daytime	ICNG	-	70
Industrial	Daytime	ICNG	-	75
Childcare centre	Daytime	GCCCAA	40	50[1]
Educational	Daytime	ICNG	45	55[1]
Library	Daytime	AS2107	45	55[1]
Active recreation area	Daytime and evening	ICNG	-	65
Passive recreation area	Daytime and evening	ICNG	-	60
Place of worship	Daytime and evening	ICNG	45	55[1]

Note 1: Receiver conservatively assumed to have openable windows and a 10 dB outside to inside facade performance.

As the noise management level for multiple other sensitive occupancy types nominated in the ICNG is an internal level, the corresponding external noise level (which the assessments are based upon) has been determined on the assumption that a 10 dB noise reduction from outside to inside is applicable. This is generally considered to be a typical assumption for a 'windows open' scenario.

4.2 Noise assessment criteria

Adopting the measured background noise levels in **Table 2**, the NMLs derived for the Proposal are outlined in **Table 6**.

Table 6 NMLs for construction

NCA	Receiver type	RBL			Standard construction (RBL+10dB)	Out of Hours (RBL+5dBA)[1]			Sleep disturbance screening (RBL+15)
		Day	Eve.	Night	Daytime period	Daytime period	Evening period	Night-time period	
NCA01	Residential (L01)	42	42 (43 actual)[2]	35	52	47	47	40	50
	Other Sensitive (Childcare Centre)	n/a	n/a	n/a	50	50	n/a	n/a	n/a
	Other Sensitive (Outdoor Passive Recreation)	n/a	n/a	n/a	60	60	60	n/a	n/a
	Other Sensitive (Place of Worship)	n/a	n/a	n/a	55	55	55	n/a	n/a
NCA02	Residential (L02)	47	47 (48 actual)[2]	37	57	52	52	42	52
	Other Sensitive (Childcare Centre)	n/a	n/a	n/a	50	50	n/a	n/a	n/a
	Other Sensitive (Educational)	n/a	n/a	n/a	55	55	n/a	n/a	n/a
	Other Sensitive (Active recreation area)	n/a	n/a	n/a	65	65	n/a	n/a	n/a
	Other Sensitive (Place of Worship)	n/a	n/a	n/a	55	55	n/a	n/a	n/a
NCA03	Residential (L02)	47	47 (48 actual)[2]	37	57	52	52	42	52
	Commercial	n/a	n/a	n/a	70	70	n/a	n/a	n/a
	Industrial	n/a	n/a	n/a	75	75	n/a	n/a	n/a
	Other Sensitive (Childcare Centre)	n/a	n/a	n/a	50	50	n/a	n/a	n/a
	Other Sensitive (Educational)	n/a	n/a	n/a	55	55	n/a	n/a	n/a
	Other Sensitive (Library)	n/a	n/a	n/a	55	55	55	n/a	n/a
	Other Sensitive (Active recreation area)	n/a	n/a	n/a	65	65	65	n/a	n/a
	Other Sensitive (Outdoor Passive Recreation)	n/a	n/a	n/a	60	60	60	n/a	n/a
	Other Sensitive (Place of Worship)	n/a	n/a	n/a	55	55	55	n/a	n/a

Note 1: Out of Hours construction hours – Evening hours are 6pm to 10pm. Night-time hours are 10pm to 7am Sunday to Saturday and 10pm Saturday to 8am Sunday

Note 2: Where the evening RBL is higher than the daytime RBL, the daytime RBL has been adopted for calculation of the evening NML.

Note 3: ICNG internal noise goal.

Note 4: ICNG internal goal + 10 dB as openable windows are assumed. An outside-to-inside attenuation of 10 dB is assumed.

4.3 Vibration assessment criteria

The effects of vibration in buildings can be divided into three main categories – those in which the occupants or users of the building are inconvenienced or possibly disturbed, those where the building contents may be affected and those in which the integrity of the building or the structure itself may be prejudiced.

4.3.1 Human comfort vibration

The EPA's *Assessing Vibration: a technical guideline* provides guideline values for continuous, transient and intermittent events that are based on a Vibration Dose Value (VDV) rather than a continuous vibration level. The VDV is dependent upon the level and duration of the short-term vibration event, as well as the number of events occurring during the daytime or night-time period.

The VDVs recommended in the document for vibration of an intermittent nature (ie construction works where more than three distinct vibration events occur) are presented in **Table 7**.

Table 7 Acceptable vibration dose values for intermittent vibration (m/s$^{1.75}$) (*Assessing Vibration: a technical guideline)*

Building Types	Assessment Period	Vibration Dose Value[1] (m/s$^{1.75}$)	
		Preferred	Maximum
Critical Working Areas (eg hospital operating theatres, precision laboratories)	Day or Night-time	0.10	0.20
Residential	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or Night-time	0.40	0.80

Note 1: The VDV accumulates vibration energy over the daytime and night-time assessment periods, and is dependent on the level of vibration as well as the duration.

4.3.2 Effects on building contents

People can perceive floor vibration at levels well below those likely to cause damage to building contents or affect the operation of typical equipment. For most receivers, the controlling vibration criterion will be the human comfort criterion, and it is therefore not normally required to set separate criteria in relation to the effect of construction vibration on most building contents.

Where appropriate, objectives for the satisfactory operation of critical instruments or manufacturing processes should be sourced from manufacturer's data and/or other published objectives

4.3.3 Structural damage vibration

Structural damage vibration limits are based on Australian Standard AS 2187: Part 2-2006 *Explosives - Storage and Use - Part 2: Use of Explosives* and British Standard BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings Part 2*. These standards provide frequency-dependent vibration limits related to cosmetic damage, noting that cosmetic damage is very minor in nature, is readily repairable and does not affect the structural integrity of the building. The recommended vibration limits from BS 7385 for transient vibration for minimal risk of cosmetic damage to residential and industrial buildings is shown in **Table 8**.

Table 8 Transient vibration guide values for minimal risk of cosmetic damage (BS 7385)

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

4.3.4 Minimum working distances

As a guide, minimum working distances for the proposed items of vibration intensive plant are provided in the CNVS and are reproduced below in **Table 9**.

Table 9 Recommended minimum working distances for vibration intensive plant

Plant item	Rating/description	Minimum working distance[1]	
		Cosmetic damage (BS 7385)	Human response (NSW EPA Vibration Guideline)
Vibratory roller	< 50 kN (Typically 1-2t)	5 m	15 m to 20 m
	< 100 kN (Typically 2-4t)	6 m	20 m
	< 200 kN (Typically 4-6t)	12 m	40 m
	< 300 kN (Typically 7-13t)	15 m	100 m
	> 300 kN (Typically 13-18t)	20 m	100 m
	> 300 kN (Typically > 18t)	25 m	100 m
Small hydraulic hammer	300 kg - 5 to 12t excavator	2 m	7 m
Medium hydraulic hammer	900 kg - 12 to 18t excavator	7 m	23 m
Large hydraulic hammer	1600 kg - 18 to 34t excavator	22 m	73 m
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure
Bored piling	< 800 mm	2 m	n/a

Note 1: More stringent conditions may apply to heritage or other sensitive structures, Refer **Section 4.9.4**.

The minimum working distances presented in **Table 9** are quoted for both cosmetic damage (refer to BS 7385:2 *Evaluation and Measurement for Vibration in Buildings Part 2: Guide to Damage Levels from Ground-borne Vibration*, 1993) and human comfort (refer to NSW EPA *Assessing Vibration: a technical guideline*, 2006).

The minimum working distances for building damage should be complied with at all times. The distances are noted as being indicative and would vary depending on the particular item of plant and local geotechnical conditions. They apply to addressing the risk of cosmetic (minor – easily reparable) damage of typical buildings under typical geotechnical conditions.

Where vibration intensive works are required to be undertaken within the specified minimum working distances, vibration monitoring should be undertaken to ensure acceptable levels of vibration are satisfied.

In relation to human comfort, the minimum working distances relate to continuous vibration. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are allowed.

4.4 Construction timing

4.4.1 Staging

Subject to approval, construction is expected to commence in mid-2020 and take around 16 months to complete. The construction methodology would be further developed during the detailed design of the Proposal by the nominated Contractor in consultation with TfNSW.

The proposed construction activities for the Proposal are identified in **Section 4.5**. The construction staging outlined in this assessment is indicative and is based on the current concept design and may change once the detailed design methodology is finalised. The staging is also dependent on the Contractor's preferred methodology, program, and sequencing of work.

4.4.2 Construction hours

Where possible, works required for the Proposal would be undertaken during standard (NSW) Environment Protection Authority (EPA) construction hours, which are as follows:

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

Works may need to occur outside standard hours and would include night works and works during scheduled Sydney Trains track work periods, which are scheduled closures that would occur regardless of the Proposal when part of the rail network is temporarily closed and trains are not operating.

Out of hours works are required in some cases to minimise disruptions to customers, pedestrians, motorists and nearby sensitive receivers; and to ensure the safety of railway workers and operational assets. It is estimated that scheduled Sydney Trains track work periods would be required to facilitate the following:

- overhead wiring works
- electrical upgrades
- extension of the existing footbridge and installation of the two lifts
- replacement of existing stairs with new 3m wide entry stairs at the western station entry (Railway Parade)

- replacement of the entry stairs at the western station entry (Railway Parade)
- platform works (such as regrading, trenching for power/communications systems and installation of TGSIs)
- reconfiguration of internal station buildings

Out of hours works may also be scheduled outside scheduled Sydney Trains track work periods. Approval from TfNSW would be required for any out of hours work and the affected community would be notified as outlined in TfNSW's *Construction Noise and Vibration Strategy* (TfNSW, 2018).

4.5 Construction works scenarios

In order to assess the potential noise and vibration impacts during construction, a number of scenarios comprising typical plant and equipment have been developed. These are summarised in **Table 10**.

Piling works are associated with several works activities. For the purpose of this assessment, it is assumed that piling works would be performed using bored piling. If the construction contractor elects to use an alternative piling method, the noise and vibration levels generated by the use of this plant may be different to those presented in this assessment and should be reviewed during detailed design.

Table 10 Indicative construction scenarios

	Plant Item		Chainsaw	Chipper	Concrete Mixer Truck	Concrete Pump	Concrete Saw	Concrete Vibrator	Elevated Working Platform	Excavator	Flatbed Truck	Forklift	Grinder	Hand Tools	Mobile Crane	Piling - Bored	Roller - Vibratory	Truck	Water Pump	Jackhammer	Truck (Hiab)
	Sound Power Level (L_{Aeq})[1]		119	120	103	106	124	102	97	100	100	101	110	94	100	111	114	108	83	113	108
	Assumed On-time in 15 Minute Period (Minutes)		15	15	15	15	5	15	3	7.5	3	15	5	15	7.5	7.5	15	3	7.5	10	3
	SWL Max (L_{Amax})		116	128	112	109	127	105	102	105	106	106	108	100	107	118	117	112	83	115	116
ID	**Scenario**	**Activity**																			
1A	Site establishment	Establishment of site compounds							X					X	X			X			
1B		Vegetation removal	X	X						X				X				X			
2A	Main Works	Piling								X				X		X		X			
2B		Concrete works			X	X		X													
2C		Installation of lift, services, and fit-out							X	X		X		X	X						X
2D		Platform resurfacing					X		X	X	X	X	X		X		X			X	
2E		Demolition of structures					X		X	X	X	X	X	X				X		X	
2F		Station building construction and fitout			X	X		X	X	X	X	X		X	X			X			
3A	Interchange Works	Interchange upgrade					X		X	X	X	X	X		X		X	X		X	
4A	Site Demobilisation	Commissioning and demobilisation								X				X	X			X			

Note 1: Incorporates the ICNG 'annoyance penalty'

4.6 Predicted noise impacts

In order to quantify noise emissions from the proposed construction works, a 3D computer noise model has been used to predict the $L_{Aeq(15minute)}$ and $L_{A1(1minute)}$ noise levels at the nearest receivers.

The predictions include the source noise levels of the anticipated equipment, the location of the nearest sensitive receivers, the number of plant items likely to be operating at any given time, the distance between the equipment and the receivers, and shielding or reflections provided by topography and/or buildings.

The resultant daytime, daytime Out of Hours, evening and night-time worst-case $L_{Aeq(15minute)}$ and $L_{A1(1minute)}$ noise level predictions are presented in **Table 11**. The results are presented as a summary of the worst-case impacts for each works scenario when the works are located at the nearest position within the works area to each receiver.

In practice, the noise levels will vary due to the fact that plant will move around the worksites and will not all be operating concurrently. As such, noise levels are likely to be lower than the worst-case noise levels presented for notable periods of time during the works.

The ICNG states that where construction works are planned to extend over more than two consecutive nights, the impact assessment should cover the maximum noise level from the proposed works.

Table 11 Predicted noise levels

Ref	Works Activity	Worst Case Construction Period	NCA	Type	Noise Level – LAeq(15minute) (dBA)												Noise Level – LA1(60second) (dBA) (sleep disturbance)		
					Worst-case Predicted	RBL			NML				Exceedance				Worst-case Predicted	Screening Criteria (RBL+15 dBA)	Exceedance
						Day	Eve	Night	Day	Day OOH	Eve	Night	Day	Day OOH	Eve	Night			
Site establishment																			
01A	Establishment of site compounds	Standard Daytime	NCA01	RES	65	42	43	35	52	47	47	40	13	-	-	-	-	-	-
			NCA01	OCC	39	-	-	-	50	50	-	-	0	-	-	-	-	-	-
			NCA01	OOP	45	-	-	-	60	60	60	-	0	-	-	-	-	-	-
			NCA01	OPW	46	-	-	-	55	55	55	-	0	-	-	-	-	-	-
			NCA02	RES	68	47	48	37	57	52	52	42	11	-	-	-	-	-	-
			NCA02	OCC	33	-	-	-	50	50	-	-	0	-	-	-	-	-	-
			NCA02	OED	67	-	-	-	55	55	-	-	12	-	-	-	-	-	-
			NCA02	OOA	55	-	-	-	65	65	-	-	0	-	-	-	-	-	-
			NCA02	OPW	57	-	-	-	55	55	55	-	2	-	-	-	-	-	-
			NCA03	RES	66	47	48	37	57	52	52	42	9	-	-	-	-	-	-
			NCA03	COM	74	-	-	-	70	70	-	-	4	-	-	-	-	-	-
			NCA03	IND	58	-	-	-	75	75	-	-	0	-	-	-	-	-	-
			NCA03	OCC	54	-	-	-	50	50	-	-	4	-	-	-	-	-	-
			NCA03	OED	41	-	-	-	55	55	-	-	0	-	-	-	-	-	-
			NCA03	OLI	41	-	-	-	55	55	55	-	0	-	-	-	-	-	-
			NCA03	OOA	58	-	-	-	65	65	65	-	0	-	-	-	-	-	-
			NCA03	OOP	55	-	-	-	60	60	60	-	0	-	-	-	-	-	-
			NCA03	OPW	67	-	-	-	55	55	55	-	12	-	-	-	-	-	-
01B	Vegetation removal	Standard Daytime	NCA01	RES	≥80	42	43	35	52	47	47	40	30	-	-	-	-	-	-
			NCA01	OCC	58	-	-	-	50	50	-	-	8	-	-	-	-	-	-
			NCA01	OOP	61	-	-	-	60	60	60	-	1	-	-	-	-	-	-
			NCA01	OPW	65	-	-	-	55	55	55	-	10	-	-	-	-	-	-
			NCA02	RES	≥80	47	48	37	57	52	52	42	28	-	-	-	-	-	-
			NCA02	OCC	52	-	-	-	50	50	-	-	2	-	-	-	-	-	-
			NCA02	OED	86	-	-	-	55	55	-	-	31	-	-	-	-	-	-
			NCA02	OOA	74	-	-	-	65	65	-	-	9	-	-	-	-	-	-
			NCA02	OPW	76	-	-	-	55	55	55	-	21	-	-	-	-	-	-
			NCA03	RES	≥80	47	48	37	57	52	52	42	24	-	-	-	-	-	-
			NCA03	COM	≥80	-	-	-	70	70	-	-	13	-	-	-	-	-	-
			NCA03	IND	77	-	-	-	75	75	-	-	2	-	-	-	-	-	-
			NCA03	OCC	73	-	-	-	50	50	-	-	23	-	-	-	-	-	-
			NCA03	OED	60	-	-	-	55	55	-	-	5	-	-	-	-	-	-
			NCA03	OLI	60	-	-	-	55	55	55	-	5	-	-	-	-	-	-
			NCA03	OOA	77	-	-	-	65	65	65	-	12	-	-	-	-	-	-
			NCA03	OOP	68	-	-	-	60	60	60	-	8	-	-	-	-	-	-

Ref	Works Activity	Worst Case Construction Period	NCA	Type	Noise Level – LAeq(15minute) (dBA)												Noise Level – LA1(60second) (dBA) (sleep disturbance)		
					Worst-case Predicted	RBL			NML				Exceedance				Worst-case Predicted	Screening Criteria (RBL+15 dBA)	Exceedance
						Day	Eve	Night	Day	Day OOH	Eve	Night	Day	Day OOH	Eve	Night			
			NCA03	OPW	79	-	-	-	55	55	55	-	24	-	-	-	-	-	-
Main Works																			
02A	Piling	Night-time	NCA01	RES	68	42	43	35	52	47	47	40	16	21	21	28	76	50	26
			NCA01	OCC	43	-	-	-	50	50	-	-	0	0	-	-	51	-	-
			NCA01	OOP	48	-	-	-	60	60	60	-	0	0	0	-	56	-	-
			NCA01	OPW	51	-	-	-	55	55	55	-	0	0	0	-	59	-	-
			NCA02	RES	67	47	48	37	57	52	52	42	10	15	15	25	75	52	23
			NCA02	OCC	38	-	-	-	50	50	-	-	0	0	-	-	46	-	-
			NCA02	OED	71	-	-	-	55	55	-	-	16	16	-	-	79	-	-
			NCA02	OOA	48	-	-	-	65	65	-	-	0	0	-	-	56	-	-
			NCA02	OPW	45	-	-	-	55	55	55	-	0	0	0	-	53	-	-
			NCA03	RES	57	47	48	37	57	52	52	42	0	5	5	15	65	52	13
			NCA03	COM	74	-	-	-	70	70	-	-	4	4	-	-	82	-	-
			NCA03	IND	48	-	-	-	75	75	-	-	0	0	-	-	56	-	-
			NCA03	OCC	44	-	-	-	50	50	-	-	0	0	-	-	52	-	-
			NCA03	OED	42	-	-	-	55	55	-	-	0	0	-	-	50	-	-
			NCA03	OLI	40	-	-	-	55	55	55	-	0	0	0	-	48	-	-
			NCA03	OOA	49	-	-	-	65	65	65	-	0	0	0	-	57	-	-
			NCA03	OOP	52	-	-	-	60	60	60	-	0	0	0	-	60	-	-
			NCA03	OPW	59	-	-	-	55	55	55	-	4	4	4	-	67	-	-
02B	Concrete works	Night-time	NCA01	RES	70	42	43	35	52	47	47	40	18	23	23	30	78	50	28
			NCA01	OCC	43	-	-	-	50	50	-	-	0	0	-	-	51	-	-
			NCA01	OOP	50	-	-	-	60	60	60	-	0	0	0	-	58	-	-
			NCA01	OPW	51	-	-	-	55	55	55	-	0	0	0	-	59	-	-
			NCA02	RES	66	47	48	37	57	52	52	42	9	14	14	24	74	52	22
			NCA02	OCC	38	-	-	-	50	50	-	-	0	0	-	-	46	-	-
			NCA02	OED	71	-	-	-	55	55	-	-	16	16	-	-	79	-	-
			NCA02	OOA	48	-	-	-	65	65	-	-	0	0	-	-	56	-	-
			NCA02	OPW	46	-	-	-	55	55	55	-	0	0	0	-	54	-	-
			NCA03	RES	57	47	48	37	57	52	52	42	0	5	5	15	65	52	13
			NCA03	COM	79	-	-	-	70	70	-	-	9	9	-	-	87	-	-
			NCA03	IND	46	-	-	-	75	75	-	-	0	0	-	-	54	-	-
			NCA03	OCC	44	-	-	-	50	50	-	-	0	0	-	-	52	-	-
			NCA03	OED	44	-	-	-	55	55	-	-	0	0	-	-	52	-	-
			NCA03	OLI	40	-	-	-	55	55	55	-	0	0	0	-	48	-	-
			NCA03	OOA	49	-	-	-	65	65	65	-	0	0	0	-	57	-	-
			NCA03	OOP	60	-	-	-	60	60	60	-	0	0	0	-	68	-	-

Ref	Works Activity	Worst Case Construction Period	NCA	Type	Noise Level – LAeq(15minute) (dBA)												Noise Level – LA1(60second) (dBA) (sleep disturbance)		
					Worst-case Predicted	RBL			NML				Exceedance				Worst-case Predicted	Screening Criteria (RBL+15 dBA)	Exceedance
						Day	Eve	Night	Day	Day OOH	Eve	Night	Day	Day OOH	Eve	Night			
			NCA03	OPW	59	-	-	-	55	55	55	-	4	4	4	-	67	-	-
02C	Installation of lift, services, and fit-out	Night-time	NCA01	RES	65	42	43	35	52	47	47	40	13	18	18	25	73	50	23
			NCA01	OCC	40	-	-	-	50	50	-	-	0	0	-	-	48	-	-
			NCA01	OOP	45	-	-	-	60	60	60	-	0	0	0	-	53	-	-
			NCA01	OPW	48	-	-	-	55	55	55	-	0	0	0	-	56	-	-
			NCA02	RES	63	47	48	37	57	52	52	42	6	11	11	21	71	52	19
			NCA02	OCC	35	-	-	-	50	50	-	-	0	0	-	-	43	-	-
			NCA02	OED	68	-	-	-	55	55	-	-	13	13	-	-	76	-	-
			NCA02	OOA	45	-	-	-	65	65	-	-	0	0	-	-	53	-	-
			NCA02	OPW	42	-	-	-	55	55	55	-	0	0	0	-	50	-	-
			NCA03	RES	54	47	48	37	57	52	52	42	0	2	2	12	62	52	10
			NCA03	COM	73	-	-	-	70	70	-	-	3	3	-	-	81	-	-
			NCA03	IND	43	-	-	-	75	75	-	-	0	0	-	-	51	-	-
			NCA03	OCC	41	-	-	-	50	50	-	-	0	0	-	-	49	-	-
			NCA03	OED	41	-	-	-	55	55	-	-	0	0	-	-	49	-	-
			NCA03	OLI	37	-	-	-	55	55	55	-	0	0	0	-	45	-	-
			NCA03	OOA	46	-	-	-	65	65	65	-	0	0	0	-	54	-	-
			NCA03	OOP	50	-	-	-	60	60	60	-	0	0	0	-	58	-	-
			NCA03	OPW	56	-	-	-	55	55	55	-	1	1	1	-	64	-	-
02D	Platform resurfacing	Night-time	NCA01	RES	≥80	42	43	35	52	47	47	40	30	35	35	42	90	50	40
			NCA01	OCC	52	-	-	-	50	50	-	-	2	2	-	-	60	-	-
			NCA01	OOP	62	-	-	-	60	60	60	-	2	2	2	-	70	-	-
			NCA01	OPW	61	-	-	-	55	55	55	-	6	6	6	-	69	-	-
			NCA02	RES	75	47	48	37	57	52	52	42	18	23	23	33	83	52	31
			NCA02	OCC	49	-	-	-	50	50	-	-	0	0	-	-	57	-	-
			NCA02	OED	77	-	-	-	55	55	-	-	22	22	-	-	85	-	-
			NCA02	OOA	60	-	-	-	65	65	-	-	0	0	-	-	68	-	-
			NCA02	OPW	55	-	-	-	55	55	55	-	0	0	0	-	63	-	-
			NCA03	RES	68	47	48	37	57	52	52	42	11	16	16	26	76	52	24
			NCA03	COM	87	-	-	-	70	70	-	-	17	17	-	-	95	-	-
			NCA03	IND	57	-	-	-	75	75	-	-	0	0	-	-	65	-	-
			NCA03	OCC	53	-	-	-	50	50	-	-	3	3	-	-	61	-	-
			NCA03	OED	56	-	-	-	55	55	-	-	1	1	-	-	64	-	-
			NCA03	OLI	50	-	-	-	55	55	55	-	0	0	0	-	58	-	-
			NCA03	OOA	57	-	-	-	65	65	65	-	0	0	0	-	65	-	-
			NCA03	OOP	72	-	-	-	60	60	60	-	12	12	12	-	80	-	-
			NCA03	OPW	69	-	-	-	55	55	55	-	14	14	14	-	77	-	-

Ref	Works Activity	Worst Case Construction Period	NCA	Type	Noise Level – LAeq(15minute) (dBA)												Noise Level – LA1(60second) (dBA) (sleep disturbance)		
					Worst-case Predicted	RBL			NML				Exceedance				Worst-case Predicted	Screening Criteria (RBL+15 dBA)	Exceedance
						Day	Eve	Night	Day	Day OOH	Eve	Night	Day	Day OOH	Eve	Night			
02E	Demolition of structures	Night-time	NCA01	RES	≥80	42	43	35	52	47	47	40	28	33	33	40	88	50	38
			NCA01	OCC	54	-	-	-	50	50	-	-	4	4	-	-	62	-	-
			NCA01	OOP	59	-	-	-	60	60	60	-	0	0	0	-	67	-	-
			NCA01	OPW	62	-	-	-	55	55	55	-	7	7	7	-	70	-	-
			NCA02	RES	77	47	48	37	57	52	52	42	20	25	25	35	85	52	33
			NCA02	OCC	49	-	-	-	50	50	-	-	0	0	-	-	57	-	-
			NCA02	OED	≥80	-	-	-	55	55	-	-	27	27	-	-	90	-	-
			NCA02	OOA	59	-	-	-	65	65	-	-	0	0	-	-	67	-	-
			NCA02	OPW	56	-	-	-	55	55	55	-	1	1	1	-	64	-	-
			NCA03	RES	68	47	48	37	57	52	52	42	11	16	16	26	76	52	24
			NCA03	COM	≥80	-	-	-	70	70	-	-	17	17	-	-	95	-	-
			NCA03	IND	57	-	-	-	75	75	-	-	0	0	-	-	65	-	-
			NCA03	OCC	55	-	-	-	50	50	-	-	5	5	-	-	63	-	-
			NCA03	OED	55	-	-	-	55	55	-	-	0	0	-	-	63	-	-
			NCA03	OLI	51	-	-	-	55	55	55	-	0	0	0	-	59	-	-
			NCA03	OOA	60	-	-	-	65	65	65	-	0	0	0	-	68	-	-
			NCA03	OOP	64	-	-	-	60	60	60	-	4	4	4	-	72	-	-
			NCA03	OPW	70	-	-	-	55	55	55	-	15	15	15	-	78	-	-
02F	Station building construction and fitout	Night-time	NCA01	RES	71	42	43	35	52	47	47	40	19	24	24	31	79	50	29
			NCA01	OCC	41	-	-	-	50	50	-	-	0	0	-	-	49	-	-
			NCA01	OOP	51	-	-	-	60	60	60	-	0	0	0	-	59	-	-
			NCA01	OPW	46	-	-	-	55	55	55	-	0	0	0	-	54	-	-
			NCA02	RES	65	47	48	37	57	52	52	42	8	13	13	23	73	52	21
			NCA02	OCC	35	-	-	-	50	50	-	-	0	0	-	-	43	-	-
			NCA02	OED	65	-	-	-	55	55	-	-	10	10	-	-	73	-	-
			NCA02	OOA	49	-	-	-	65	65	-	-	0	0	-	-	57	-	-
			NCA02	OPW	45	-	-	-	55	55	55	-	0	0	0	-	53	-	-
			NCA03	RES	54	47	48	37	57	52	52	42	0	2	2	12	62	52	10
			NCA03	COM	77	-	-	-	70	70	-	-	7	7	-	-	85	-	-
			NCA03	IND	47	-	-	-	75	75	-	-	0	0	-	-	55	-	-
			NCA03	OCC	42	-	-	-	50	50	-	-	0	0	-	-	50	-	-
			NCA03	OED	41	-	-	-	55	55	-	-	0	0	-	-	49	-	-
			NCA03	OLI	39	-	-	-	55	55	55	-	0	0	0	-	47	-	-
			NCA03	OOA	47	-	-	-	65	65	65	-	0	0	0	-	55	-	-
			NCA03	OOP	58	-	-	-	60	60	60	-	0	0	0	-	66	-	-
			NCA03	OPW	55	-	-	-	55	55	55	-	0	0	0	-	63	-	-

Ref	Works Activity	Worst Case Construction Period	NCA	Type	Noise Level – LAeq(15minute) (dBA)												Noise Level – LA1(60second) (dBA) (sleep disturbance)		
					Worst-case Predicted	RBL			NML				Exceedance				Worst-case Predicted	Screening Criteria (RBL+15 dBA)	Exceedance
						Day	Eve	Night	Day	Day OOH	Eve	Night	Day	Day OOH	Eve	Night			
Interchange Works																			
03A	Interchange upgrade	Night-time	NCA01	RES	≥80	42	43	35	52	47	47	40	36	41	41	48	96	50	46
			NCA01	OCC	55	-	-	-	50	50	-	-	5	5	-	-	63	-	-
			NCA01	OOP	61	-	-	-	60	60	60	-	1	1	1	-	69	-	-
			NCA01	OPW	61	-	-	-	55	55	55	-	6	6	6	-	69	-	-
			NCA02	RES	76	47	48	37	57	52	52	42	19	24	24	34	84	52	32
			NCA02	OCC	49	-	-	-	50	50	-	-	0	0	-	-	57	-	-
			NCA02	OED	≥80	-	-	-	55	55	-	-	25	25	-	-	88	-	-
			NCA02	OOA	60	-	-	-	65	65	-	-	0	0	-	-	68	-	-
			NCA02	OPW	58	-	-	-	55	55	55	-	3	3	3	-	66	-	-
			NCA03	RES	69	47	48	37	57	52	52	42	12	17	17	27	77	52	25
			NCA03	COM	≥80	-	-	-	70	70	-	-	21	21	-	-	99	-	-
			NCA03	IND	58	-	-	-	75	75	-	-	0	0	-	-	66	-	-
			NCA03	OCC	54	-	-	-	50	50	-	-	4	4	-	-	62	-	-
			NCA03	OED	56	-	-	-	55	55	-	-	1	1	-	-	64	-	-
			NCA03	OLI	52	-	-	-	55	55	55	-	0	0	0	-	60	-	-
			NCA03	OOA	59	-	-	-	65	65	65	-	0	0	0	-	67	-	-
			NCA03	OOP	68	-	-	-	60	60	60	-	8	8	8	-	76	-	-
			NCA03	OPW	71	-	-	-	55	55	55	-	16	16	16	-	79	-	-

Ref	Works Activity	Worst Case Construction Period	NCA	Type	Noise Level – LAeq(15minute) (dBA)												Noise Level – LA1(60second) (dBA) (sleep disturbance)		
					Worst-case Predicted	RBL			NML				Exceedance				Worst-case Predicted	Screening Criteria (RBL+15 dBA)	Exceedance
						Day	Eve	Night	Day	Day OOH	Eve	Night	Day	Day OOH	Eve	Night			
Site demobilisation																			
04A	Commissioning and demobilisation	Standard Daytime	NCA01	RES	65	42	43	35	52	47	47	40	13	-	-	-	-	-	-
			NCA01	OCC	39	-	-	-	50	50	-	-	0	-	-	-	-	-	-
			NCA01	OOP	45	-	-	-	60	60	60	-	0	-	-	-	-	-	-
			NCA01	OPW	46	-	-	-	55	55	55	-	0	-	-	-	-	-	-
			NCA02	RES	68	47	48	37	57	52	52	42	11	-	-	-	-	-	-
			NCA02	OCC	33	-	-	-	50	50	-	-	0	-	-	-	-	-	-
			NCA02	OED	67	-	-	-	55	55	-	-	12	-	-	-	-	-	-
			NCA02	OOA	55	-	-	-	65	65	-	-	0	-	-	-	-	-	-
			NCA02	OPW	57	-	-	-	55	55	55	-	2	-	-	-	-	-	-
			NCA03	RES	66	47	48	37	57	52	52	42	9	-	-	-	-	-	-
			NCA03	COM	74	-	-	-	70	70	-	-	4	-	-	-	-	-	-
			NCA03	IND	58	-	-	-	75	75	-	-	0	-	-	-	-	-	-
			NCA03	OCC	54	-	-	-	50	50	-	-	4	-	-	-	-	-	-
			NCA03	OED	41	-	-	-	55	55	-	-	0	-	-	-	-	-	-
			NCA03	OLI	41	-	-	-	55	55	55	-	0	-	-	-	-	-	-
			NCA03	OOA	58	-	-	-	65	65	65	-	0	-	-	-	-	-	-
			NCA03	OOP	55	-	-	-	60	60	60	-	0	-	-	-	-	-	-
			NCA03	OPW	67	-	-	-	55	55	55	-	12	-	-	-	-	-	-

Note 1: Worst-case predicted noise levels greater than 75 dBA are highlighted in pink and indicates highly affected receiver noise levels as defined in the ICNG.
Note 2: Predicted exceedances of the sleep disturbance screening criteria are highlighted in brown.
Note 3: Receiver classification abbreviations are residential (RES), commercial (COM), industrial (IND), other sensitive – childcare centre (OCC), other sensitive – educational facility (OED), other sensitive – Library, other sensitive – outdoor active recreation (OOA), other sensitive – outdoor passive recreation (OOP), other sensitive – place of worship (OPW).

4.7 Discussion

4.7.1 Site establishment

During establishment of site compounds, the most potentially affected residential receivers are predicted to exceed the daytime NMLs by up to 13 dB, 9 dB, and 12 dB, in NCA01, NCA02, and NCA03 respectively. During these noise-intensive works the receivers with NML exceedances are generally limited to those with direct line of site to the equipment and are situated within 200 m.

During the vegetation removal works, the highest predicted daytime NML exceedances are 30 dB, 28 dB, and 24 dB in NCA01, NCA02, and NCA03 respectively. High NML exceedances of this magnitude would be limited to periods when noise intensive equipment for vegetation removal works (chainsaw and wood chipper) are operating directly adjacent to the sensitive receivers. Sensitive receivers which are located further away from the proposed works areas would have lower NML exceedances. For example, the predicted noise levels at the second row of receivers from the works area typically reduce by 10 dB when compared with the front row. However, due to the noise intensive nature of the equipment, daytime NML exceedances are predicted over the adjacent area during the vegetation removal works.

Site establishment works are proposed to be undertaken during standard daytime construction hours only. The use of high noise equipment associated with vegetation clearing works is not anticipated to extend for more than a few days.

4.7.2 Main works

The majority of the main works associated with lift construction and platform resurfacing are proposed to occur during standard daytime construction hours and during out-of-hours periods occurring during scheduled Sydney Trains track work periods.

During the less intensive piling, concreting and installation works, the most potentially affected residential receivers are predicted to exceed the daytime NMLs by up to 18 dB and 10 dB in NCA01 and NCA02 respectively, and no residential NML exceedances in NCA03. However, the highest predicted noise levels in NCA03 exceed the daytime NMLs for commercial and place of worship categorised receivers by up to 9 dB. NML exceedances of this magnitude would generally be limited to sensitive receivers with a line of site to the proposed equipment for these works.

The highest impacts are associated with demolition and platform resurfacing works. During these scenarios exceedances of the daytime NMLs of up to 30 dB, 18 dB, and 11 dB are predicted for the nearest residential receivers in NCA01, NCA02, and NCA03 respectively. Similarly, exceedance of the night-time NMLs are predicted up to 42 dB, 33 dB, and 26 dB at the nearest residential receivers in NCA01, NCA02 and NCA03 respectively.

The high magnitude of these impacts at the most potentially affected sensitive receivers is largely the result of the highly noise intensive concrete saw, jackhammer, and vibratory roller included in the proposed works scenarios. Additionally, the night-time noise management levels are based on the notably lower background noise level during this period. The culmination of these factors results in an increased risk of sleep disturbance at many surrounding residential receivers. Where practical it is recommended that use of noise intensive equipment is scheduled to occur in the less sensitive daytime period to reduce the magnitude of the resultant NML exceedances and sleep disturbance impacts.

4.7.3 Interchange works

Exceedances of the daytime NMLs up to 36 dB, 19 dB and 12 dB are predicted for the nearest residential receivers in NCA01, NCA02 and NCA03 respectively during the proposed interchange upgrades. Exceedances of the night-time NMLs up to 48 dB, 34 dB and 27 dB are predicted for the nearest residential receivers in NCA01, NCA02 and NCA03 respectively. Similarly to the Main works, these worst-case exceedances are driven by the use of a concrete saw, jackhammer, and vibratory roller.

The interchange works activities are proposed to be undertaken during standard daytime construction hours and during out-of-hours periods occurring during shorter duration scheduled Sydney Trains track work periods. Consistent with the main works scenarios, the use of noise intensive equipment during night-time period increases the risk of sleep disturbance at the surrounding residential receivers. Where practical it is recommended that use of noise intensive equipment is scheduled to occur in the less sensitive daytime period to reduce the magnitude of the resultant NML exceedances and sleep disturbance impacts.

4.7.4 Site demobilisation

The most potentially affected residential receivers are predicted to exceed the daytime NMLs by up to 13 dB, 11 dB and 9 dB, in NCA01, NCA02 and NCA03 respectively. The noise profile of these works is similar to that of site establishment with the exclusion of the vegetation removal works.

Sensitive receivers with NML exceedances are generally limited to those with that have a line of site to the works and are situated within 200 m. Site demobilisation activities are proposed to be undertaken during standard daytime construction hours only.

4.7.5 Highly noise affected receivers

Receivers are considered to be highly noise affected if noise levels from construction exceed 75 dBA $L_{Aeq(15minute)}$.

With reference to **Table 11**, *Vegetation removal, Platform resurfacing, Demolition of structures,* and *Interchange upgrades* are predicted to result in 'highly noise affected' receivers. Due to the close vicinity of the works to receivers directly adjacent to Canley Vale Station, worst case construction daytime noise levels are predicted above 75 dBA $L_{Aeq(15minute)}$ in all NCAs during the operation of noise intensive equipment.

The location of receivers with potential to be highly noise affected at noise intensive times during these activities is shown in **Figure 2**.

Figure 2 Highly noise affected receivers

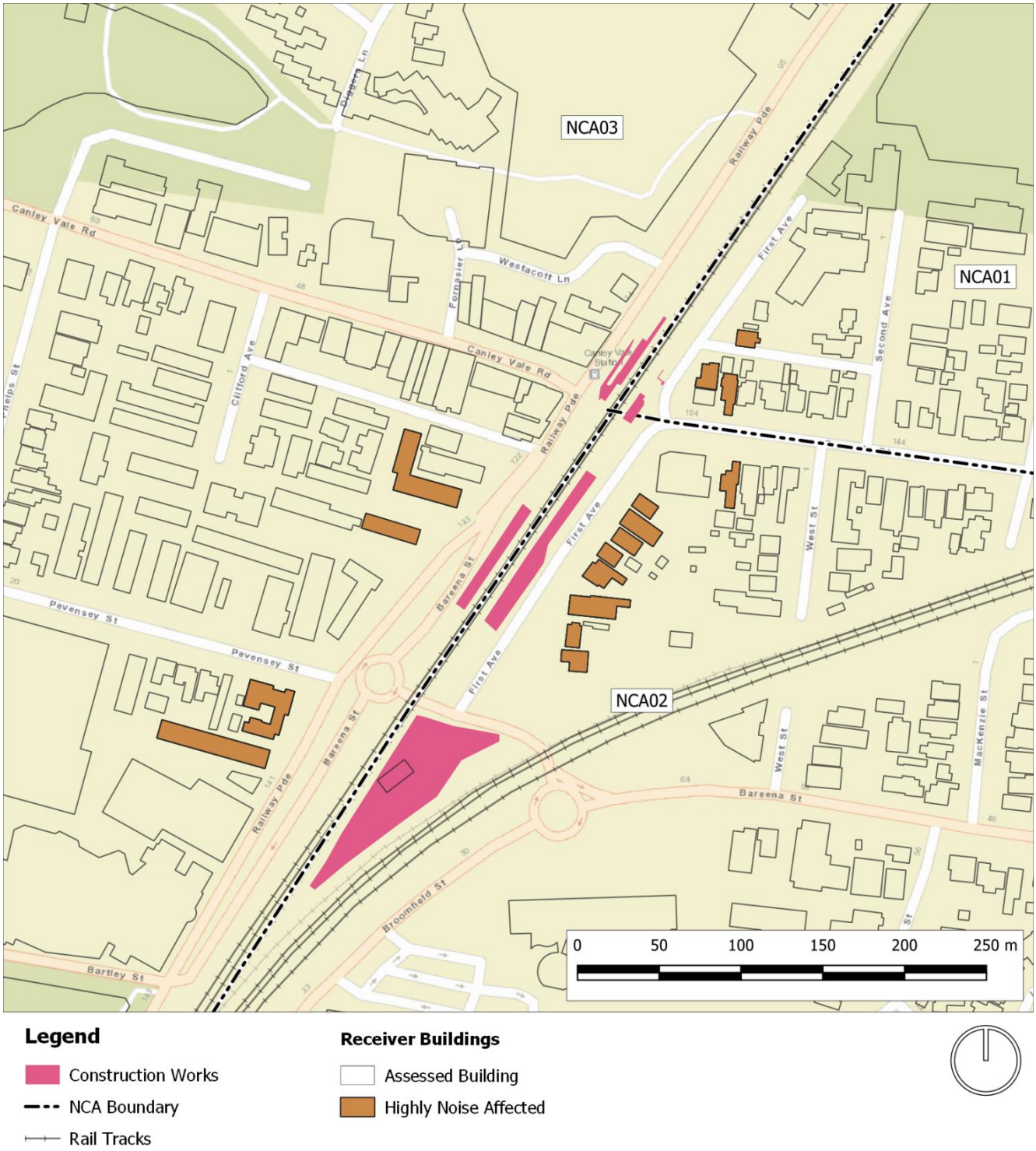


Figure 2 shows the location of the 16 residential receiver buildings that are predicted to be highly noise affected during noise intensive works. This includes single and two-storey residences adjacent to the works areas in NCA01 and NCA02, and multi-story residential unit buildings in NCA03.

Mitigation measures recommended to minimise the impacts are outlined in **Section 5**.

4.7.6 Cumulative noise impacts

Cumulative noise impacts warrant assessment where more than one works scenario operates at the same time and in the same location such that the same receiver is impacted by noise from more than one works scenario. Generally, the proposed works are scheduled in consecutive phases and therefore cumulative noise impacts are not predicted as the assessment is controlled by noise impacts from the individual phases (as assessed).

4.7.7 Noise impacts at educational receivers

Pal Buddhist School is situated in NCA02, directly to the east of the existing Canley Vale Station and proposed construction works areas. Due to its immediate proximity to the works this receiver has maximum exceedances of the daytime NML for educational facilities predicted between 10 dB and 31 dB at times during the works scenarios.

Additionally, Canley Value Public School and Sacred Heart Catholic Primary School are situated approximately 450 m to the west of the proposed works in NCA03. Relatively minor impacts are predicted for these schools, with a maximum exceedance of the daytime NML for educational facilities predicted up to 5 dB.

Mitigation measures recommended to minimise the impacts are outlined in **Section 5** and include consultation with the schools to minimise impacts during sensitive periods as far as practicable.

It is important to note that for sensitive receivers such as schools, the criteria presented in **Table 5** is based on internal noise levels. For the purpose of this assessment, it is assumed that these receivers have openable windows. On the basis that external noise levels are typically 10 dB higher than internal noise levels when windows are open, an external L_{Aeq} criteria of 55 dBA L_{Aeq} has been adopted. Notwithstanding, it is likely receivers such as the educational building at Pal Buddhist School would have fixed windows and relatively well performing facades due to existing noise exposure from the adjacent rail line.

4.8 Construction road traffic

It is not expected to exceed 20 light vehicles and 10 heavy vehicles per day during peak construction periods (scheduled Sydney Trains track work periods) and less during non-track work periods.

The relatively small number of construction vehicles accessing the site is predicted to have an insignificant effect on existing road traffic noise levels and further consideration of noise impacts due to construction traffic is not required

4.9 Construction vibration assessment

4.9.1 Vibration intensive equipment

Vibration intensive equipment is proposed during the main works scenarios which include the use of a vibratory roller, jackhammers and bored piling.

For the purpose of this assessment, it is assumed that piling works would be performed using non-vibration intensive bored piling. If the construction contractor elects to use an alternative piling method, the vibration levels generated by the use of this plant may be higher than those presented in this assessment.

Vibratory rolling is proposed during the following scenarios:

- Platform resurfacing, tactiles, services work
- Reconfiguration of internal station buildings
- Interchange upgrade works (footpath, amenities fitout, landscaping)

With reference to the layout sketch shown in **Figure 1**, vibratory rolling during the interchange works is likely to be the closest to the adjacent receiver buildings, with a worst-case minimum working distance of 15 m from the closest commercial receiver on Railway Parade.

4.9.2 Cosmetic damage assessment

For most sources of intermittent vibration during construction, the predominant vibration energy occurs at frequencies usually in the 10 Hz to 100 Hz range. On this basis, and with reference to BS 7385:2 and **Section 4.3**, a vibration damage screening level of 7.5 mm/s has been adopted for the purpose of assessing potential impacts from continuous vibration.

BS 7385:2 sets guide values for vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration-induced damage, where minimal risk is usually taken as 95 per cent probability of no effect.

Based on the safe working distances presented in the TfNSW CNVS, indicative vibration levels at the representative receivers are shown in **Table 12**.

Table 12 Indicative vibration levels at nearby receivers

Receiver[1]	Approximate distance to works[2]	Indicative Vibration Level (mm/s)[3]
NCA01 (RES)	20 m	4.8
NCA02 (OED)	40 m	1.6
NCA03 (COM)	15 m	7.5

Note 1: Receiver classification abbreviations are residential (RES), commercial (COM), and other sensitive – educational facility (OED).

Note 2: Approximate distance of works areas within the Proposal area based on works areas shown in **Figure 1**.

Note 3: Estimated from the minimum working distances specified in TfNSW CNVS for a medium vibratory roller (< 50 kN, Typically 7-13 tonnes) and assumed dense rock.

The information presented in **Table 12** indicates that the separation distance from the nearest receivers is sufficient to mitigate the potential impacts for a medium sized vibratory roller.

Other items of plant (jackhammer, bored piling) are associated with a lower vibration level, and are not identified any closer to the receivers than the vibratory rolling scenario. As such, it is considered that structural or cosmetic damage impacts from vibration intensive works are unlikely for the adjacent receivers.

If vibration intensive works such as large vibratory rollers or other equipment are required to be undertaken within the specified minimum working distances outlined in **Section 4.3.4**, or in close proximity to potentially vibration-sensitive structures, vibration monitoring should be undertaken to ensure acceptable levels of vibration are satisfied.

4.9.3 Human comfort vibration assessment

In relation to human comfort (response), the safe working distances in **Section 4.3.4** relate to continuous vibration and apply to **residential** receivers. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are permitted, as discussed in *Assessing Vibration - a technical guideline*.

Vibration at the nearest receivers is likely to be perceptible at times during the works.

For vibratory rolling, where the nearest affected receiver is located approximately 15 m from the works area, assuming a medium vibratory roller operating continuously near the adjacent site boundary, it is anticipated that the day-time VDV criterion of 0.4 $m/s^{1.75}$ will be reached within an impractical working time. For the majority of receivers surrounding the relevant works area which are situated at least 50 m from the site boundary, the time to reach the day-time VDV criterion of 0.4 $m/s^{1.75}$ is anticipated to be within approximately 45 minutes for a medium vibratory roller operating continuously near the adjacent site boundary.

Where vibratory rolling is required at a location less than 50 m from the nearest sensitive receiver it is recommended that a small vibratory roller is used where practicable. Assuming a 1-2 tonne vibratory roller operating continuously at a distance of 15 m from the nearest receiver, it is anticipated that the day-time VDV criterion of 0.4 $m/s^{1.75}$ will be reached in approximately 20 minutes. For adjacent buildings other than the front row of commercial receivers on Railway Parade, directly adjacent to the works, it is anticipated that the corresponding VDV criterion will be reached within in the region of 2 hours of continuous operation near the adjacent site boundary, assuming the use of a small vibratory roller.

This assessment indicates that vibration monitoring is required at the start of works to determine the site specific vibration propagation characteristics and provide information to the construction team in relation to likely allowable working durations with the vibratory roller.

4.9.4 Heritage buildings

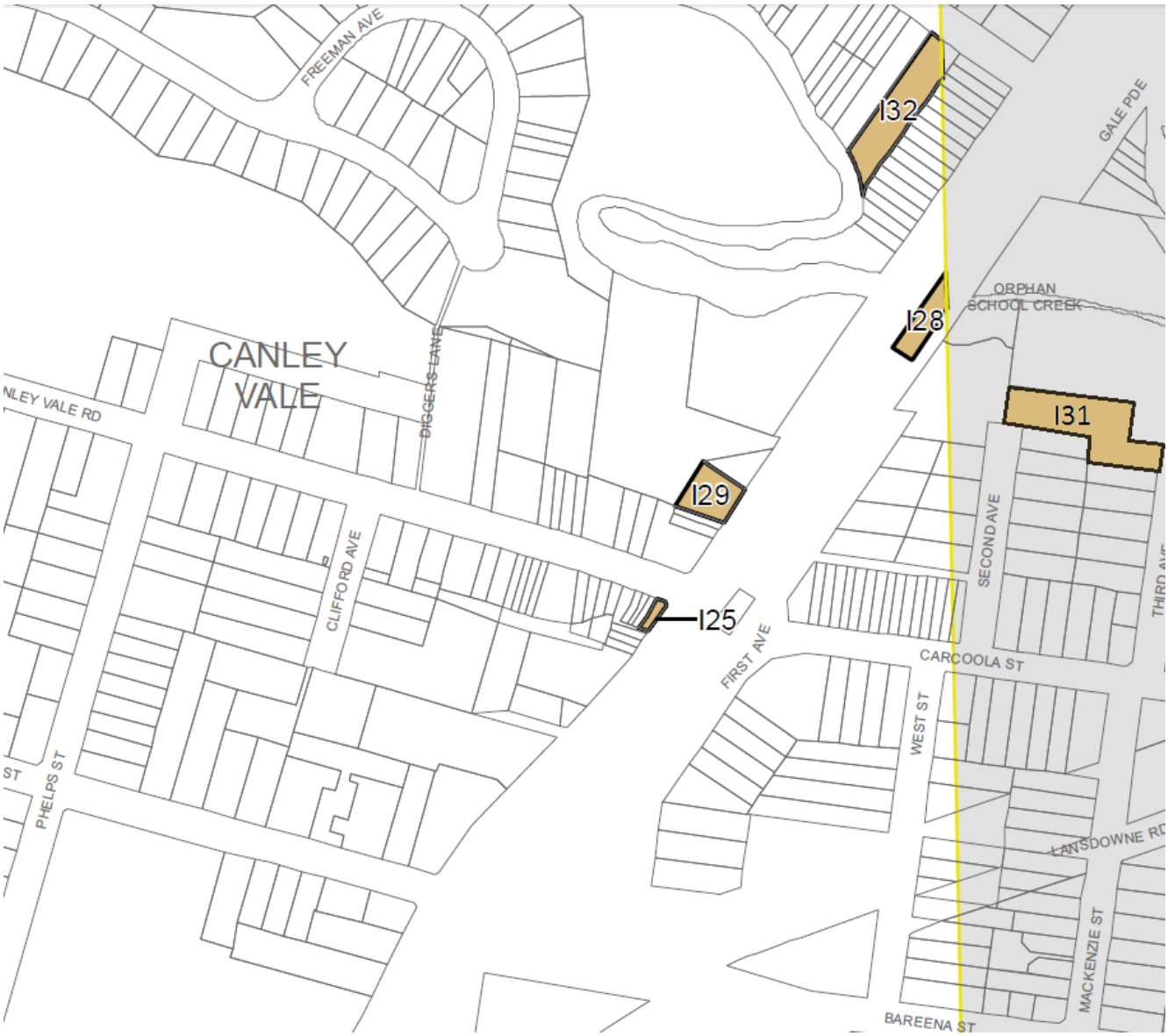
At this stage in the Proposal, the following heritage listed structures have been identified within approximately 100m of the proposed works involving vibration-generating plant described in **Section 4.9.1**. These locations are shown in **Figure 3**.

Table 13 Heritage listed structures within 100 metres of vibration generating works

LEP Designation	Address	Description
I25	2 Canley Vale Road	Corner shop
I28	Railway Parade (between Stuart Street and Canley Vale Road—Orphan School Creek)	Railway viaduct
I29	110 Railway Parade	Victorian cottage—"Westacott Cottage"
I32	1 Stuart Street	Victorian house

LEP Designation	Address	Description
I31	2 Second Avenue, Canley Vale	Temple

Figure 3 Fairfield City Council Local Environmental Plan 2013



BS 7385 states that "*a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive*".

Heritage buildings are to be considered on a case by case bases. Where a historic building is deemed to be sensitive to damage from vibration (following inspection), it is recommended to reduce the vibration criteria accordingly in line with the TfNSW CNVS. The more conservative DIN 4150 superficial cosmetic damage criteria of 2.5 mm/s should be considered for vibration sensitive structures. Where heritage buildings of a typical residential-type construction are not found to be structurally unsound, DIN 4150 superficial cosmetic damage criteria of 5 mm/s may be more suitable as a screening criterion.

Where vibration intensive works are required to be undertaken within the specified safe working distances outlined in **Section 4.3.4**, or in close proximity to vibration sensitive heritage structures such as the station building and existing footbridge, vibration monitoring should be undertaken to ensure acceptable levels of vibration are satisfied.

In relation to the heritage structures, it is recommended to limit equipment to low vibration items (ie non-vibratory rollers) when works are required within 50 m of any heritage structure. Note this is to be confirmed with site measurements to quantify the site-specific vibration levels. This could be undertaken prior to commencement of the works near any sensitive structures and include operator-attended monitoring.

At locations where the predicted and/or measured vibration levels are greater than the nominated screening levels, a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure would be required to determine the applicable safe vibration level.

5 CONSTRUCTION NOISE AND VIBRATION MITIGATION MEASURES

The construction noise and vibration predictions indicate that the proposed construction activities are likely to exceed the construction noise management levels at locations adjacent to the construction works areas. The predicted exceedances should therefore be managed in accordance with mitigation measures as detailed within this report and TfNSW procedures.

A detailed construction methodology and associated management plans (including a Construction Noise and Vibration Management Plan) should be developed during the detailed design phase of the Proposal to manage impacts.

5.1 Standard mitigation measures

Particular effort should be directed towards the implementation of all feasible and reasonable noise mitigation and management strategies as per the standard mitigation measures detailed in the ICNG.

Reference should also be made to the Transport for NSW (TfNSW) *Construction Noise and Vibration Strategy* (CNVS, version 4.1) which details a number of standard mitigation measures for construction activities likely to result in adverse noise or vibration impacts associated with infrastructure projects.

Where identified in the impact assessment, particular effort should be directed towards the implementation of all feasible and reasonable noise mitigation and management strategies, noting that additional site specific measures may also be recommended.

Standard mitigation measures which may be considered appropriate for the Proposal, as taken from the CNVS, are shown in **Table 14**.

Table 14 Recommended standard noise mitigation measures

Action required	Applies to	Details
Management measures		
Implementation of any project specific mitigation measures required	Airborne noise. Ground-borne noise and vibration	In addition to the measures set out in this table, any *project specific* mitigation measures identified in the environmental assessment documentation (eg Environmental Impact Statement, Review of Environmental Factors, submissions or representations report) or approval or licence conditions must be implemented
Implement community consultation measures	Airborne noise. Ground-borne noise and vibration	Periodic Notification (monthly letterbox drop)[1] Notifications for night/weekend noisy works Website and web based surveys Project information and construction response telephone line Social media and email distribution list Community Engagement Managers
Register of Noise Sensitive Receivers	Airborne noise Ground-borne noise and vibration	A register of all noise and vibration sensitive receivers (NSRs) would be kept on site. The register would include the following details for each NSR: • address of receiver • category of receiver (eg Residential, Commercial etc.) • contact name and phone number
Site inductions	Airborne noise Ground-borne noise and vibration	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • all relevant project specific and standard noise and vibration mitigation measures • relevant licence and approval conditions • permissible hours of work • any limitations on high noise generating activities • location of nearest sensitive receivers • construction employee parking areas • designated loading/unloading areas and procedures • site opening/closing times (including deliveries) • environmental incident procedures.
Behavioural practices	Airborne noise	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height; throwing of metal items; and slamming of doors. No excessive revving of plant and vehicle engines Refrain from idling vehicles Controlled release of compressed air.
Monitoring	Airborne noise Ground-borne noise and vibration	A noise monitoring program is to be carried out for the duration of the works in accordance with the Construction Noise and Vibration Management Plan and any approval and licence conditions.
Attended vibration measurements	Ground-borne vibration	Attended vibration measurements shall be undertaken at all buildings within 25 m of vibration generating activities when these activities commence to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage.
Building condition surveys	Vibration Blasting	Undertake building dilapidation surveys on all buildings located within the buffer zone prior to major project construction activities with the potential to cause property damage.

Action required	Applies to	Details
Construction respite period	Ground-borne noise and vibration Airborne noise	High noise and vibration generating activities[2] may only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block[3].
Construction hours and scheduling	Airborne noise Ground-borne noise and vibration	Works are only proposed to occur during Standard Construction Hours. Work generating high noise and/or vibration levels would be scheduled during less sensitive time periods.
Source controls		
Equipment selection	Airborne noise Ground-borne noise and vibration	Use quieter and less vibration emitting construction methods where feasible and reasonable.
Maximum noise levels	Airborne-noise	The noise levels of plant and equipment must have operating Sound Power Levels compliant with the criteria in Appendix C (of the CNVS).
Rental plant and equipment	Airborne-noise	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Appendix C (of the CNVS).
Plan worksites and activities to minimise noise and vibration	Airborne noise Ground-borne vibration	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.
Non-tonal reversing alarms	Airborne noise	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Minimise disturbance arising from delivery of goods to construction sites	Airborne noise	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers.
Path controls		
Shield stationary noise sources such as pumps, compressors, fans etc	Airborne noise	Stationary noise sources would be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained where necessary. Appendix F of AS 2436: 1981 lists materials suitable for shielding.
Shield sensitive receivers from noisy activities	Airborne noise	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where necessary) and consideration of site topography when situating plant.

Note 1 Detailing all upcoming construction activities at least 7 days prior to commencement of relevant works.

Note 2 Includes jack and rock hammering, sheet and pile driving, rockbreaking and vibratory rolling.

Note 3 "Continuous" includes any period during which there is less than a 60 minutes respite between ceasing and recommencing any of the work.

5.2 Additional noise mitigation measures

Additional noise mitigation measures to be explored in the CNVMPs in the event of predicted exceedances of the noise goals, particularly during Out of Hours Works (OOHWs), are described in the Transport for NSW *Construction Noise and Vibration Strategy* (CNVS). This strategy includes definition of the level of noise impact which triggers consideration of each additional mitigation measure (reproduced in **Table 15**).

The additional mitigation measures described in the CNVS are summarised below, with discussion of their potential applicability to these works. The objective of these additional noise mitigation measures is to engage, inform and provide project-specific messages to the community, recognising that advanced warning of potential disruptions can assist in reducing the impact.

- **Periodic Notifications** – Periodic notifications include regular newsletters, letterbox drops or advertisements in local papers to provide an overview of current and upcoming works and other topics of interest
- **Website** – The project website would form a resource for members of the community to seek further information, including noise and vibration management plans and current and upcoming construction activities. Community notifications and newsletters would also be uploaded on the website.
- **Project Info-line and Construction Response Line** – Transport for NSW operate a Construction Response Line and Project Info-line. These numbers provide a dedicated 24 hour contact point for any complaints regarding construction works and for any project enquiries. All complaints require a verbal response within two hours. All enquiries require a verbal response within 24 hours during standard construction hours, or on the next working day during out of hours work (unless the enquirer agrees otherwise)
- **Email Distribution List** – An email distribution list would be used to disseminate project information to interested stakeholders
- **Signage** – Signage on construction sites would be provided to notify stakeholders of project details and project emergency or enquiry information
- **Specific Notifications (SN)** – Specific notifications would be letterbox dropped or hand distributed to the nearby residences and other sensitive receivers no later than seven days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advise of unscheduled works
- **Phone Calls (PC)** – Phone calls may be made to identified/affected stakeholders within seven days of proposed work
- **Individual Briefings (IB)** – Individual briefings may be used to inform stakeholders about the impacts of high noise activities and mitigation measures that would be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities
- **Monitoring (M)** – Ongoing noise monitoring during construction at sensitive receivers during critical periods would be used to identify and assist in managing high risk noise events. Monitoring of noise would also be undertaken in response to complaints. All noise monitoring would be carried out by an appropriately trained person in the measurement and assessment of construction noise and vibration, who is familiar with the requirements of the relevant standards and procedures
- **Project Specific Respite Offer (RO)** – Residents subjected to lengthy periods of noise or vibration may be eligible for a project specific respite offer. The purpose of such an offer is to provide residents with respite from an ongoing impact

- **Alternative Accommodation (AA)** – As described in the Transport for NSW *Construction Noise Strategy*, provision of alternative accommodation for residents would be considered in the event that highly intrusive noise impacts are predicted during the night-time period (between 10pm and 7am).

Table 15 Additional mitigation measures matrix – Airborne construction noise (TfNSW Construction Noise and Vibration Strategy)

Time period	Receiver perception	dBA above RBL	dBA above NML	Additional management measures
Standard Mon-Fri (7am - 6pm) Sat (8am - 1pm) Sun/Pub Hol (Nil)	Noticeable	5 to 10	0	-
	Clearly Audible	>10 to 20	<10	-
	Moderately Intrusive	>20 to 30	>10 to 20	PN, V
	Highly Intrusive	>30	>20	PN, V
	Above 75 dBA	N/A	N/A	PN, V, SN
OOHW Period 1 Mon-Fri (6pm - 10pm) Sat (7am - 8am) & (1pm - 10pm) Sun/Pub Hol. (8am - 6pm)	Noticeable	5 to 10	<5	-
	Clearly Audible	>10 to 20	5 to 15	PN
	Moderately Intrusive	>20 to 30	>15 to 25	PN, V, SN, RO
	Highly Intrusive	>30	>25	PN, V, SN, RO, RP, DR
OOHW Period 2 Mon-Fri (10pm - 7am) Sat (10pm - 8am) Sun/Pub Hol. (6pm - 7am)	Noticeable	5 to 10	<5	PN
	Clearly Audible	>10 to 20	5 to 15	PN, V
	Moderately Intrusive	>20 to 30	>15 to 25	PN, V, SN, RP, DR
	Highly Intrusive	>30	>25	PN, V, SN, AA, RP, DR

Notes: PN = Project notification, SN = Specific notification, individual briefings, or phone call, V = Verification of monitoring, AA = Alternative accommodation, DR = Duration Reduction RO = Project specific respite offer, RP = Respite Period

5.3 Additional vibration mitigation measures

Where the vibration management levels for building damage may be exceeded, vibration monitoring should be conducted to determine site specific minimum working distances. Alternative construction methodologies may need to be considered where it is not possible to complete the works within the building damage vibration management levels. The additional mitigation measures described in the CNVS are summarised below in **Table 16**.

Table 16 Additional mitigation measures matrix – Construction vibration (TfNSW Construction Noise Strategy Revision 4)

Time Period	Receiver Perception	Vibration Management Level	Additional Management Measures
Standard Mon-Fri (7am - 6pm) Sat (8am - 1pm) Sun/Pub Hol (Nil)	Human comfort	Exceeds HVML	PN, V, RO
	Building damage	Exceeds DVML	V, AC
OOHW Period 1 Mon-Fri (6pm - 10pm) Sat (7am - 8am) & (1pm - 10pm) Sun/Pub Hol. (8am - 6pm)	Human comfort	Exceeds HVML	PN, V, SN, RO, RP, DR
	Building damage	Exceeds DVML	V, AC
OOHW Period 2 Mon-Fri (10pm - 7am) Sat (10pm - 8am) Sun/Pub Hol. (6pm - 7am)	Human comfort	Exceeds HVML	PN, V, SN, RO, AA, RP, DR
	Building damage	Exceeds DVML	V, AC

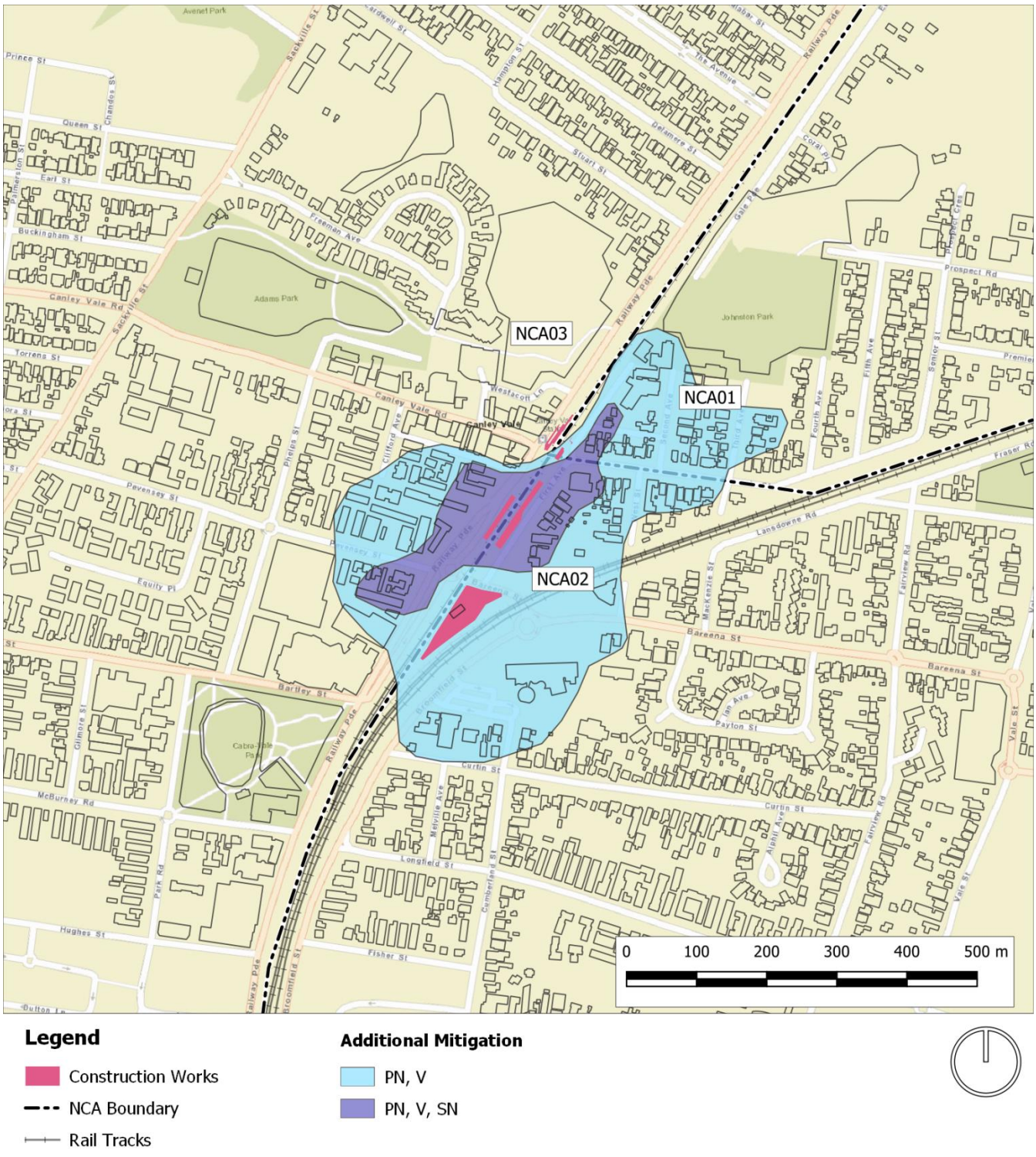
Notes: PN = Project notification SN = Specific notification, individual briefings, or phone call, V = Verification of monitoring, AA = Alternative accommodation, DR = Duration Reduction, RO = Project specific respite offer, RP = Respite Period, AC = Alternative construction methodology

5.4 Summary of additional mitigation

Based on the predicted noise levels in **Section 4.6**, additional mitigation measures as per the requirements shown in **Table 15** have been determined for works during the proposed construction hours. The extent of additional mitigation measures are representative of the worst-case construction activities with the daytime and night-time affected receiver areas shown in **Figure 4** and **Figure 5** respectively.

Respite offers and respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration projects. In this instance and where it can be strongly justified, it may be beneficial to increase the work duration, number of evenings or nights worked so that the project can be progressed and completed in a shorter timeframe. The approach to respite periods would be confirmed during preparation of the CNVMP and in consultation with the community.

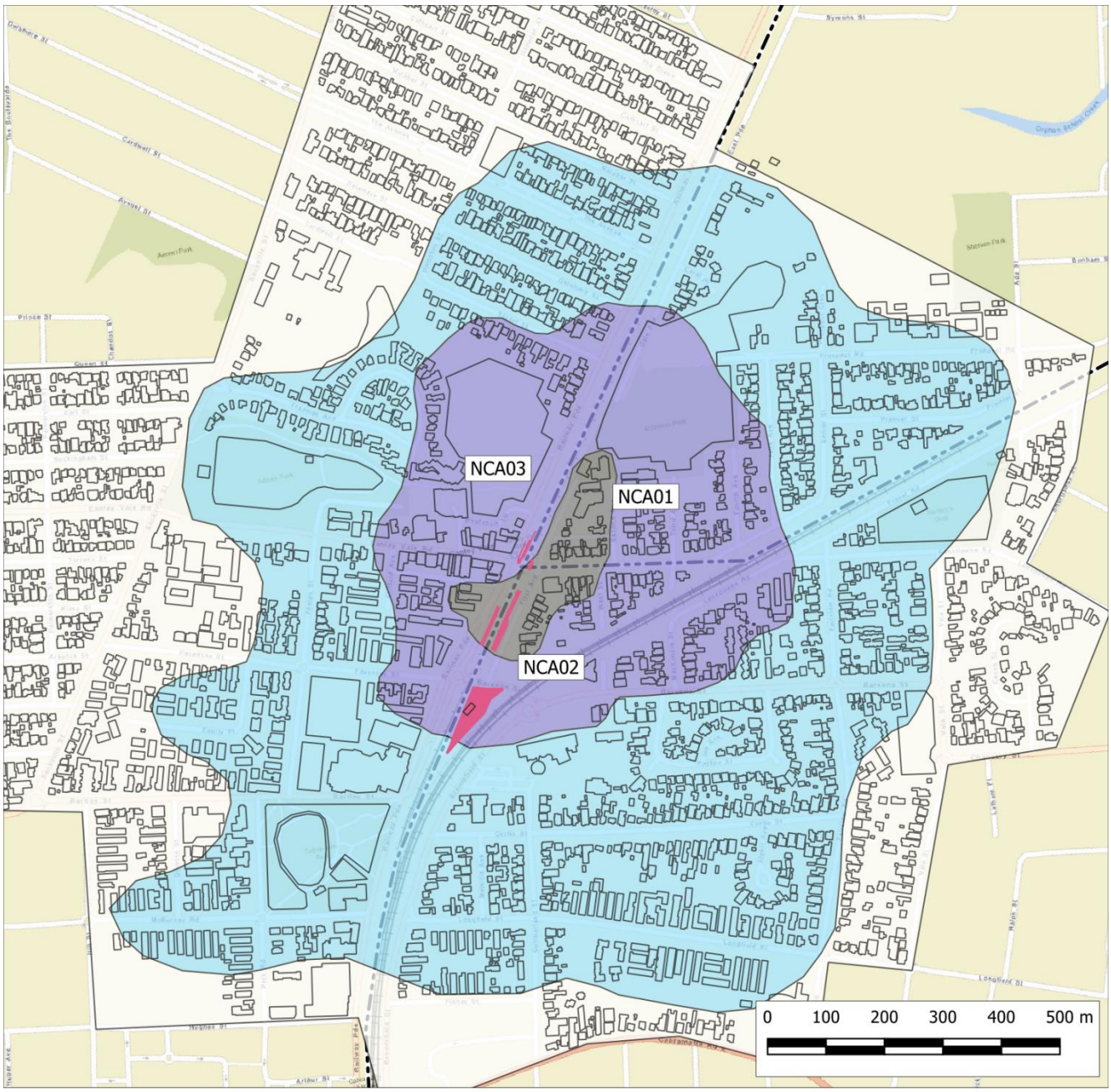
Figure 4 Additional mitigation summary - Standard daytime



Notes: PN = Project notification SN = Specific notification, individual briefings, or phone call, V = Verification of monitoring

Additional mitigation measures are required for daytime works at residential receivers surrounding Canley Vale Station. These mitigation requirements are a result of construction activities with high noise plant such as a chainsaw, chipper, concrete saw, jackhammer, or vibratory roller.

Figure 5 Additional mitigation summary - Out of hours period 2 works



Notes: PN = Project notification SN = Specific notification, individual briefings, or phone call, V = Verification of monitoring, AA = Alternative accommodation, DR = Duration Reduction, RO = Project specific respite offer, RP = Respite Period, AC = Alternative construction methodology

Additional mitigation measures are required for out of hours works at residential receivers surrounding the Proposal. These mitigation measures mostly involve project notification and verification monitoring during OOHW works periods. Receivers located to the immediate vicinity of Canley Vale Station require consideration of additional measures with multiple residential receivers qualifying for consideration of alternative accommodation during the most noise intensive OOHW works.

It is recommended that mitigation measures to minimise impacts at the surrounding educational facilities are agreed in consultation with the schools to understand key periods where activities are more sensitive to noise (eg major exam dates). Where practicable, works activities should be scheduled to minimise impacts during these times.

The extent of impacts would depend on the finalised scheduled Sydney Trains track work periods and works schedule (eg timing noise intensive plant during less sensitive periods) to be confirmed in a CNVIS for the possession activities and managed in accordance with the CNVMP.

6 Operational noise assessment

6.1 NPfI trigger noise levels

The EPA has regulatory responsibility for the control of noise from 'scheduled premises' under the *Protection of the Environment Operations Act 1997*. In implementing the NPfI, the EPA has two broad objectives:

- controlling intrusive noise levels in the short term
- maintaining noise amenity levels for particular land uses over the medium to long-term.

In general terms, the NPfI sets out procedures for establishing the project intrusiveness $L_{Aeq(15minute)}$ and project amenity $L_{Aeq(period)}$ noise levels, with a view to determining the lower (that is, the more stringent) being the Project Trigger Noise Level (PTNL), NPfI Section 2.1 states:

> *The project intrusiveness noise level aims to protect against significant changes in noise levels, whilst the project amenity noise level seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses. Applying the most stringent requirement as the project noise trigger level ensures that both intrusive noise is limited and amenity is protected and that no single industry can unacceptably change the noise level of an area.*

For assessing intrusiveness, the existing background noise generally needs to be measured. The intrusiveness trigger level essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5 dBA above the measured (or default) Rating Background Level (RBL).

The amenity assessment is based on amenity noise levels specific to the land use and associated activities. The project noise levels relate only to industrial-type noise and do not include road, rail or community-related noise. Based on the NPfI land use descriptions residences surrounding the development have been classified for the purposes of this noise assessment as 'Suburban'.

Applicable PTNLs for all noise sensitive receiver areas surrounding the Proposal have been established with reference to the NPfI and are contained in **Table 17**.

Table 17 Project Trigger Noise Levels

Type of receiver	Noise amenity area	NCA	Time of day	Measured level, dBA		Project Trigger Noise Level, dBA		
				RBL[1]	LAeq(period)	Intrusive	Amenity[2,3]	**Overall**
Residential	Suburban	NCA01 (L01)	Day	42	58	47	53	**47**
			Evening	42 (43 actual)[4]	56	47	44	**44**
			Night	35	53	40	38	**38**
		NCA02 (L02)	Day	47	60	52	53	**52**
			Evening	47 (48 actual)[4]	60	52	48	**48**
			Night	37	56	42	38	**38**
		NCA03 (L02)	Day	47	60	52	53	**52**
			Evening	47 (48 actual)[4]	60	52	48	**48**
			Night	37	56	42	38	**38**
Commercial	n/a	All	When in use	n/a	n/a	n/a	65	**65**
Childcare[5,6]	n/a	All	When in use	n/a	n/a	n/a	50	**50**
Educational[5]	n/a	All	When in use	n/a	n/a	n/a	45	**45**
Library[5,7]	n/a	All	When in use	n/a	n/a	n/a	45	**45**
Place of worship[5]	n/a	All	When in use	n/a	n/a	n/a	50	**50**
Passive recreation	n/a	All	When in use	n/a	n/a	n/a	50	**50**
Active recreation	n/a	All	When in use	n/a	n/a	n/a	55	**55**

Note 1: RBL = Rating Background Level.

Note 2: The recommended amenity noise levels have been reduced by 5 dB to give the project amenity noise levels due to other sources of industrial noise being present in the area, as outlined in the NPfI.

Note 3: The project amenity noise levels have been converted to a 15 minute level by adding 3 dB, as outlined in the NPfI.

Note 4: RBL reduced to be no higher than the daytime RBL.

Note 5: The criterion is specified as an internal noise level for this receiver category. As the noise model predicts external noise levels, it has been conservatively assumed that all schools and places of worship have openable windows and external noise levels are therefore 10 dB higher than the corresponding internal level, which is generally considered representative of windows being partially open for ventilation.

Note 6: The NPfI and AS2107 do not provide specific guideline noise levels for childcare centres, as such an internal criteria of 40 dBA $L_{Aeq(15minute)}$ has been adopted.

Note 7: The NPfI does not provide specific guideline noise levels for libraries, as such an internal criteria of 45 dBA has been adopted from AS2107.

6.2 Operational noise sources

The key identified fixed noise sources associated with the station upgrade include new station lifts. The indicative positions of the lifts are displayed in **Figure 6**.

Figure 6 Position of New Mechanical Plant

6.3 Operational noise source management

At this stage of the design specific lift systems have not been selected, which means it is too early to assess compliance with the applicable noise criteria. However given this type of noise source generally has relatively low noise emissions, it an anticipated that the lift system designs could be relatively easily mitigated if required during the detailed phase of the Proposal through the selection of appropriate equipment. The applicable criteria for operational noise from the new station lifts is shown in **Table 17**.

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other less-obtrusive noise sources at the same level. To account for this additional annoyance, the NPfI describes modifying factors to be applied when assessing amenity and intrusiveness. It assumed that the new noise sources would not exhibit these characteristics if designed and constructed in accordance with industry best practice procedures.

The station upgrade has potential for minor modifications to existing noise producing plant such as the relocation of HVAC system components. Given that the specifications for new mechanical plant and reconfigurations of existing plant will not be available or finalised until the detailed design phase of the Proposal, this assessment is limited to setting the applicable noise criteria. Compliance with the criteria would be assessed at the detailed design phase of the Proposal and form part of the detailed design documentation.

Cumulative noise impacts from all station noise sources should be assessed in the detailed design stage when selecting specific equipment locations and models for the lift facilities.

APPENDIX A

Acoustic Terminology

1 Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that in common usage 'noise' is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or L_P are commonly used to represent Sound Pressure Level. The symbol L_A represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB(lin) or dB.

3 Sound Power Level

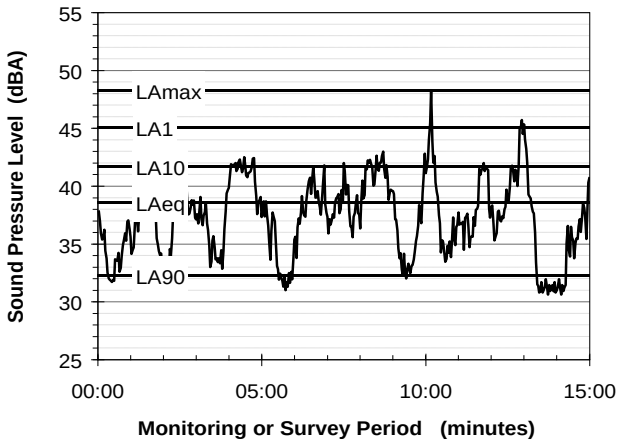
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or L_W, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

L_{A1} The noise level exceeded for 1% of the 15 minute interval.

L_{A10} The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

L_{A90} The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

L_{Aeq} The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the 'repeatable minimum' L_{A90} noise level over the daytime and night-time measurement periods, as required by the EPA. In addition, the method produces mean or 'average' levels representative of the other descriptors (L_{Aeq}, L_{A10}, etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than 'broad band' noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

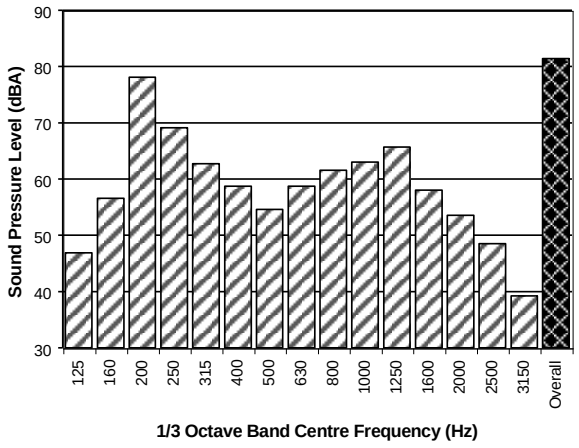
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/V_o), where V_o is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used by some organisations.

9 Human Perception of Vibration

People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

10 Over-Pressure

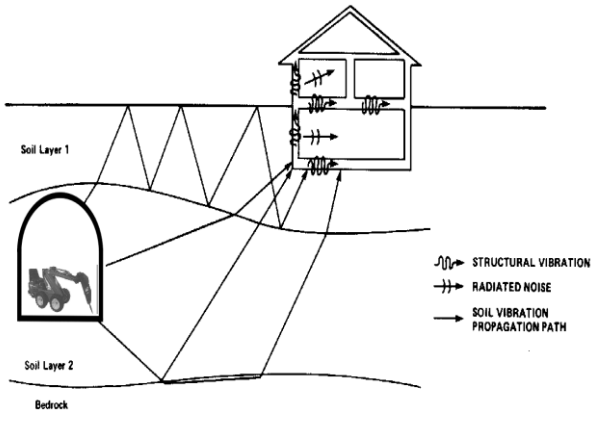
The term 'over-pressure' is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11 Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise

APPENDIX B

Ambient Noise Monitoring Results

Noise Monitoring Location	L.01
Noise Monitoring Address	**161 Carcoola Street, Canley Vale**

Logger Device Type: Svantek 957, Logger Serial No: 20664
Sound Level Meter Device Type: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3004636

Ambient noise logger deployed at residential address 161 Carcoola Street, Birrong. Logger located south-west corner of front yard with partial view of the Canley Vale Station to the west

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from Carcoola Street to the south and First Avenue to the west. Rail noise at Canley Vale Station, heavy traffic on Railway Parade to the west of the rail line, and a regular light aircraft flight path also contribute to the ambient noise at this location.

Recorded Noise Levels (L_{Amax}):
14/10/2019: Light-vehicle passby: 58-62 dBA, Heavy-vehicle passby: 70-78 dBA, Horn: 80 dBA,
Train passby: 52-53 dBA, Aircraft: 52-57 dBA, Traffic on Railway Pde: 44-46 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	L_{Aeq}	L_{10}	L_1
Daytime	42	58	60	67
Evening	43	56	59	66
Night-time	35	53	51	63

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	$L_{Aeq(period)}$	$L_{Aeq(1hour)}$
Daytime (7am-10pm)	57	59
Night-time (10pm-7am)	53	59

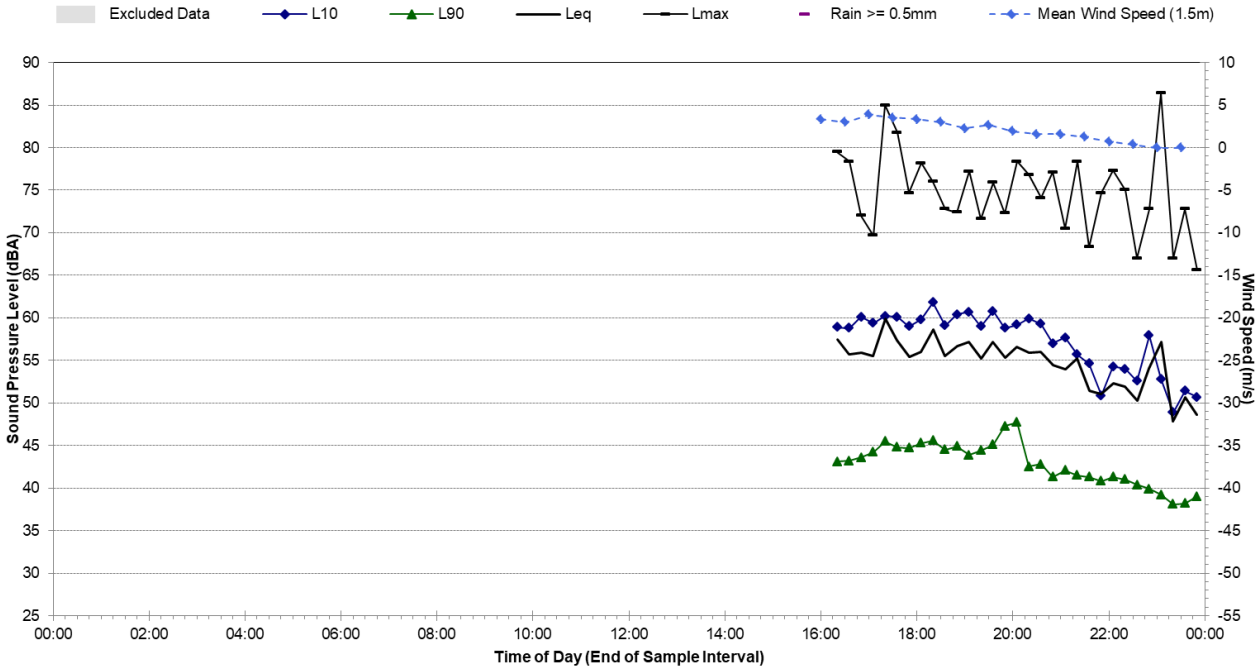
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		L_{A90}	L_{Aeq}	L_{Amax}
14/10/2019	15:16	46	59	80

Photo of Noise Monitoring Location

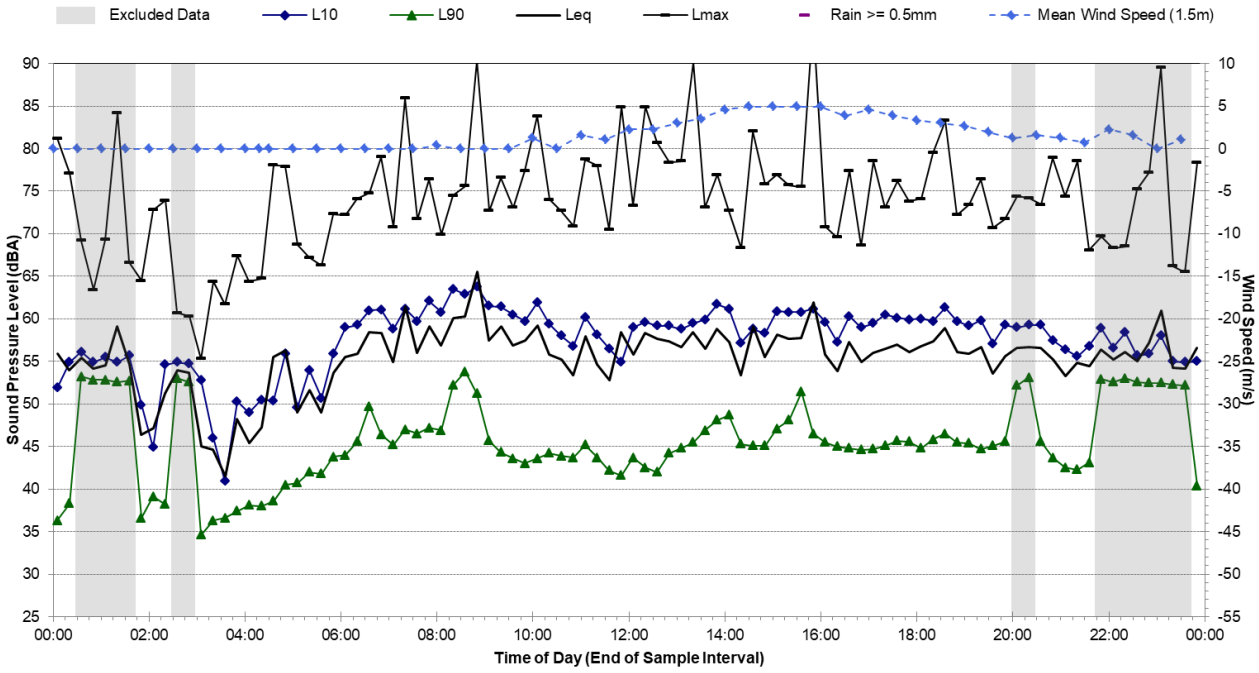
Statistical Ambient Noise Levels

L01 - 161 Carcoola Street, Canley Vale - Monday, 14 October 2019



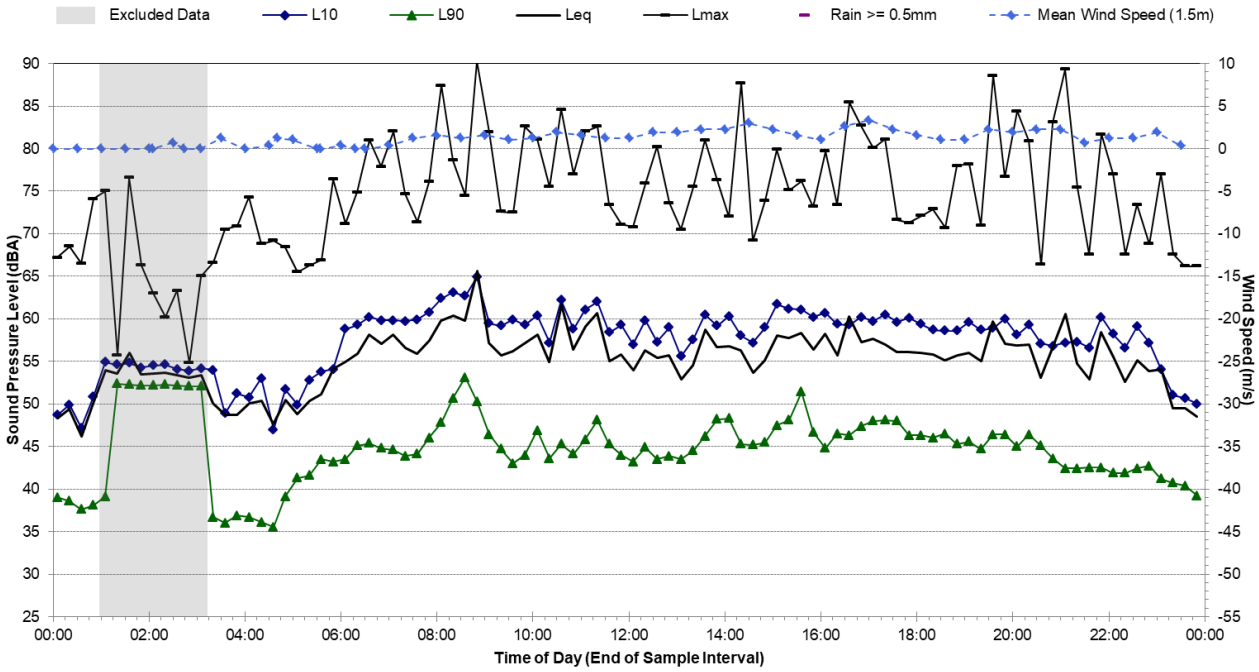
Statistical Ambient Noise Levels

L01 - 161 Carcoola Street, Canley Vale - Tuesday, 15 October 2019



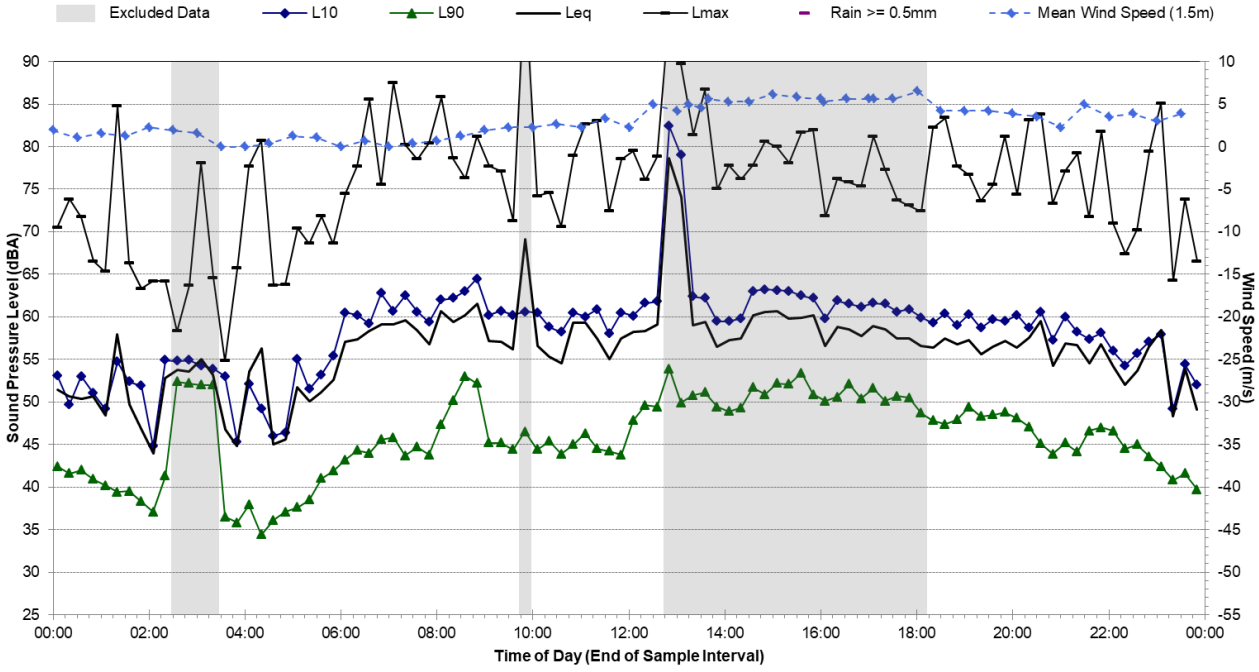
Statistical Ambient Noise Levels

L01 - 161 Carcoola Street, Canley Vale - Wednesday, 16 October 2019



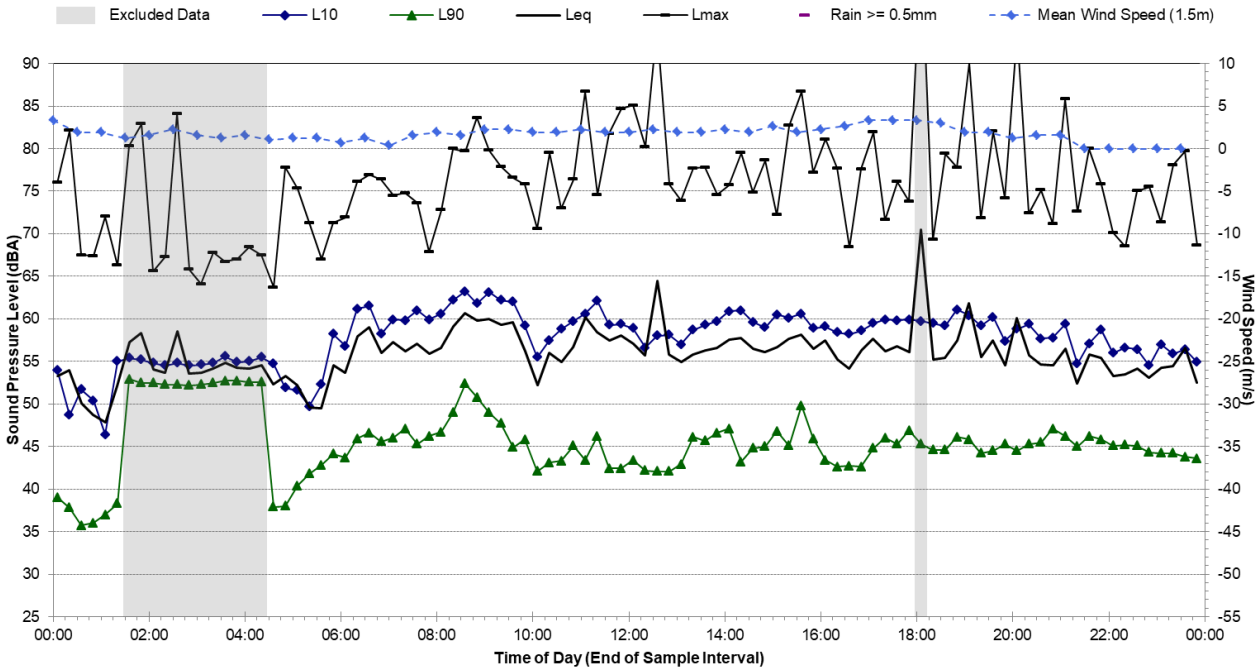
Statistical Ambient Noise Levels

L01 - 161 Carcoola Street, Canley Vale - Thursday, 17 October 2019



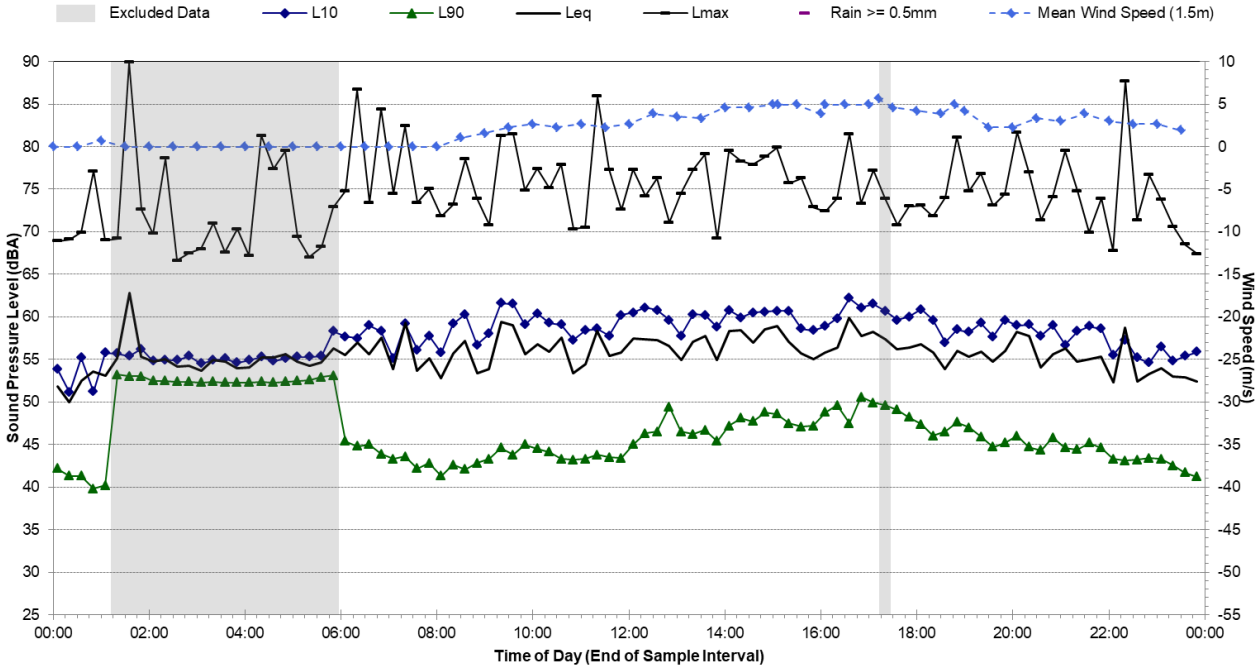
Statistical Ambient Noise Levels

L01 - 161 Carcoola Street, Canley Vale - Friday, 18 October 2019



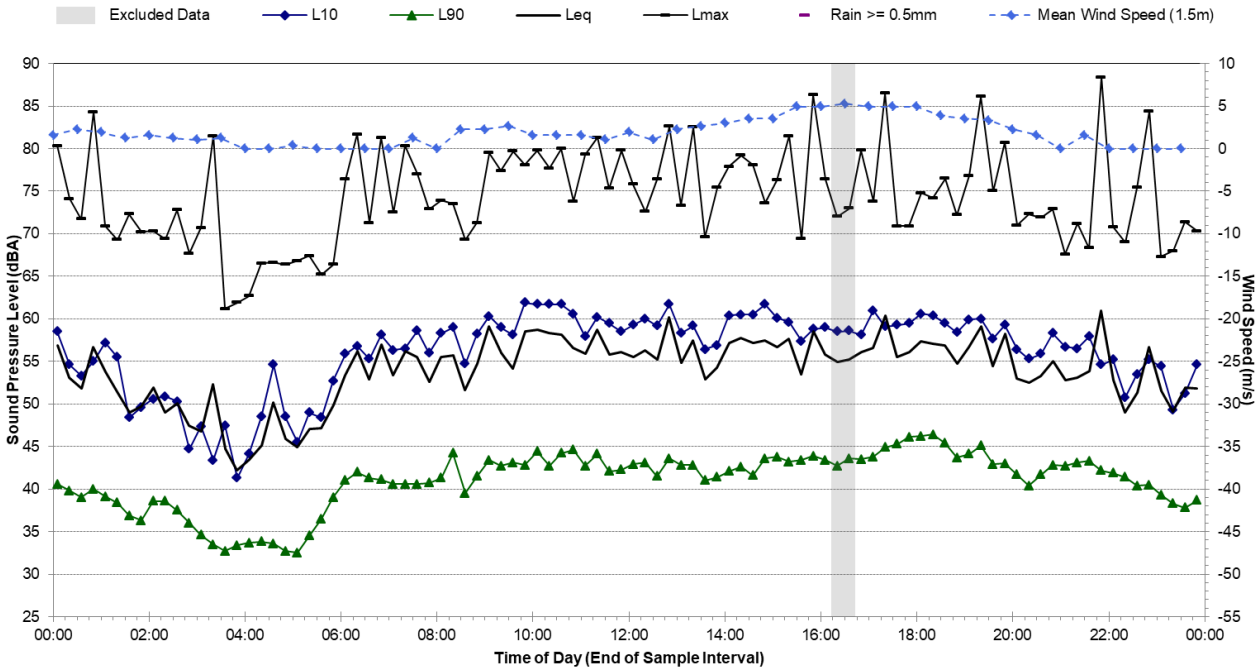
Statistical Ambient Noise Levels

L01 - 161 Carcoola Street, Canley Vale - Saturday, 19 October 2019



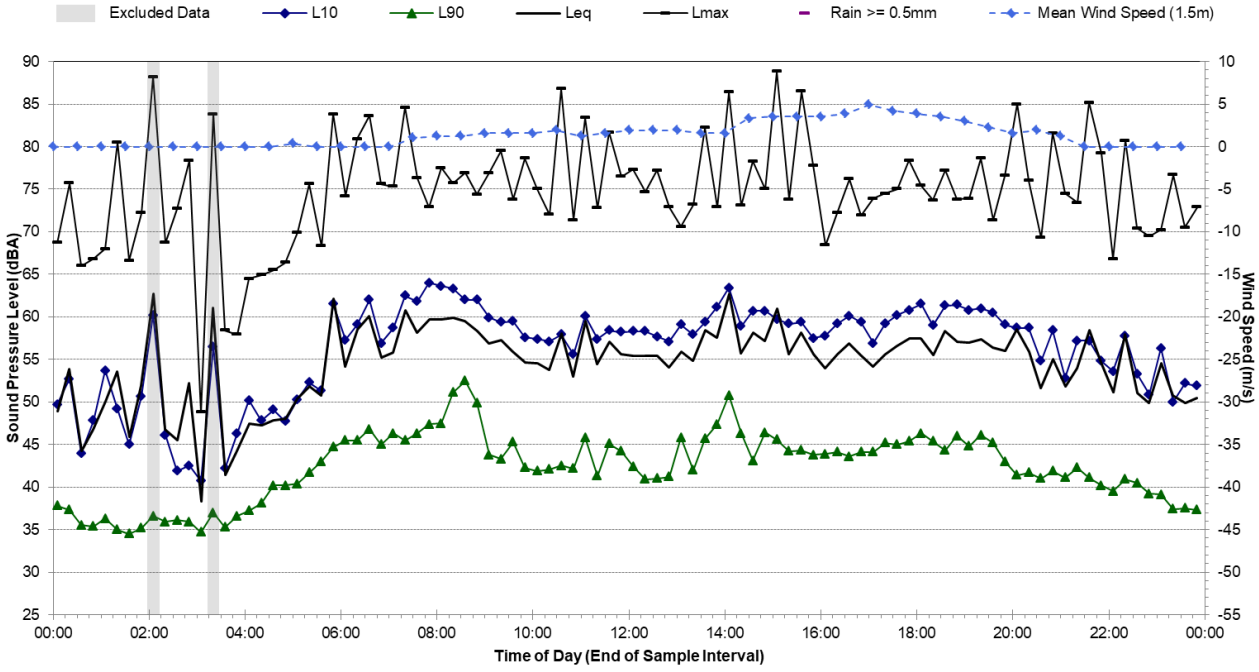
Statistical Ambient Noise Levels

L01 - 161 Carcoola Street, Canley Vale - Sunday, 20 October 2019



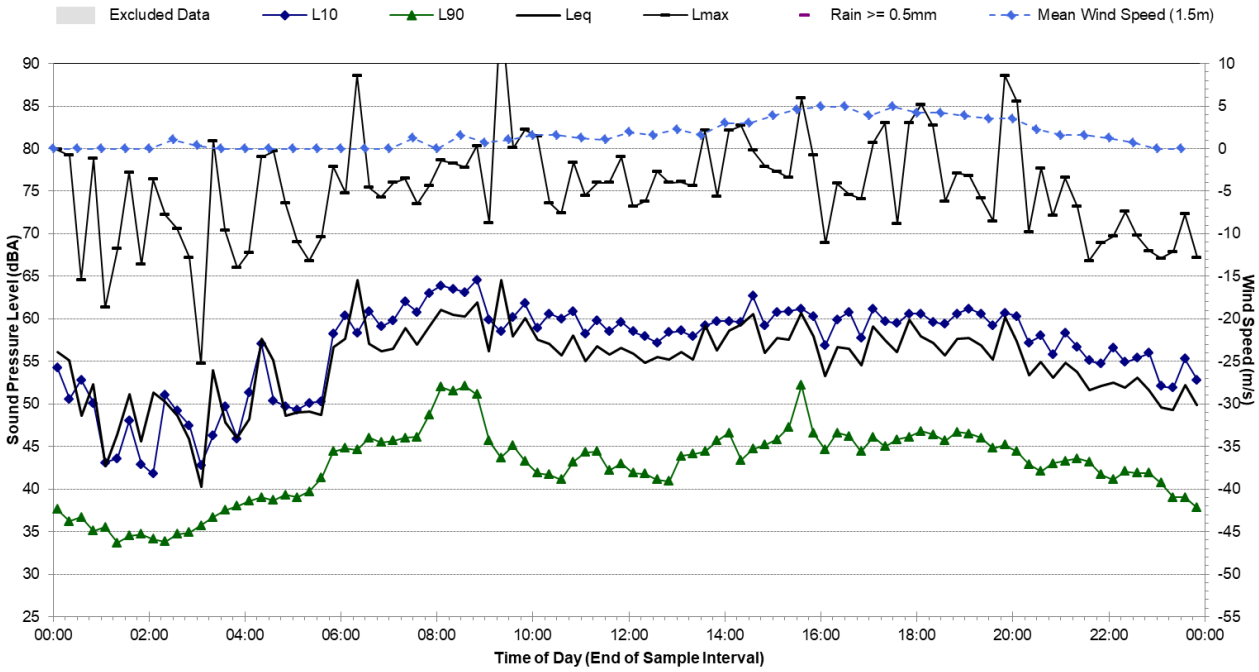
Statistical Ambient Noise Levels

L01 - 161 Carcoola Street, Canley Vale - Monday, 21 October 2019



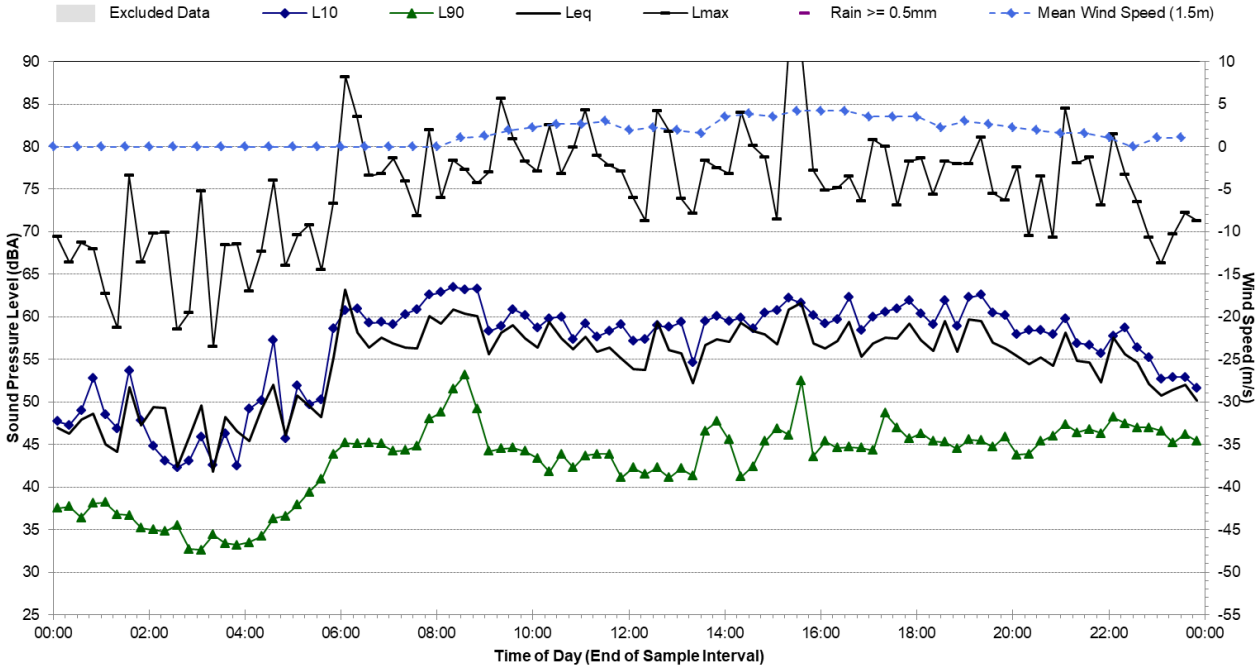
Statistical Ambient Noise Levels

L01 - 161 Carcoola Street, Canley Vale - Tuesday, 22 October 2019



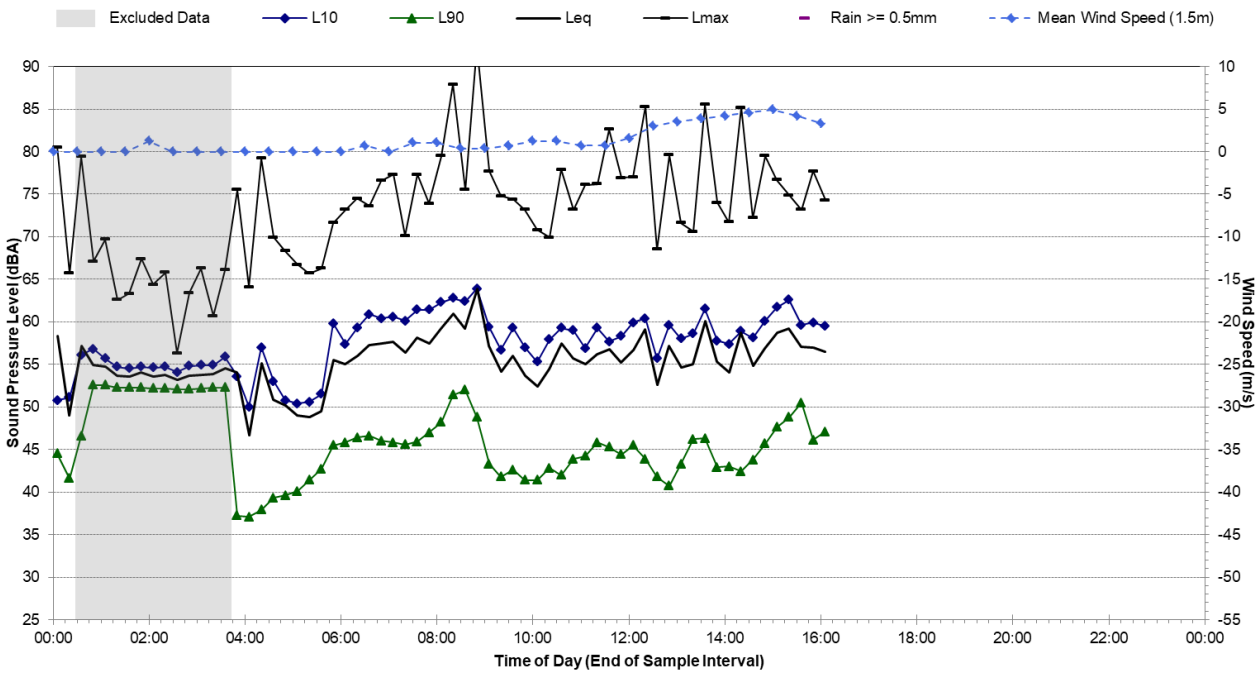
Statistical Ambient Noise Levels

L01 - 161 Carcoola Street, Canley Vale - Wednesday, 23 October 2019



Statistical Ambient Noise Levels

L01 - 161 Carcoola Street, Canley Vale - Thursday, 24 October 2019



Noise Monitoring Location	L.02
Noise Monitoring Address	**20 First Avenue, Canley Vale**

Logger Device Type: Svantek 957, Logger Serial No: 23244
Sound Level Meter Device Type: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3004636

Ambient noise logger deployed at residential address 20 First Avenue, Birrong. Logger located in front yard with direct view of Canley Vale Station to the north and First Avenue to the west.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from First Avenue to the west and rail noise surrounding Canley Vale Station. Heavy traffic on Railway Parade to the west of the rail line and a regular light aircraft flight path also contribute to the ambient noise at this location.

Recorded Noise Levels (L_{Amax}):
14/10/2019: Light-vehicle passby: 60-65 dBA, Heavy-vehicle passby: 72-75 dBA, Train passby: 64-65 dBA, Aircraft: 60-62 dBA, Traffic on Railway Pde: 52-55 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L_{10}	L_1
Daytime	47	60	63	68
Evening	48	60	64	69
Night-time	37	56	58	67

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	60	61
Night-time (10pm-7am)	57	61

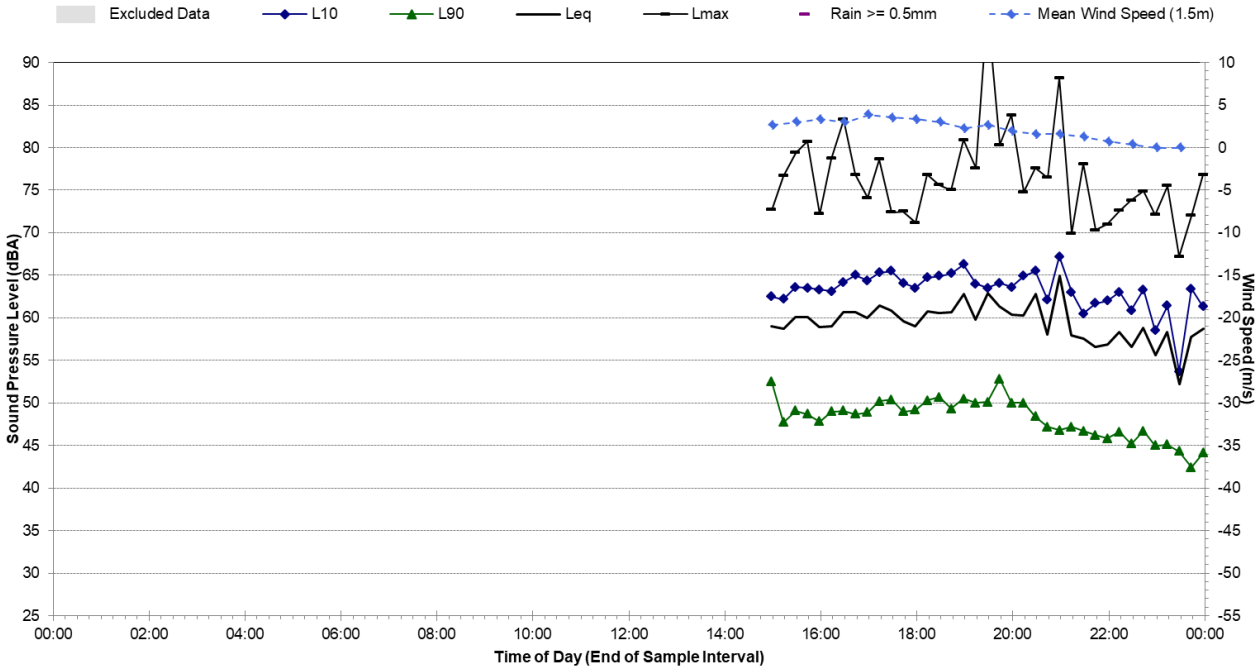
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
14/10/2019	14:21	50	59	82

Photo of Noise Monitoring Location

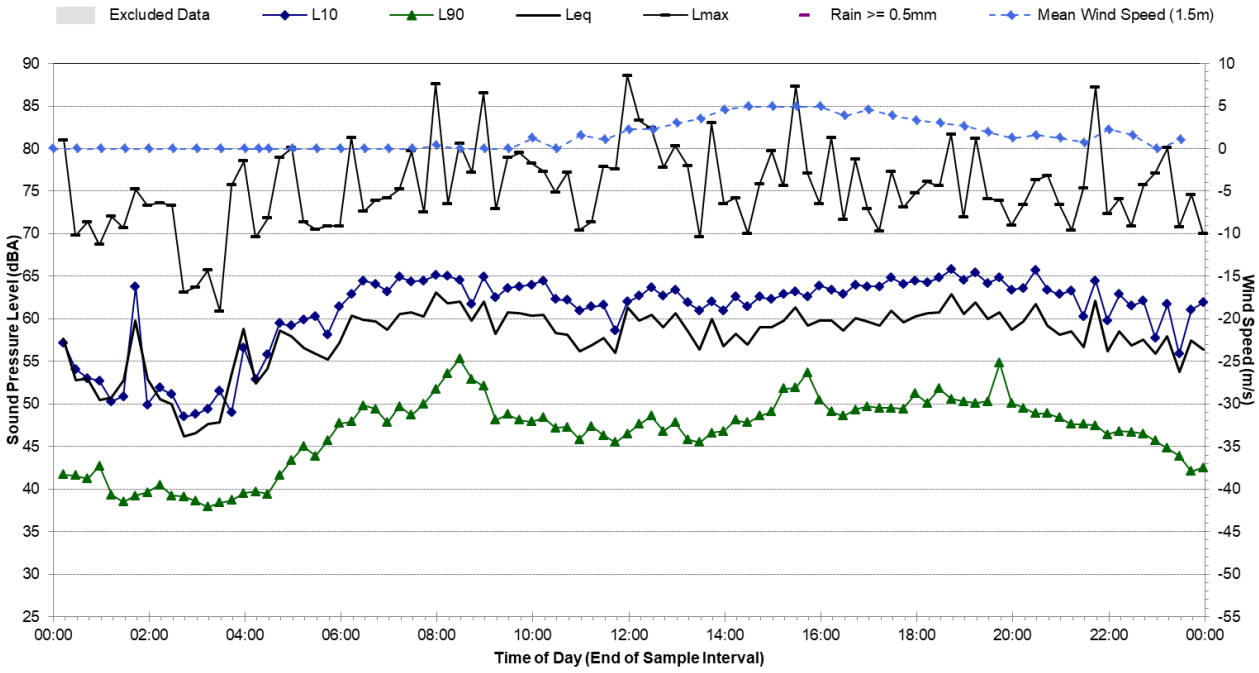
Statistical Ambient Noise Levels

L02 - 20 First Avenue, Canley Vale - Monday, 14 October 2019



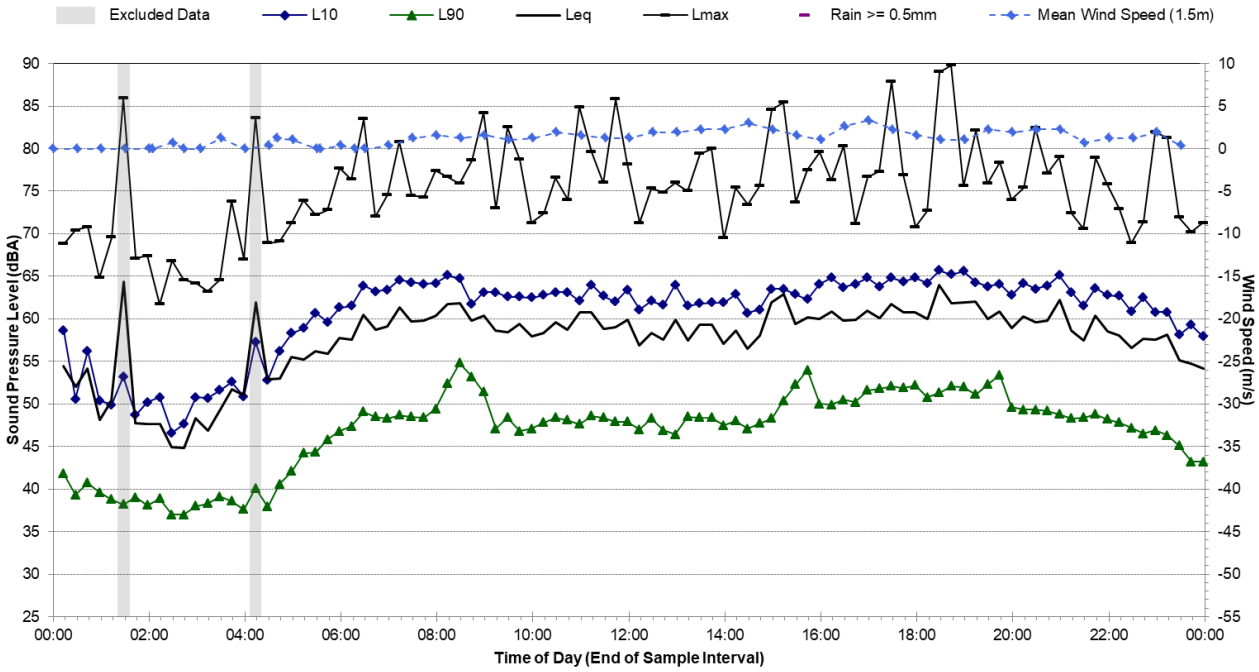
Statistical Ambient Noise Levels

L02 - 20 First Avenue, Canley Vale - Tuesday, 15 October 2019



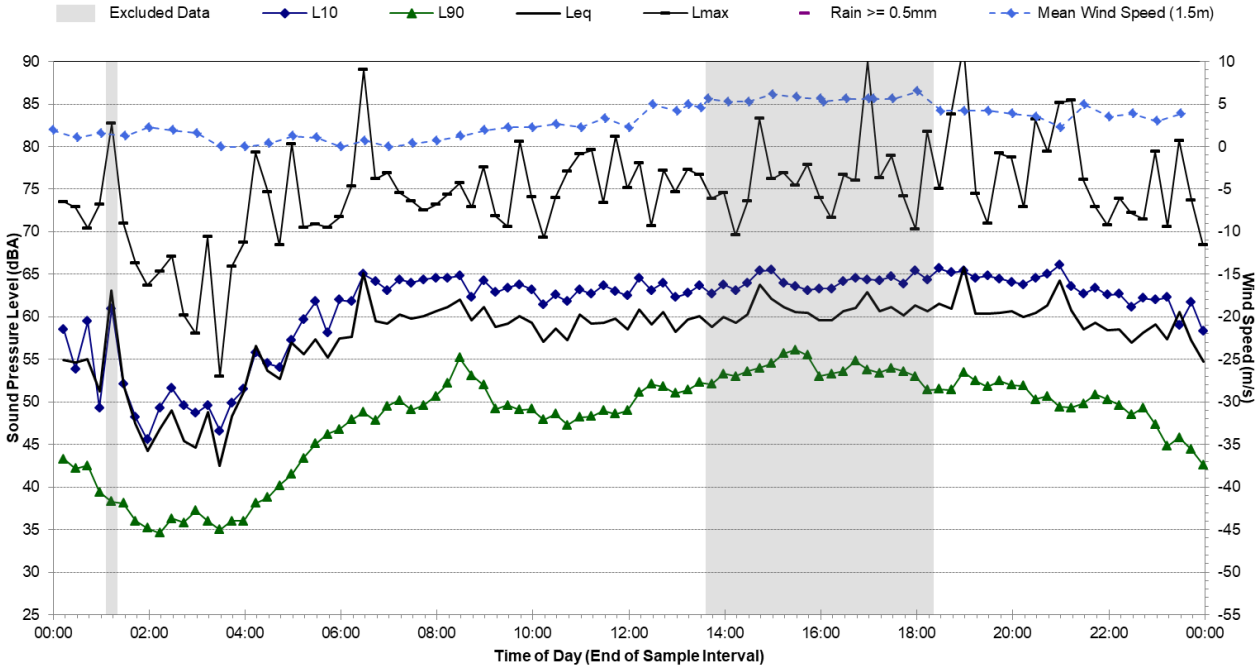
Statistical Ambient Noise Levels

L02 - 20 First Avenue, Canley Vale - Wednesday, 16 October 2019



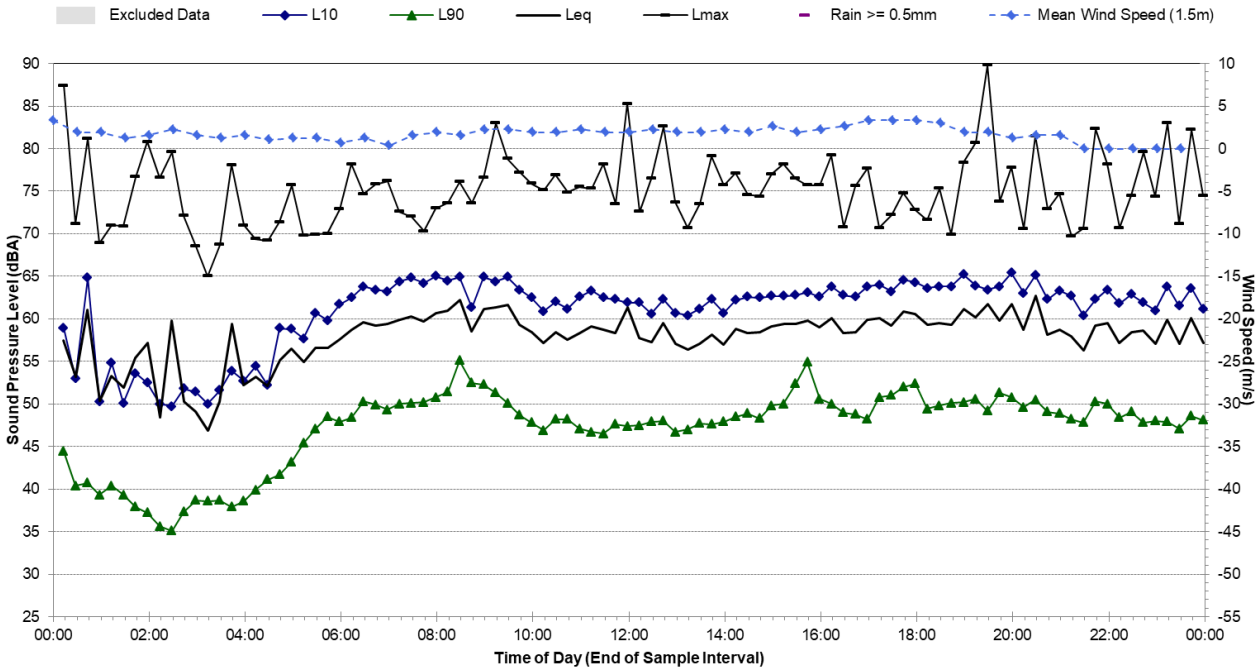
Statistical Ambient Noise Levels

L02 - 20 First Avenue, Canley Vale - Thursday, 17 October 2019



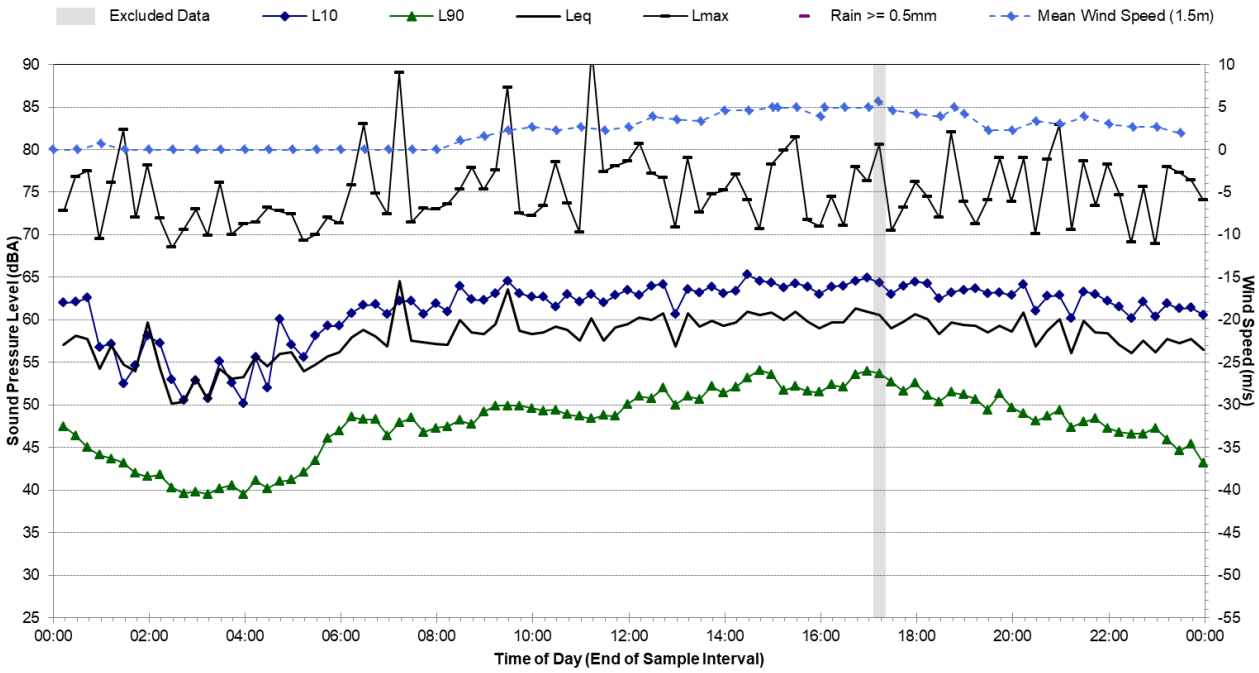
Statistical Ambient Noise Levels

L02 - 20 First Avenue, Canley Vale - Friday, 18 October 2019



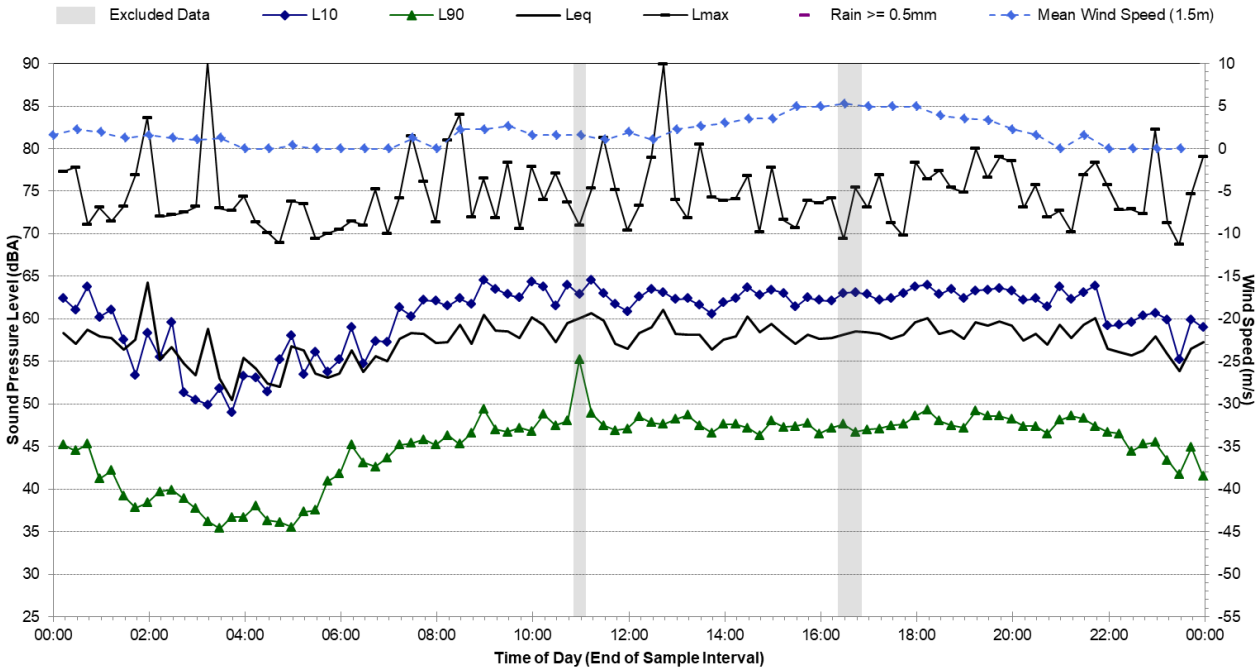
Statistical Ambient Noise Levels

L02 - 20 First Avenue, Canley Vale - Saturday, 19 October 2019



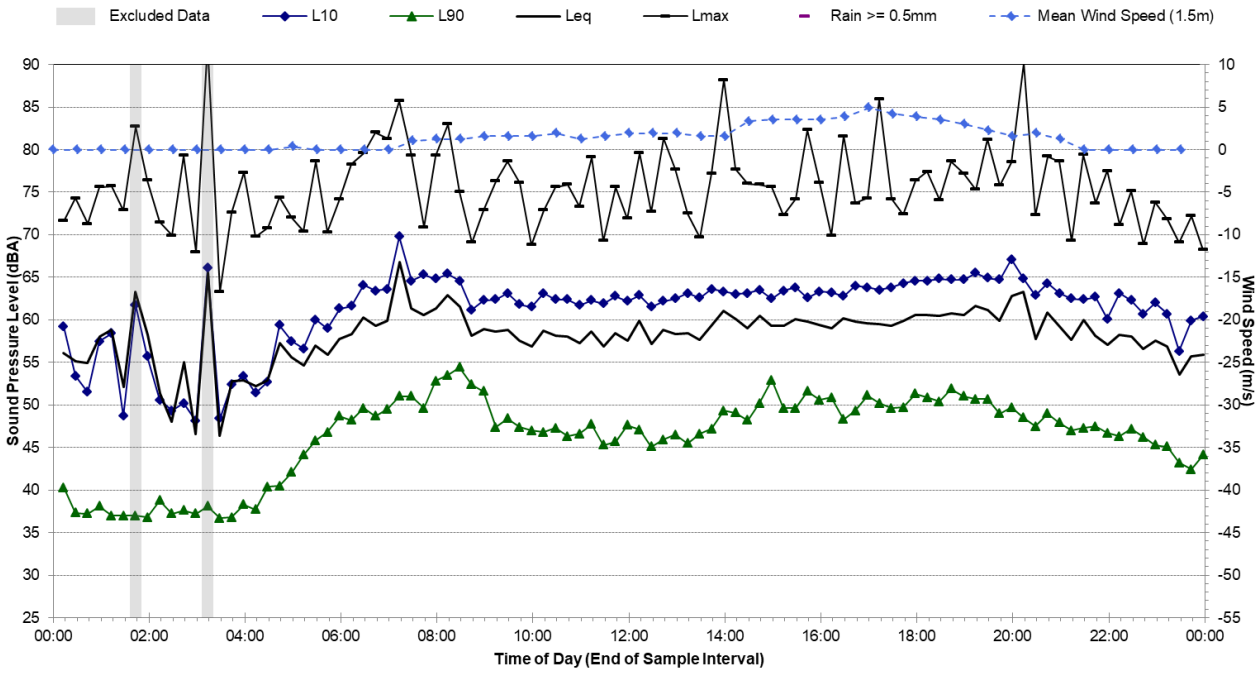
Statistical Ambient Noise Levels

L02 - 20 First Avenue, Canley Vale - Sunday, 20 October 2019



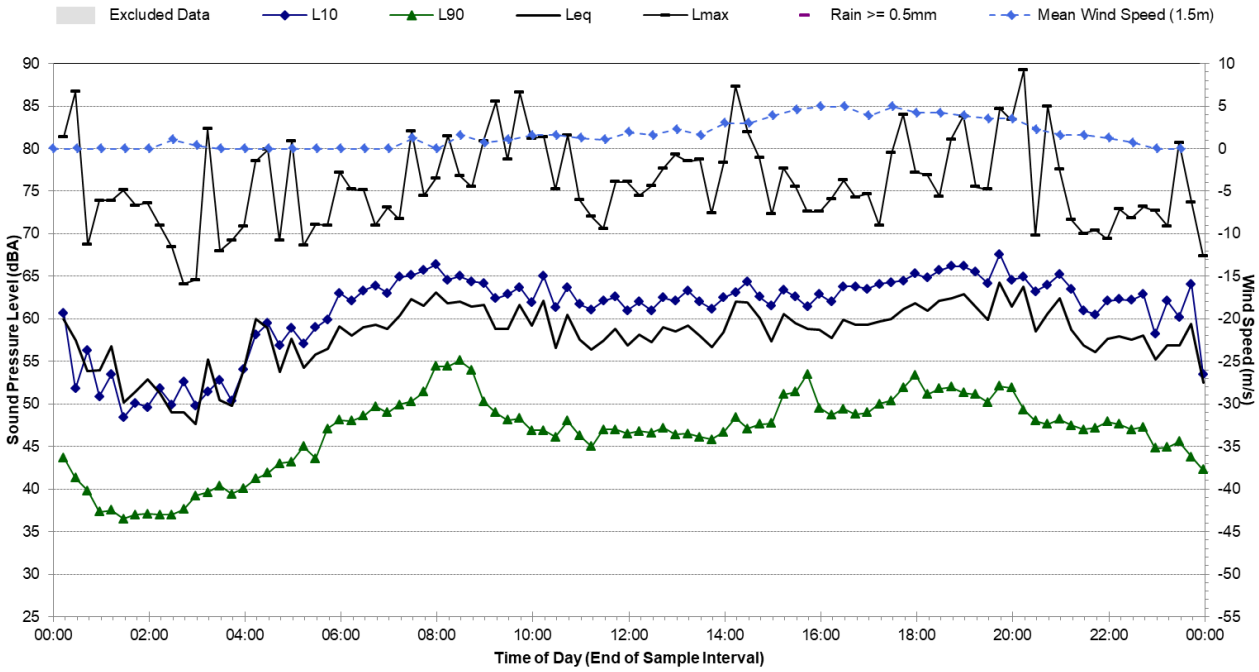
Statistical Ambient Noise Levels

L02 - 20 First Avenue, Canley Vale - Monday, 21 October 2019



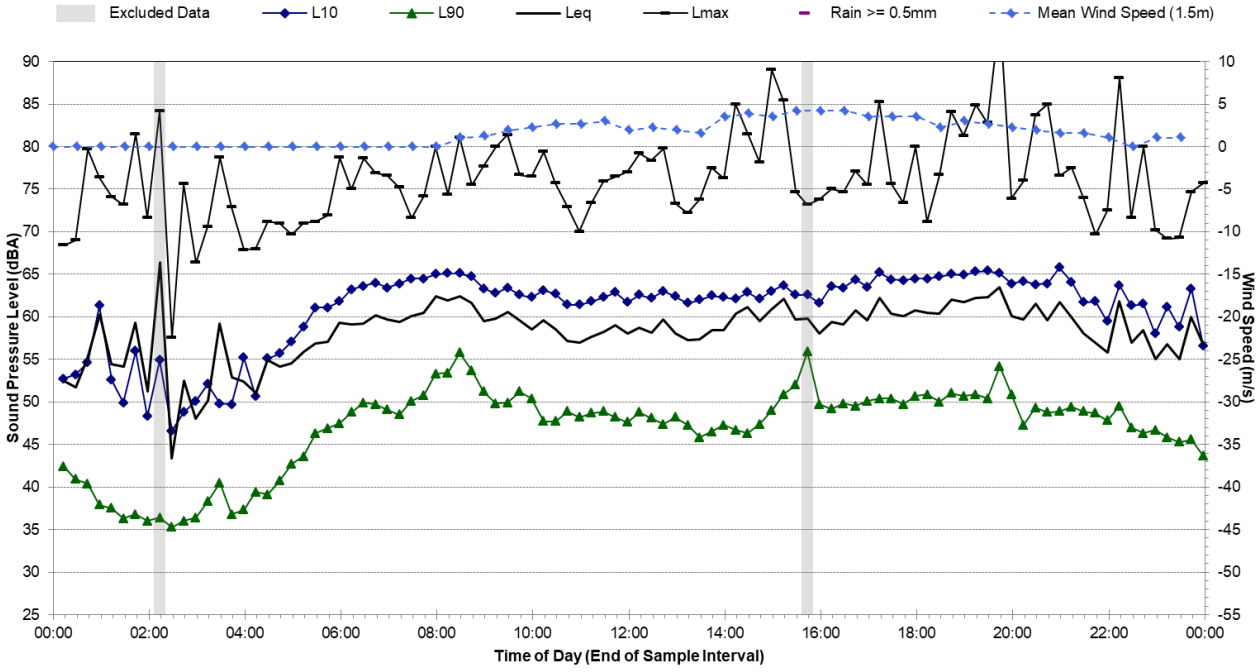
Statistical Ambient Noise Levels

L02 - 20 First Avenue, Canley Vale - Tuesday, 22 October 2019



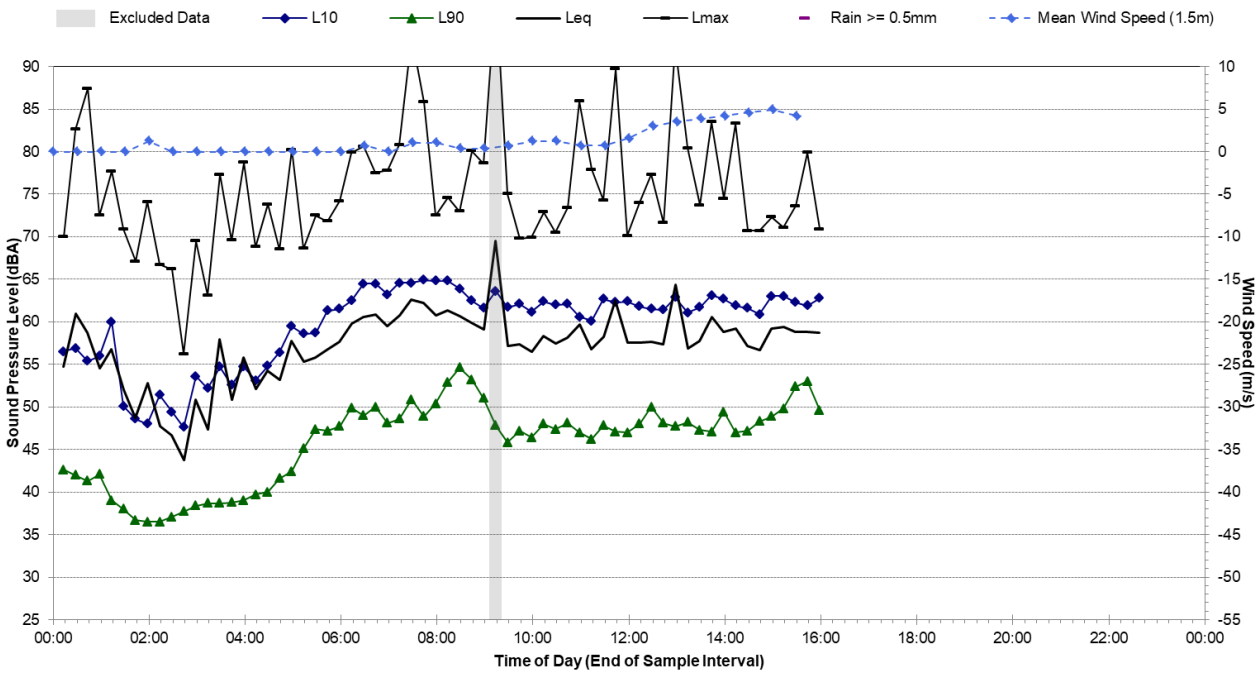
Statistical Ambient Noise Levels

L02 - 20 First Avenue, Canley Vale - Wednesday, 23 October 2019



Statistical Ambient Noise Levels

L02 - 20 First Avenue, Canley Vale - Thursday, 24 October 2019



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