

PDP FOR EASING SYDNEY CONGESTION WAKEHURST PARKWAY IMPROVEMENTS - FRENCHS FOREST TO NARRABEEN - CONCEPT DESIGN NOISE AND VIBRATION IMPACT ASSESSMENT

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Noise and Vibration Impact Assessment

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1 INTRODUCTION

1.1 Background

Transport for NSW (TfNSW) has engaged SustainJV to undertake a Noise and Vibration Impact Assessment (NVIA) for the proposed Wakehurst Parkway Improvements between Frenchs Forest and Narrabeen, in the Northern Beaches Council local government area (LGA) ('the proposal'), as part of the Easing Sydney's Congestion Program (ESC).

This report presents the results of the assessment and has been prepared to support and inform the Review of Environmental Factors (REF) for the proposal.

1.2 Purpose of this Report

The objective of this Noise and Vibration Impact Assessment (NVIA) is to assess potential noise and vibration impacts associated with the construction and operation of the Wakehurst Parkway Improvements proposal. This NVIA is being prepared as an input into the Review of Environmental Factors (REF) for the Wakehurst Parkway Improvements proposal.

1.2.1 Scope

The scope of this NVIA includes:

- Assessment of existing road traffic noise levels and background noise levels by undertaking long term noise monitoring at two locations
- Review of the proposed construction methodology and identify potential construction equipment
- Assessment of potential construction noise impacts
- Assessment of potential construction vibration impacts
- Assessment of potential operational noise impacts
- Provision of mitigation and measurement measures where suitable
- Preparation of a report summarising the findings of the NVIA.

1.2.2 Limitations

This report has been prepared by SustainJV for Transport for NSW and may only be used and relied on by Transport for NSW for the purpose agreed between SustainJV and Transport for NSW.

SustainJV otherwise disclaims responsibility to any person other than Transport for NSW arising in connection with this report. SustainJV also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by SustainJV in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. SustainJV has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by SustainJV described in this report. SustainJV disclaims liability arising from any of the assumptions being incorrect.

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The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Conditions at other parts of the proposed footprint may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

1.3 Key features of the proposal

The Wakehurst Parkway Improvements – Frenchs Forest to Narrabeen Project seeks to improve safety and capacity of Wakehurst Parkway, between Frenchs Forest Road and Pittwater Road.

The proposal area comprises sections along Wakehurst Parkway from Trefoil Creek to Dreadnought Road and Dreadnought Road to Oxford Falls Road (Southern section), and Elanora Road to Mirrool Street (Northern section).

Key features of the proposal include the following:

Wakehurst Parkway from Trefoil Creek to Dreadnought Road

- Widening of Wakehurst Parkway southbound between Trefoil Creek and Dreadnought Road to provide an additional southbound lane (resulting in two continuous southbound lanes from Oxford Falls Road to Frenchs Forest Road).

Wakehurst Parkway from Dreadnought Road to Oxford Falls Road

- Widening of Wakehurst Parkway on the northbound approach to the Dreadnought Road intersection to accommodate a longer shared through and left turn lane, the new concrete median and new shoulders
- Widening of Wakehurst Parkway to the west of the northbound lane from Dreadnought Road to Oxford Falls Road to accommodate an additional lane in each direction. The northbound kerbside lane would become a dedicated left turn on approach to the Oxford Falls Road intersection
- Widening of Oxford Falls Road intersection in the southwest corner to accommodate the new dedicated left turn lane from Wakehurst Parkway northbound
- Extension of the existing right turn bay on Wakehurst Parkway southbound onto Dreadnought Road to provide additional storage capacity
- Construction of new left turn slip lane from Wakehurst Parkway southbound onto Dreadnought Road with a pedestrian island and signalised pedestrian crossing at the north-eastern corner of the intersection
- Installation of a dedicated right turn bay from Wakehurst Parkway southbound onto Oxford Falls Road
- Construction of a rock cutting wall on Wakehurst Parkway southbound, opposite Oxford Falls Road intersection
- Installation of a new northbound bus bay north of the Dreadnought Road intersection, on Wakehurst Parkway
- Installation of a new southbound bus bay north of the Dreadnought Road intersection, at the end of the new left turn slip lane onto Dreadnought Road
- Installation of signalised pedestrian crossings on the western, eastern and southern legs of the Dreadnought Road intersection.

Wakehurst Parkway from Elanora Road to Mirrool Street

- Localised widening of Wakehurst Parkway southbound at the Mirrool Street intersection to allow through traffic to pass vehicles waiting to turn right into Mirrool Street

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- Widening of Wakehurst Parkway northbound between Elanora Road and Mirrool Street to accommodate a new left turn bay
- Conversion of the existing kerbside through lane on northbound approach to Elanora Road into a dedicated left turn lane
- Banning right turn movements into or out of the parallel service road (near Palm Terrace) at the intersection with Wakehurst Parkway, converting the intersection to left-in and left-out only.

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1.4 Glossary and Terms

The glossary and terms used throughout this report are summarised in Table 1-1.

Table 1-1: Glossary and Terms

Acronym	Name
dB	Decibel is the unit used for expressing the sound pressure level or sound power level (SWL) in acoustics
dBA	Decibel expressed with the frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at low and high frequencies.
CNVG	Construction Noise and Vibration Guideline (for road and maritime works)
ICNG	Interim Construction Noise Guideline
NCA	Noise catchment area
NML	Noise management level
NVSR	Noise and Vibration Sensitive Receiver
OOHW	Out-of-hours works
RBL	Rating Background Level. The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period
RNCG	Road Noise Criteria Guideline
TfNSW	Transport for NSW

1.5 Assumptions

- This report is being prepared based on the agreed methodology provided in the Wakehurst Parkway Approved Work Order.
- Additionally, TfNSW have requested that long term noise monitoring be conducted to quantify existing road traffic noise levels and determine RBL levels.
- The measured background noise levels are not proposed for use in the construction noise assessment as the TfNSW noise estimator does not allow measured background levels as an input. Representative noise category areas have been selected based on the results of the measured background noise monitoring.

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2 EXISTING ENVIRONMENT

2.1 Proposal site

Wakehurst Parkway (MR 397) is a State Road connecting Pittwater Road, North Narrabeen and Warringah Road, Frenchs Forest within the Northern Beaches LGA.

The proposal area for the southern and northern areas is shown in Figure 2.1 and Figure 2.2 respectively. The Southern section comprises Wakehurst Parkway from Trefoil Creek to Dreadnought Road and Dreadnought Road to Oxford Falls Road. The Northern Section comprises of Elanora Road to Mirrool Street. Also shown on the figures are the two noise monitoring locations (NM1 and NM2) used to quantify existing noise levels and measure existing Rating Background Levels (RBLs) for each of the study areas.

2.2 Study area and noise sensitive receivers

The study area for each section of works has been defined as 600 metres from the proposed construction works areas. The proposal area, noise sensitive receivers, and the extent of each study area is shown for both sections in Figure 2.1 and Figure 2.2.

The proposal area section with the closest proximity to residential noise sensitive receivers is the Northern section, with many residential receivers fronting Wakehurst Parkway directly. Non residential receivers within the study area include:

- The Narrabeen Baptist Church
- Elanora Heights Primary School
- Various commercial receivers along Pittwater Road
- St Joseph's Primary School and Catholic Church

The Southern section works are mostly proposed around the intersection of Dreadnought Road and Wakehurst Parkway. Adjacent this intersection are three large education campuses;

- The C3 SYD Pentecostal Church and associated Christian College
- St Pius X College playing fields and sporting facilities
- Oxford Falls Grammar School.

The Southern section also has many residential receivers within 600 metres of Wakehurst Parkway, however they are generally located at a set back from Wakehurst Parkway.



Legend

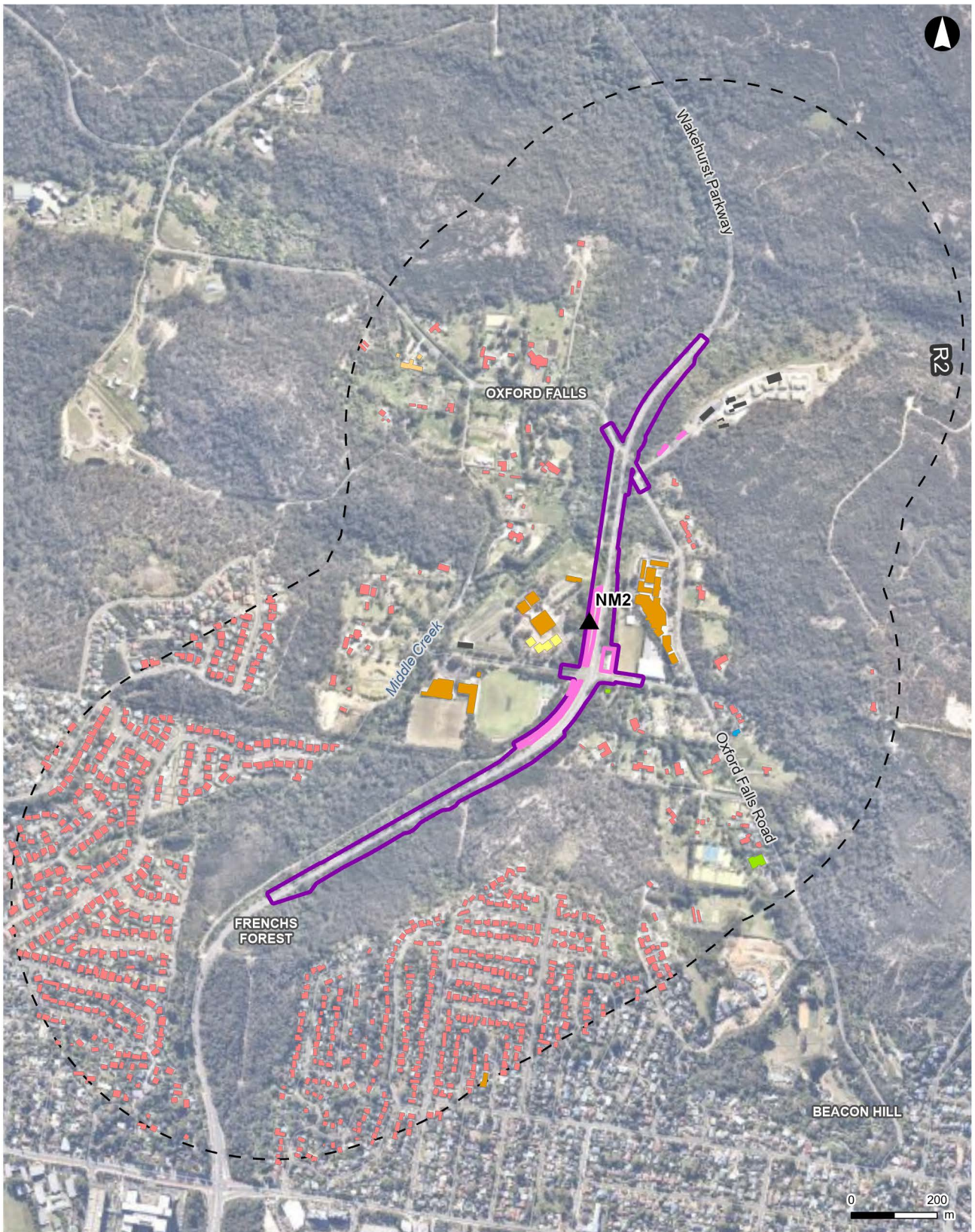
- | | | |
|---------------------------|--------------------------------|-------------|
| Proposal area | Sensitive receivers Commercial | Residential |
| Proposed compound site | Educational | |
| Study area | Industrial | |
| Noise monitoring location | Place of worship | |
| | Recreation | |



Figure 2-1, Noise sensitive receivers and noise monitoring locations within the Northern study area

1:10,750 at A4
 Coordinate System: GDA2020 MGA Zone 56
 Date issued: September 4, 2023
 Imagery: Neamap 2023





Legend

- | | | |
|---------------------------|---------------------|-------------|
| Proposal area | Sensitive receivers | Recreation |
| Proposed compound site | Child care | Residential |
| Study area | Commercial | |
| Noise monitoring location | Educational | |
| | Industrial | |
| | Place of worship | |

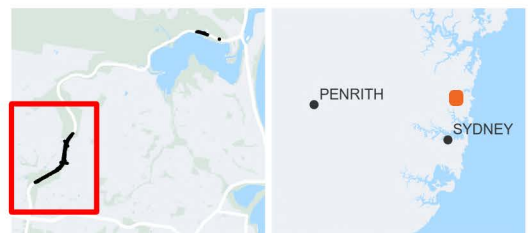


Figure 2-2, Noise sensitive receivers and noise monitoring locations within the Southern study area

1:13,250 at A4
 Coordinate System: GDA2020 MGA Zone 56
 Date issued: September 4, 2023
 Imagery: Nearmap 2023



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2.3 Noise monitoring

2.3.1 Noise monitoring methodology

Long term unattended noise monitoring was undertaken at the following two locations:

- **NM1:** 76 Wakehurst Parkway, North Narrabeen. This location is adjacent the proposed works for the Northern section at Elanora Road to Mirrool Street
- **NM2:** 2 Dreadnought Road, Oxford Falls. This location is adjacent the proposed works for the Southern section at Dreadnought Road to Oxford Falls Road.

Noise monitoring results from NM1 have been used to inform the noise area category selected for the Northern section. Noise monitoring results from NM2 inform the noise area categories selected for the Southern section.

The methodology for the noise monitoring was:

- Noise monitoring was undertaken using Svan 977 environmental noise loggers, which were programmed to accumulate the L_{A90} , L_{A10} and L_{Aeq} noise descriptors continuously over the entire monitoring period
- Meteorological data was sourced from the Bureau of Meteorology's Terrey Hills Automatic Weather Station (AWS) (Station ID 66059) at a distance of 6 km from the proposal site
- A calibration check was performed on the noise monitoring equipment using a sound level calibrator with a sound pressure level of 94 dBA at 1 kHz. At completion of the measurements, the meter's calibration was re-checked to ensure the sensitivity of the noise monitoring equipment had not varied. The noise loggers were found to be within the acceptable tolerance of ± 1 dB(A)
- The data collected by the loggers was downloaded and analysed. Data was excluded during periods where average wind speeds were greater than 5 m/s or when rainfall occurred.

Descriptions of the noise monitoring equipment at each noise monitoring location are provided in Table 2-1.

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Table 2-1: Noise monitoring locations and equipment details

Item	NM1	NM2
Location	76 Wakehurst Parkway, North Narrabeen	2 Dreadnought Road, Oxford Falls
Noise catchment area	NCA01	NCA01
Easting / Northing	-33.709335, 151.286563	-33.738282, 151.244505
Measurement start	29/05/23	29/05/23
Measurement end	05/06/23	05/06/23
Equipment details	Svan 977 (SN36873)	Svan 977 (SN45733)
Equipment settings	A weighted, Fast time response, 15 minutes	A weighted, Fast time response, 15 minutes
Calibration drift	± 1 dB	± 1 dB
Distance to road	21 metres	22 metres
Site photo		

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2.4 Noise monitoring results

A summary of the measured noise levels is provided in the following tables:

- Rating background level (RBL) in Table 2-2
- Road traffic noise levels in Table 2-3.

Daily noise measurements and noise level charts are provided in Appendix B.

Table 2-2: Measured rating background noise levels, dBA

ID	Location	Day 7 am to 6 pm	Evening 6 pm to 10 pm	Night 10 pm to 7 am
NM1	76 Wakehurst Parkway, North Narrabeen	52	36	30 (27 actual) ¹
NM2	2 Dreadnought Road, Oxford Falls	59	40	34

Note 1: The minimum night time background level of 30 dBA is applied for the purposes of defining the criteria.

Table 2-3: Measured road traffic noise levels, dBA

ID	Location	Day 7 am to 10 pm	Night 10 pm to 7 am
NM1	76 Wakehurst Parkway, North Narrabeen (21 metres to road edge)	64	57
NM2	2 Dreadnought Road, Oxford Falls (22 metres to road edge)	67	60

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3 ASSESSMENT CRITERIA

3.1 Overview

The guidelines used to develop the assessment criteria are summarised in Table 3-1.

Table 3-1: Guideline summary

Impact	Guideline / document
Construction noise	<p><i>Interim Construction Noise Guideline</i> (Department of Environment and Climate Change (DECC), 2009)</p> <p><i>Construction Noise and Vibration Guideline (for road and maritime works)</i> (TfNSW, 2022a)</p> <p><i>Construction Noise Estimator Tool</i></p>
Construction traffic	<p><i>Road Noise Policy</i> (Department of Environment, Climate Change and Water (DECCW), 2011)</p>
Construction vibration	<p><i>Assessing Vibration: a technical guideline</i> (Department of Environment and Conservation (DEC), 2006)</p> <p><i>BS 7385-2:1993 Evaluation and measurement for vibration in buildings: Guide for measurement of vibration and evaluation of their effects on buildings</i></p>
Operational noise	<p><i>Road Noise Policy</i> (DECCW, 2011)</p> <p><i>Road Noise Criteria Guideline</i> (TfNSW, 2022b)</p> <p><i>Application Notes for the Road Noise Criteria Guideline</i> (TfNSW, 2022c)</p>

3.2 Construction noise

3.2.1 Proposed construction hours

Construction noise management levels for the proposal are based on the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) and the *Construction Noise and Vibration Guideline (for road and maritime works)* (CNVG) (TfNSW, 2022a).

Construction works are planned to be undertaken during and outside the recommended standard hours for construction defined in the ICNG. The CNVG separates Out-Of-Hours Works (OOHW) into two additional categories:

- OOHW Period 1 (Day / Evening)
- OOHW Period 2 (Evening / Night).

Recommended standard construction hours and OOHW periods are shown in Table 3-2.

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Table 3-2: Construction hours

Hour starting	12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm
Monday	OOHW Period 2						Standard construction hours						OOHW Period 1											
Tuesday	OOHW Period 2						Standard construction hours						OOHW Period 1											
Wednesday	OOHW Period 2						Standard construction hours						OOHW Period 1											
Thursday	OOHW Period 2						Standard construction hours						OOHW Period 1 (Evening)											
Friday	OOHW Period 2						Standard construction hours						OOHW Period 1											
Saturday	OOHW Period 2						Standard construction hours						OOHW Period 2											
Sunday	OOHW Period 2						OOHW Period 1 (Day)						OOHW Period 2											
Public holidays	OOHW Period 2						OOHW Period 1 (Day)						OOHW Period 2											

3.2.2 Noise area categories (RBL)

The construction noise estimator tool being used to conduct the construction noise assessment utilises fixed RBL levels used to derive the Noise Management Levels (NMLs). The day, evening and night time levels are categorised in 'noise area categories' and are based on those provided in the CNVG. Table 3-3 provides the noise area categories in the construction noise estimator tool, where:

- Noise monitoring results from NM1 (76 Wakehurst Parkway, North Narrabeen) have been used to inform the noise area category and noise management levels for the Northern section (noise area category R1)
- Noise monitoring results from NM2 (2 Dreadnought Road, Oxford Falls) have been used to inform the noise area category and noise management levels for the Southern section (noise area category R2).

Based on the measured background levels provided in Table 2-2, the selected noise area categories are considered to be conservative.

Table 3-3: Noise area categories

Noise area category	Description of typical environment	Average background A-weighted sound pressure level, L_{A90}		
		Day	Evening	Night
R1	Areas with negligible transportation	40	35	30
R2	Areas with low density transportation	45	40	35

3.2.3 Construction noise management levels

Construction NML for the proposal have been derived based on the guidance outlined in the ICNG. The applicable NMLs are based on the land use for each identified sensitive receiver.

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Residential noise management levels

The ICNG method to determine the NMLs for residential receivers is outlined in Table 3-4. These are based on the background noise level during each assessment time period as described in section 3.2.1.

The residential noise management levels are assessed externally.

Table 3-4: Noise management levels for residential receivers

Time of day	Noise management level, $L_{Aeq}(15 \text{ min})$	Application notes
Recommended standard hours	Noise affected: RBL + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise: <ul style="list-style-type: none"> - where the predicted or measured $L_{Aeq}(15 \text{ min})$ 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 restricting the hours that the very noisy activities can occur, taking into account: <ul style="list-style-type: none"> - 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	Noise affected: RBL + 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 measures have been applied and noise is more than 5 dBA above the noise affected level, the proponent should consult with the community.

The ICNG recommends that sleep disturbance and awakenings be considered where construction works are planned to extend over two or more consecutive nights. The ICNG references the NSW road traffic noise guidelines to determine the potential for sleep disturbance impacts. The *Road Noise Policy* (DECCW, 2011) states that maximum internal noise levels below 50 to 55 dBA are unlikely to awaken people from sleep.

As per the approved scope of works, measured background noise levels were used to select the corresponding noise area category for the purposes of conducting the assessment using the construction noise estimator tool. The NMLs for residential receivers adopted for this assessment are provided in Table 3-5.

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Table 3-5: Residential NMLs for each assessment period, dBA

Works	Standard construction hours	Outside standard construction hours			
		Day	Evening	Night	Sleep disturbance ¹
Northern works (R1)	50	45	40	35	65
Southern works (R2)	55	50	45	40	65

Note 1: Based on an internal noise level of 55 dBA. A 10 dBA addition has been applied to the internal noise level to account for a typical noise reduction through an open window.

Non-residential noise management levels

Noise management levels for other sensitive land uses are provided in Table 3-6, and only apply when the properties are in use.

Table 3-6: Noise management levels for other sensitive land uses

Sensitive land use	Noise management level, $L_{Aeq(15\text{ min})}$ dBA
Commercial premises	70 (external)
Industrial	75 (external)
Educational institutes	55 (external) ¹
Places of worship	55 (external) ¹
Active recreation	65 (external)

Note 1: Based on an internal noise level of 55 dBA. A 10 dBA addition has been applied to the internal noise level to account for a typical noise reduction through an open window.

3.3 Construction vibration

3.3.1 Human comfort

Acceptable vibration levels for human comfort have been set with consideration to *Assessing Vibration: a technical guideline* (DEC, 2006) which is based on the guidelines contained in British Standard *BS 6472 – 1992, Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)*.

Typically, construction activities generate ground vibration of an intermittent nature. Intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in Table 3-7 for sensitive receivers.

Table 3-7: Human comfort intermittent vibration limits (BS 6472-1992)

Receiver type	Period	Intermittent vibration dose value ($m/s^{1.75}$)	
		Preferred value	Maximum value
Residential	Day (7 am to 10 pm)	0.2	0.4

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Receiver type	Period	Intermittent vibration dose value (m/s ^{1.75})	
		Preferred value	Maximum value
	Night (10 pm to 7 am)	0.13	0.26
Offices, schools, educational institutes and places of worship	When in use	0.4	0.8

Whilst the assessment of response to vibration in *BS 6472:1992* is based on vibration dose value and weighted acceleration, for construction related vibration, it is considered more appropriate to provide guidance in terms of a peak value, since this parameter is likely to be more routinely measured based on the more usual concern over potential building damage.

Humans are capable of detecting vibration at levels which are well below those causing risk of damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in British Standard, *BS 5228.2 – 2009, Code of Practice Part 2 Vibration for noise and vibration on construction and open sites – Part 2: Vibration* and are shown below in Table 3-8.

Table 3-8: Guidance on effects of vibration levels for human comfort

Vibration level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential environments will cause complaints but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure.

3.3.2 Guidelines for general structures

The effects of transient vibration on structures are considered in *BS 7385 Part 2 – 1993 Evaluation and measurement for vibration in buildings*. The criteria provided in BS 7385 are presented in Table 3-9.

Table 3-9: Transient vibration guide values – minimal risk of cosmetic damage

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
Unreinforced or light framed structures. Residential or light commercial type building	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

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The guide values in Table 3-9 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings. Where the dynamic loading caused by continuous vibration may give rise to dynamic magnification due to resonance, especially at lower frequencies, then the guide values may need to be reduced by up to 50 per cent.

The predominant vibration for most construction activities involving intermittent vibration sources such as rock breakers, piling rigs, vibratory rollers and excavators occurs at frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range). On this basis, a conservative vibration damage screening level per receiver type is given below:

- reinforced or framed structures: 25.0 mm/s
- unreinforced or light framed structures: 7.5 mm/s.

3.3.3 Guidelines for vibration sensitive structures

Heritage buildings and structures would be assessed using the guide values in Table 3-9. A heritage building or structure should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound. If a heritage building or structure is found to be structurally unsound (following inspection) a more conservative cosmetic damage criterion of 3 mm/s peak component particle velocity (from DIN 4150) should be considered.

3.4 Construction traffic

The *Road Noise Policy* (DECCW, 2011) provides road traffic noise criteria for residential land uses affected by construction traffic on the public road network. The *Applying the NSW Road Noise Policy Application notes* (NSW EPA, 2011) state that any increase in the total noise level at existing residences and other sensitive land uses affected by traffic generation on existing roads should be limited to 2 dBA above current levels. This limit only applies when the noise level without the development is within 2 dBA or exceeds the road traffic noise criterion provided in the *Road Noise Policy* (DECCW, 2011).

Where construction traffic increases the existing road traffic noise levels by more than 2 dBA then further assessment against the road traffic noise criteria in Table 3-10.

Table 3-10: Road traffic noise criteria, dBA

Type of development	Day, $L_{Aeq}(15 \text{ min})$ 7 am to 10 pm	Night, $L_{Aeq}(15 \text{ min})$ 10 pm to 7 am
Existing residence affected by additional traffic on freeway/arterial/sub-arterial roads	60	55
Existing residence affected by additional traffic on local roads	55	50

3.5 Operational noise

The *Road Noise Criteria Guideline* (RNCG) (TfNSW, 2022b) outlines the methodology for the assessment of road traffic noise from public roads on noise sensitive receivers. This methodology is outlined in the following section.

The operational noise criteria applied depends on the type of road project as defined in the RNCG. These road projects are new, redeveloped and minor works.

In the context of the assessment of noise emissions, the proposal is considered minor works as the works:

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- Involve additional lanes and left-turn slip lanes, realignment of existing lanes, additional and realignment of pedestrian crossings with the primary focus on improving safety

The RCNG proposes that:

Transport applies existing road criteria (Road Noise Policy (DEECCW, 2011) Table 8, see Appendix D of this guideline) where the minor works increase noise levels by more than 2.0 dBA relative to the existing noise levels at the worst affected receiver (Principles 1, 2, and 3 – refer Section 2 of RNCG)

Therefore if road noise levels are predicted to increase by more than 2.0 dB, the assessment criteria in Table 3-10 should be applied.

3.5.1 Assessment criteria

RNCG Minor works road projects are assessed to determine whether existing road traffic noise levels increase by more than 2.0 dBA at the worst affected receiver.

Where the increase in road traffic noise levels is more than 2.0 dBA, the existing road traffic noise criteria outlined in Table 3-11 apply.

Table 3-11: Road traffic noise assessment criteria

Road category	Type of project / land use	Receiver Type	Assessment criteria, dBA	
			Day 7 am to 10 pm	Night 10 pm to 7 am
Arterial / sub-arterial roads	Existing residences affected by noise from redevelopment of existing arterial/sub-arterial roads	Residential	L _{Aeq} (15 hour) 60 (external)	L _{Aeq} (9 hour) 55 (external)
		School classrooms	L _{Aeq} (1 hour) 40 (internal)	-
		Open space (passive use)	L _{Aeq} (15 hour) 55 (external)	-

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4 CONSTRUCTION IMPACT ASSESSMENT

4.1 Construction noise

4.1.1 Construction methodology

Construction staging

The construction scenarios in Table 4-3 have been developed based on the *Construction Staging Strategy Report* (SustainJV, 2023). Each of the proposal sections (Northern and Southern) have their own construction methodology, however they are similar in staging and activities. An overview of the construction staging for each section is provided below in Table 4-1 and Table 4-2.

Table 4-1: Staging and work methodology – Northern section

Staging	Work methodology
Stage 1 – Predominantly night works under traffic control	<ul style="list-style-type: none"> – Site establishment, including site offices, storage and stockpile areas – Install site security fencing – Positively locate and identify existing utilities and services – Installation of environmental controls – Commence utility relocations wherever possible – Clearing & grubbing – Install construction access points – Install pedestrian exclusion fencing where required – Roadwork signage and re-line marking for Stage 1 – Temporary pavement works to enable Stage 1 – Traffic barriers placed in preparation for the Stage 1 Traffic switch.
Stage 2 – Day and night works	<ul style="list-style-type: none"> – Complete utility adjustments – Perform earthworks and new full depth pavement construction on the southbound – Roadwork signage and re-line marking for Stage 2. – Traffic signal adjustments to enable Stage 2. – Traffic barriers would be placed in preparation for the Stage 2 Traffic switch
Stage 3 – Day and night works	<ul style="list-style-type: none"> – Perform property adjustments – Perform earthworks and new full depth pavement construction on the northbound – Works can generally be undertaken during daytime working hours however nightworks will still be required for difficult access works – Traffic barriers removed in preparation for the Stage 2 Traffic switch.
Stage 4 – Day and night works	<ul style="list-style-type: none"> – Place final medians behind bollards – Place final asphalt layers at night – Finishing, signage, landscaping works etc.

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Table 4-2: Staging and work methodology – Southern section

Staging	Work methodology
Stage 1 – Predominantly night works under traffic control	<ul style="list-style-type: none"> – Site establishment, including site offices, storage and stockpile areas – Install site security fencing – Positively locate and identify existing utilities and services. – Installation of environmental controls. – Commence utility relocations wherever possible. – Clearing & grubbing. – Any drainage crossings can commence. – Install construction access points. – Install pedestrian exclusion fencing where required. – Roadwork signage and re-line marking for Stage 1. – Temporary pavement works to enable Stage 1 – Traffic signal adjustments to enable Stage 1 – Traffic barriers placed in preparation for Stage 1 traffic
Stage 2 – Day and night works	<ul style="list-style-type: none"> – Perform property adjustments where required. – Complete utility adjustments. – Traffic signal modifications. – Perform earthworks and new full depth pavement construction – Roadwork signage and re-line marking for Stage 2 – Traffic signal adjustments to enable Stage 2 – Traffic barriers placed in preparation for the Stage 2 Traffic switch.
Stage 3 – Day and night works	<ul style="list-style-type: none"> – Traffic signal modifications – Perform earthworks and new full depth pavement construction – Roadwork signage and re-line marking for Stage 3 – Traffic signal adjustments to enable Stage 3 – Traffic barriers removed in preparation for the Stage 3 Traffic switch.
Stage 4 – Day and night works	<ul style="list-style-type: none"> – Final traffic signal modifications – Place final medians behind bollards – Place final asphalt layers at night – Finishing, signage, landscaping works etc.

There are 10 proposed locations for compound sites within the proposal area (Northern and Southern). Collectively, the compound sites will hold site offices, lunch sheds, ablutions, car parking and laydown areas. It is noted that each location is unlikely to have all of these facilities, and some will only be used as laydown areas or as site offices. Additionally, multiple compound sites are likely to be used to provide all required facilities across the work areas in the Northern and Southern sections. Hours of operation will be generally 6:00 am to 6:00 pm with overnight use during night works.

Construction works would be required outside standard hours in order to provide a safe work environment, accommodate utility relocations and to minimise traffic disruptions on the local road network.

Indicative construction scenarios have been selected from the TfNSW construction and maintenance noise estimator excel tool that most closely match the construction staging provided. The scenarios are provided in Table 4-3 below.

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Table 4-3: Indicative construction Scenarios

Scenario	Description	Standard hours	Out of hours works		
			Day	Eve	Night
Site establishment	Installing construction boundary hoardings/ fences and traffic barriers	X	X	X	X
Utility, property, service adjustment	Adjustment of property boundaries (where required); relocation of services	X	X	X	X
Corridor clearing	General land clearing, tree and stump removal, topsoil stripping, loading	X	X	X	X
Retaining walls / noise walls	Construction of retaining walls and noise walls	X	X	X	X
Bulk earthworks	Formation of road alignment. Excavation of soil and rock, hammering/rock breaking, drilling, loading, haulage, compaction of fill areas, grading	X	X	X	X
Paving / asphaltting (including concrete sawing)	Placement of surface material, saw cutting	X	X	X	X
Road furniture installation	Signposting and line marking	X	X	X	X
Compounds	Deliveries, plant and equipment, maintenance, office areas, storage areas	X	X	X	X

Activity equipment and sound power levels

The proposed construction equipment that would be used during each construction work phase and the scenario sound power levels are provided in Table 4-4. Equipment sound power levels are sourced from the *Construction Noise and Vibration Guideline* (TfNSW, 2016)

Other equipment may be used; however, it is anticipated that they would produce similar net noise emissions when used concurrently with the equipment listed.

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Table 4-4: Construction equipment and scenario sound power levels

Activity	Plant/ Equipment	L _{Aeq} SWL	L _{Aeq} at 7m	Assumptions for quantitative assessment		
				No. Units	Activity total L _{eq} SWL	Activity total L _{A1} SWL
Mobilisation and Site Establishment	Truck (medium rigid)	103	78	4 per hour	115	116
	Road truck	108	83	4 per hour		
	Scissor lift	98	73	1		
	Franna crane	98	73	1		
Utility, property, service adjustment	Excavator (tracked) 35t	110	85	1	116	116
	Dump truck	110	85	4 per hour		
	Franna crane 20t	98	73	1		
	Pneumatic hammer	113	88	-		
	Concrete saw	118	93	1		
	Vacuum truck	109	84	-		
	Backhoe	111	86	-		
	Power generator	103	78	1		

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Activity	Plant/ Equipment	L _{Aeq} SWL	L _{Aeq} at 7m	Assumptions for quantitative assessment		
				No. Units	Activity total L _{eq} SWL	Activity total L _{A1} SWL
Corridor clearing	Bulldozer D9	116	91	1	121	128
	Excavator (tracked) 35t	110	85	1		
	Chainsaw 4-5hp	114	89	2		
	Tub grinder/ mulcher 40-50hp	116	91	1		
	Dump truck	110	85	4 per hour		
Retaining walls / noise walls	Piling rig - bored	112	87	1	119	130
	Power generator	103	78	1		
	Mobile crane	113	88	1		
	Concrete vibrator	113	88	1		
	Concrete pump	109	84	1		
	Welding equipment	105	80			
	Excavator (tracked) 35t	112	87	1		
	Air track drill	124	99			

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Activity	Plant/ Equipment	L _{Aeq} SWL	L _{Aeq} at 7m	Assumptions for quantitative assessment		
				No. Units	Activity total L _{eq} SWL	Activity total L _{A1} SWL
Bulk earthworks	Bulldozer D9	116	91	1	123	128
	Scraper 651	110	85	1		
	Excavator (tracked) 35t	110	85	1		
	As above + hydraulic hammer	122	97	1		
	Grader	113	88	1		
	Dump truck	110	85	8 per hour		
	Compactor	106	81	1		
	Roller (large pad foot)	109	84	-		
	Water cart	107	82	-		
Paving/ asphaltting (including concrete sawing)	Pavement laying machine	114	89	1	118	130
	Dump truck	110	85	4 per hour		
	Asphalt truck & sprayer	103	78	1		
	Concrete truck	109	84	1		
	Smooth drum roller	107	82	1		
	Concrete saw	118	93	1		

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Activity	Plant/ Equipment	L _{Aeq} SWL	L _{Aeq} at 7m	Assumptions for quantitative assessment		
				No. Units	Activity total L _{eq} SWL	Activity total L _{A1} SWL
Road furniture installation	Road truck	108	83	4 per hour	110	116
	Scissor lift	98	73	1		
	Franna crane 20t	98	73	1		
	Line marking truck	108	83	1		
Compounds	Front end loader	91	66	1	114	116
	Excavator (tracked) 35t	110	85	-		
	Road truck	108	83	4 per hour		
	Compressor	109	84	1		
	Welding equipment	105	80	1		
	Light vehicles	88	63	12 per hour		
	Power generator	103	78	1		

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4.1.2 Construction noise assessment

Construction noise levels were predicted using the TfNSW construction and maintenance noise estimator excel tool. Results from the estimator tool are considered to be conservative, therefore all exceedances of the NML are expected to be captured using this assessment methodology. For each indicative construction scenario, a distance-based assessment has been conducted to provide the distances for different exceedances of the noise management levels.

The following noise modelling assumptions were made:

- A noise area category R1 has been selected for the Northern section
- The area ground type for the northern works is assumed to be developed settlements (urban and suburban)
- A noise category R2 has been selected for the Southern section
- The area ground type for the Southern section is assumed to be undeveloped green fields, rural areas with isolated dwellings
- Noise monitoring results from NM1 (76 Wakehurst Parkway, North Narrabeen) has been used to inform the noise area category and noise management levels for the Northern section (noise area category R1)
- Noise monitoring results from NM2 (2 Dreadnought Road, Oxford Falls) has been used to inform the noise area category and noise management levels for the Southern section (noise area category R2)
- No line of sight (behind solid barrier) has been assumed in determining the distances for noticeable impacts, clearly audible impacts, moderately intrusive impacts. Line of sight *has* been assumed in determining the distances for highly intrusive impacts, and highly noise affected distances.

4.1.3 Predicted construction noise affected distances

Table 4-5 presents the construction noise impact buffer distances for the Northern section towards Pittwater Road, and Table 4-6 presents the construction noise impacts for the Southern section. Table 4-11 provides the relevant additional mitigation measures for receivers within each of the noise impact categories. The affected distance provided for each scenario is the distance at which the NML is exceeded, the columns that follow provide the distances at which additional mitigation measures are required. When no additional mitigation measures are recommended, cells are left empty.

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Northern section

Table 4-5: Construction noise affected distances – Northern section

Scenario	Period	Affected Distance (m)	Sleep disturbance impacts (m)	Distances at which additional mitigation measures are required for residential receivers (m)				
				Noticeable (5 to 10 dBA above RBL)	Clearly audible (10 to 20 dBA above RBL)	Moderately intrusive (20 to 30 dBA above RBL)	Highly intrusive (>30 dBA above RBL)	Highly noise affected (>75 dBA)
Site establishment	Day	215	-	-	-	85	45	25
	Day (OOHW)	330	-	-	215	85	45	
	Evening	500	-	-	330	140	85	
	Night	745	95	745	500	215	140	
Utility, property, service adjustment	Day	235	-	-	-	95	50	25
	Day (OOHW)	360	-	-	235	95	50	
	Evening	540	-	-	360	155	95	
	Night	805	95	805	540	235	155	
Corridor clearing	Day	360	-	-	-	155	95	50
	Day (OOHW)	540	-	-	360	155	95	
	Evening	800	-	-	540	235	155	
	Night	1170	230	1170	800	360	235	
Retaining walls	Day	305	-	-	-	130	75	40
	Day (OOHW)	460	-	-	305	130	75	
	Evening	685	-	-	460	200	130	
	Night	1010	330	1010	685	305	200	

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Scenario	Period	Affected Distance (m)	Sleep disturbance impacts (m)	Distances at which additional mitigation measures are required for residential receivers (m)				
				Noticeable (5 to 10 dBA above RBL)	Clearly audible (10 to 20 dBA above RBL)	Moderately intrusive (20 to 30 dBA above RBL)	Highly intrusive (>30 dBA above RBL)	Highly noise affected (>75 dBA)
Bulk earthworks	Day	425		-	-	180	115	70
	Day (OOHW)	635		-	425	180	115	
	Evening	935		-	635	280	180	
	Night	1355	280	1355	935	425	280	
Paving / asphaltting	Day	180		-	-	70	35	20
	Day (OOHW)	280		-	180	70	35	
	Evening	425		-	280	115	70	
	Night	635	330	635	425	180	115	
Road furniture installation	Day	140		-	-	45	25	15
	Day (OOHW)	215		-	140	45	25	
	Evening	330		-	215	85	45	
	Night	500	95	500	330	140	85	
Compound operation	Day	200		-	-	75	40	25
	Day (OOHW)	305		-	200	75	40	
	Evening	460		-	305	130	75	
	Night	685	95	685	460	200	130	

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Southern section

Table 4-6: Construction noise affected distances – Southern section

Scenario	Period	Affected Distance (m)	Sleep disturbance impacts (m)	Distances at which additional mitigation measures are required for residential receivers (m)				
				Noticeable (5 to 10 dBA above RBL)	Clearly audible (10 to 20 dBA above RBL)	Moderately intrusive (20 to 30 dBA above RBL)	Highly intrusive (>30 dBA above RBL)	Highly noise affected (>75 dBA)
Site establishment	Day	125	-	-	-	35	25	25
	Day (OOHW)	185	-	-	125	35	25	
	Evening	265	-	-	185	75	40	
	Night	390	95	390	265	125	75	
Utility, property, service adjustment	Day	135	-	-	-	45	25	25
	Day (OOHW)	195	-	-	135	45	25	
	Evening	290	-	-	195	85	45	
	Night	420	95	420	290	135	85	
Corridor clearing	Day	195	-	-	-	85	45	45
	Day (OOHW)	290	-	-	195	85	45	
	Evening	420	-	-	290	135	85	
	Night	605	230	605	420	195	135	
Retaining walls	Day	170	-	-	-	65	35	35
	Day (OOHW)	250	-	-	170	65	35	
	Evening	360	-	-	250	115	65	
	Night	525	330	525	360	170	115	

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Scenario	Period	Affected Distance (m)	Sleep disturbance impacts (m)	Distances at which additional mitigation measures are required for residential receivers (m)				
				Noticeable (5 to 10 dBA above RBL)	Clearly audible (10 to 20 dBA above RBL)	Moderately intrusive (20 to 30 dBA above RBL)	Highly intrusive (>30 dBA above RBL)	Highly noise affected (>75 dBA)
Bulk earthworks	Day	230	-	-	-	105	60	60
	Day (OOHW)	335	-	-	230	105	60	
	Evening	485	-	-	335	155	105	
	Night	700	280	700	485	230	155	
Paving / asphaltting	Day	105	-	-	-	25	20	20
	Day (OOHW)	155	-	-	105	25	20	
	Evening	230	-	-	155	60	30	
	Night	335	330	335	230	105	55	
Road furniture installation	Day	75	-	-	-	25	15	15
	Day (OOHW)	125	-	-	75	25	15	
	Evening	185	-	-	125	40	25	
	Night	265	95	265	185	75	35	
Compound operation	Day	75	-	-	-	25	15	20
	Day (OOHW)	125	-	-	75	25	15	
	Evening	185	-	-	125	40	25	
	Night	265	95	265	185	75	35	

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4.1.4 Construction noise impacts

The construction noise affected distances are predicted to be the greatest during bulk earthwork activities, and followed by corridor clearing. For other construction activities, the noise affected distances are predicted to be lower.

Northern section

The distances at which the noise management levels are predicted to be exceeded are:

- 180 metres for bulk earthworks and 155 metres for corridor clearing (standard hours)
- 1355 metres for bulk earthworks and 1170 metres for corridor clearing (night works).

The highly noise affected level is predicted to be exceeded for receivers within 50 metres of bulk earthworks and corridor clearing activities. There are a number of residences located along the northside of Wakehurst Parkway expected to be within this distance to construction works.

Southern section

For southern works, the distances at which the noise management levels are predicted to be exceeded are:

- 105 metres for bulk earthworks and 85 metres for corridor clearing (standard hours)
- 700 metres for bulk earthworks and 605 metres for corridor clearing (night works).

The highly noise affected level is predicted to be exceeded for receivers within 60 metres of earthwork activities and 45 metres of corridor clearing works.

Table 4-1 and Figure 4.2 provides noise affected buffer distances during the night time bulk earthworks scenario where the greatest noise affected distances are expected. Buffer distances to each impact category, including the highly noise affected level is provided.

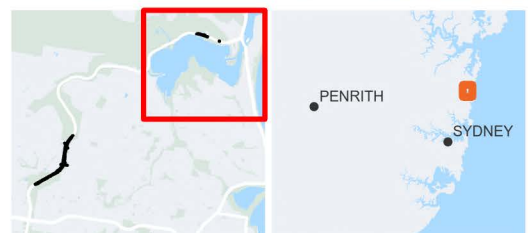
Sleep disturbance impacts

The greatest sleep disturbance impacts are predicted to occur during asphaltting / paving construction activities and retaining wall construction activities, with an affected distance of 330 metres (see Figure 4.3 and Figure 4.4).

Section 4.4 provides the additional mitigation measures required for receivers within these distances.



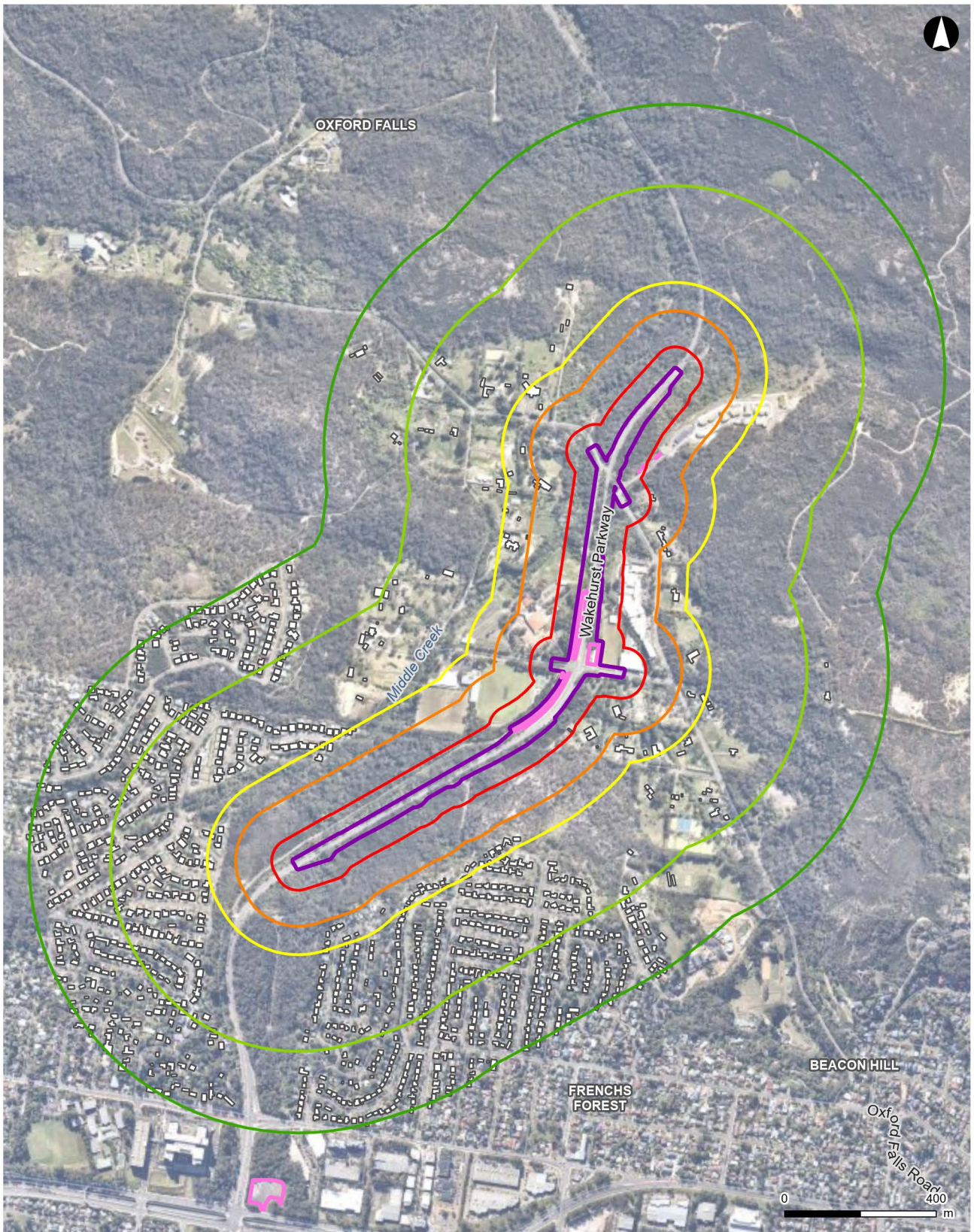
Legend		dBA above RBL	Highly noise affected level
	Proposal area	5-10	>75
	Proposed compound site	10-20	
	Residential dwelling	20-30	
		>30	











1:20,000 at A4
 Coordinate System: GDA2020 MGA Zone 56
 Date issued: September 4, 2023
 Imagery: Neamap 2023

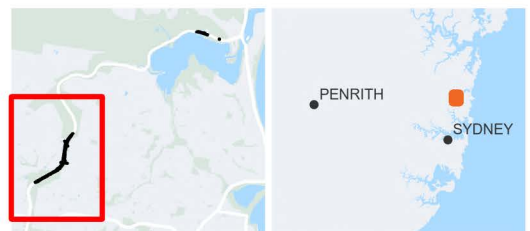


Figure 4-1, Bulk earthworks night time noise affected distances (Northern section)



Legend

- | | | | |
|---|------------------------|---|---|
|  | Proposal area | dBA above RBL | Highly noise affected level |
|  | Proposed compound site |  |  |
|  | Residential dwelling |  |  |
| | |  | |
| | |  | |



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 Imagery: Nearmap 2023



Figure 4-2, Bulk earthworks night time noise affected distances (Southern section)



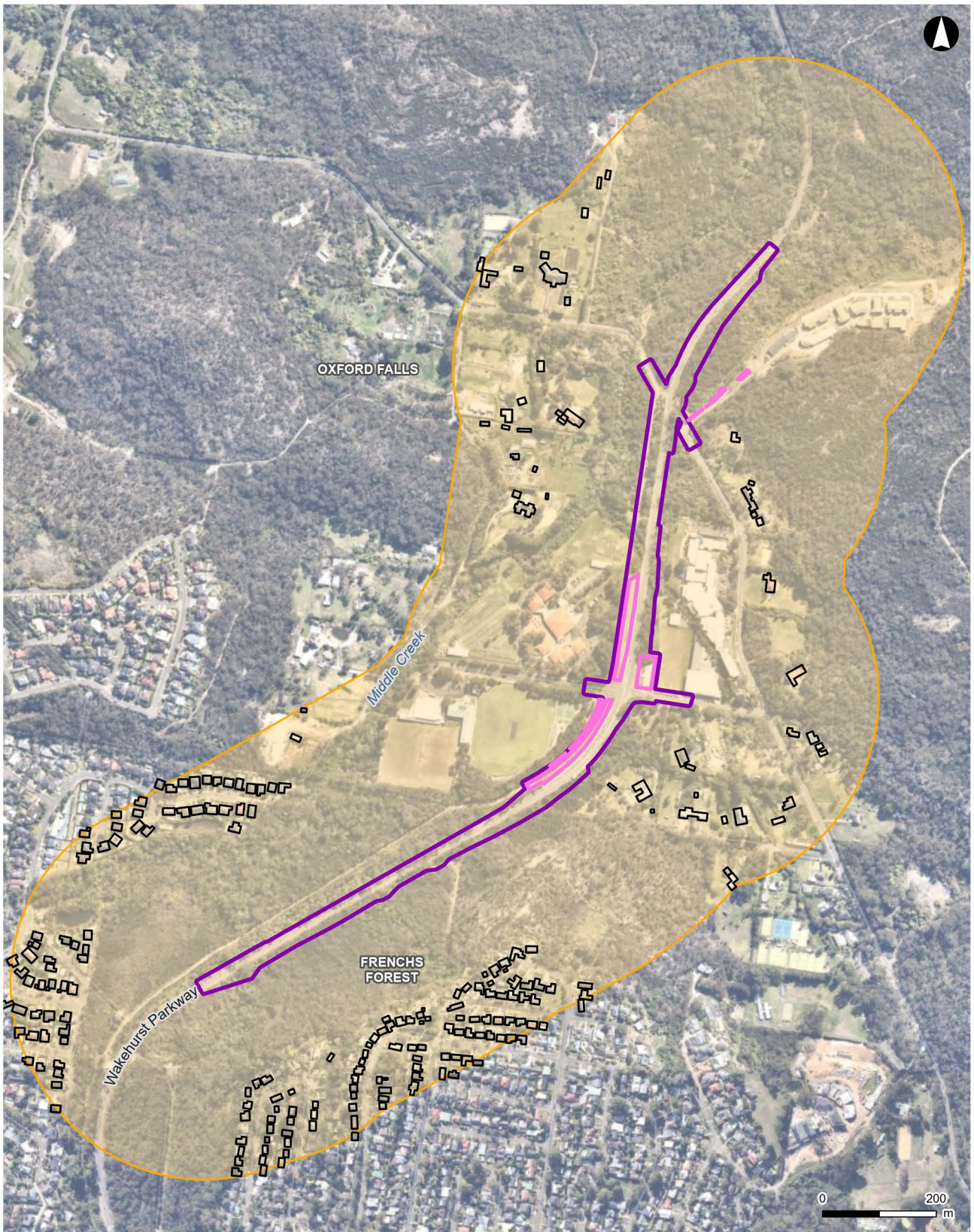
- Legend**
- Proposal area
 - Sleep disturbance buffer
 - Proposed compound site
 - Residential dwelling



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 Coordinate System: GDA2020 MGA Zone 56
 Date issued: September 4, 2023
 Imagery: Nearmap 2023

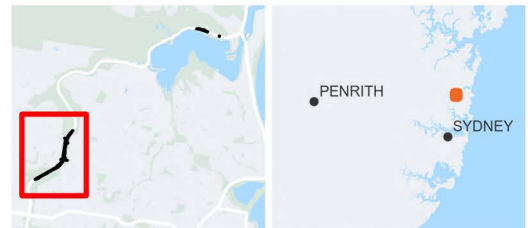


Figure 4-3, Sleep disturbance impacts buffer distance (Northern section)



Legend

-  Proposal area
-  Sleep disturbance buffer
-  Residential dwelling



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 Coordinate System: GDA2020 MGA Zone 56
 Date issued: September 4, 2023
 Imagery: Nearmap 2023



Figure 4-4, Sleep disturbance impacts buffer distance (Southern section)

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4.2 Construction traffic

The *Road Noise Policy* (DEECCW, 2011) recommends that “any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding ‘without construction’ scenario.” Construction would generate heavy vehicle movements associated with the transportation of construction machinery, equipment, and materials to the site. Light vehicle movements would be associated with employees and smaller deliveries.

All construction traffic is expected to access site via Wakehurst Parkway. To increase the road traffic noise of these roads by 2 dB, traffic would have to increase by 58%.

Existing heavy vehicle traffic counts along Wakehurst Parkway are sourced from traffic counts conducted in February 2023. The additional vehicles required to generate a 2 dB increase based on the existing traffic volumes are listed in Table 4-7. Additionally, a high level estimate of construction traffic volumes is included in Table 4-7.

Table 4-7: Construction traffic recommendations

Location	Existing heavy vehicle traffic per day	Additional heavy vehicles required per day for a 2 dB increase	Estimated heavy vehicle construction traffic volumes per day
Wakehurst Parkway between Frenches Forest Road and Dreadnought Road	1,960	1,137	40
Wakehurst Parkway between Caley Trail and Elanora Road	2,030	1,177	20

Based on the existing heavy vehicle traffic volumes along Wakehurst Parkway, additional traffic generated during the construction phase would not be significant enough to result in an increase of more than 2 dB compared to existing road traffic noise levels.

4.3 Construction vibration

4.3.1 Assessment methodology

Vibration from surface construction plant and equipment was assessed with consideration to *Assessing Vibration: A Technical Guideline* (DEC, 2006), British Standard *BS 7385 Part 2 – 1993 Evaluation and measurement for vibration in buildings* and German Standard *DIN4150-3:2016 Vibrations in buildings – Part 3: Effects on structures*.

Energy from construction equipment is transmitted into the ground and transformed into vibrations, which attenuates with distance. The magnitude and attenuation of ground vibration is dependent on the following:

- the efficiency of the energy transfer mechanism of the equipment (impulsive; reciprocating, rolling or rotating equipment)
- the frequency contents
- the impact medium stiffness
- the type of wave (surface or body)
- the ground type and topography.

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Construction and demolition work have the potential to impact human comfort and / or cause structural damage to buildings. Potential vibration inducing activities identified during construction and demolition works include:

- (vibratory) roller works.

Safe working buffer distances to comply with the human comfort, cosmetic damage and heritage structural damage criteria were taken from the CNVG and are provided in Table 4-8. The heritage structural damage criteria only applies in the event that the building is found to be structurally unsafe.

Table 4-8: Vibration safe working buffer distances

Plant Item	Cosmetic damage (metres)		Human response (EPA's vibration guideline) (metres)
	Light-framed structures	Heritage and other sensitive structures	
Vibratory roller (1-2 tonnes)	5 m	14 m	15 m to 20 m
Vibratory roller (2-4 tonnes)	6 m	16 m	20 m
Vibratory roller (4-6 tonnes)	12 m	33 m	40 m
Vibratory roller (7-13 tonnes)	15 m	41 m	100 m
Vibratory roller (13-18 tonnes)	20 m	54 m	100 m
Vibratory roller (>18 tonnes)	25 m	68 m	100 m
Pile Boring	2m (nominal)	5 m	4 m

4.3.2 Construction vibration impacts

The most vibration intensive equipment with the potential to be used on site is the use of vibratory rollers. Assuming an >18 tonne roller, the worst-case safe working distances for cosmetic damage, heritage structural damage and human comfort are 25 metres and 100 metres respectively.

Across the two Sections, approximately 5 buildings are within 25 metres of the construction works and approximately 85 buildings are within 100 metres of the construction footprint. Figure 4.5 and Figure 4.6 provides these buffer distances for each study area. Additionally, these receivers are listed in Appendix A.

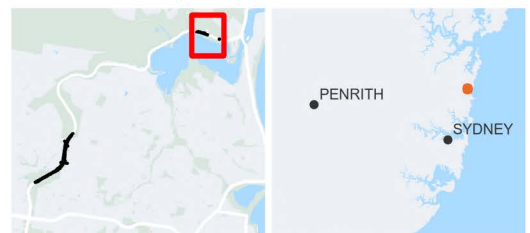
Across the two Sections, approximately two heritage sites have been identified as within the 68 metre cosmetic damage buffer distance for heritage and other sensitive structures. Both sites are located at the South Section. The heritage site of Oxford Falls Public School, including a heritage sandstone wall, has been identified to the south-east side of the intersection between Dreadnought Road and Wakehurst Parkway. Also potentially within the buffer distance is the Oxford Falls Conservation Area, located to the north-west of the intersection between Dreadnought Road and Wakehurst Parkway. This heritage item is a conservation area, as opposed to a specific man-made structure, and therefore is not considered to be a vibration sensitive receiver. The location of the Oxford Falls Public School is shown in Figure 4.6.

Where the safe working distances cannot be maintained, Section 4.4.2 provides mitigation measures for construction vibration impacts.



Legend

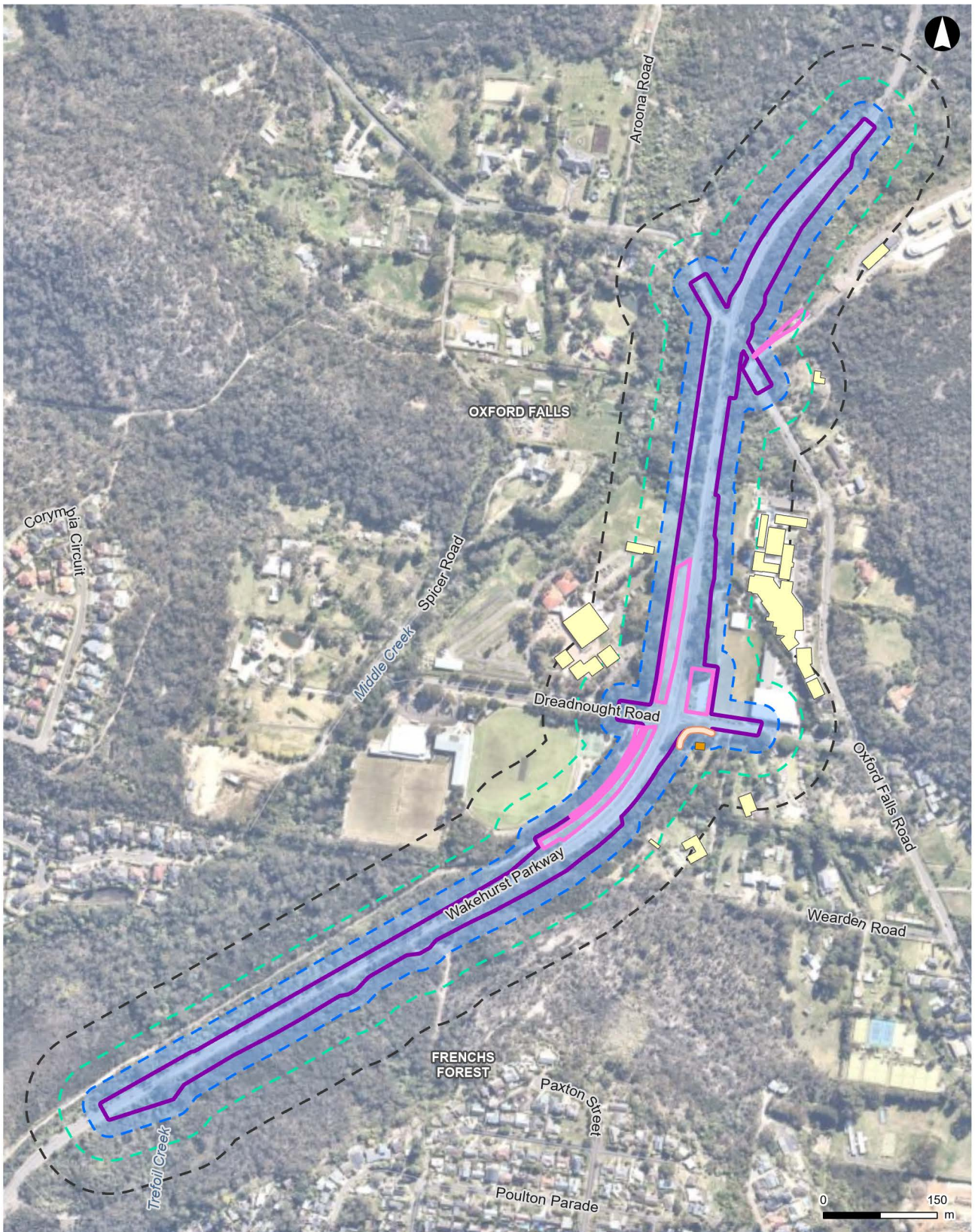
- Proposal area
- Proposed compound site
- Potential adverse human comfort impact buffer
- Heritage structure safe work buffer
- Vibration safe work buffer
- Buildings within vibration safe work buffer
- Buildings within potential adverse human comfort impact buffer



1:5,000 at A4
 Coordinate System: GDA2020 MGA Zone 56
 Date issued: September 4, 2023
 Imagery: Neamap 2023

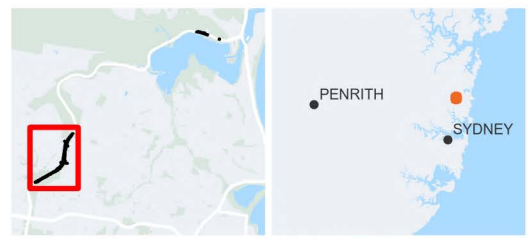


Figure 4-5, Vibration safe working buffer distance (Northern section)



Legend

- Proposal area
- Proposed compound site
- Heritage item (Sandstone Wall)
- Potential adverse human comfort impact buffer
- Heritage structure safe work buffer
- Vibration safe work buffer
- Buildings within vibration safe work buffer
- Buildings within potential adverse human comfort impact buffer



1:7,500 at A4
 Coordinate System: GDA2020 MGA Zone 56
 Date issued: September 4, 2023
 Imagery: Neamap 2023



Figure 4-6, Vibration safe working buffer distance (Southern section)

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4.4 Mitigation measures

4.4.1 Construction noise

Standard Mitigation measures

Mitigation recommendations are provided in Table 4-9 to reduce the noise levels during construction activities and have been sourced from Section 8.1 of the CNVG. These standard mitigation measures shall be applied to mitigate noise and vibration impacts of the Proposal where reasonable and feasible.

Table 4-9: Construction noise mitigation measures

Action required	Details
Management measures	
Implement community consultation measures (refer to CNVG Appendix C for future details of each measure)	<ul style="list-style-type: none"> - Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night-time period, any operational benefits from the works (where applicable) and contact telephone number. - Notification should be a minimum of 7 calendar days prior to the start of works. For proposals other than maintenance works more advanced consultation or notification may be required - Website - Email distribution list.
Site inductions	<p>All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include:</p> <ul style="list-style-type: none"> - All proposal specific and relevant 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	<ul style="list-style-type: none"> - 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.
Verification	<ul style="list-style-type: none"> - A noise verification program is to be carried out in accordance with the Construction Noise and Vibration Management Plan and any approval and licence conditions.
Attended vibration measurements	<ul style="list-style-type: none"> - Where required, attended vibration measurements should be undertaken at the commencement of vibration generating activities to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage.
Update Construction Environmental Management Plans	<ul style="list-style-type: none"> - The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.

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Action required	Details
Building condition surveys	<ul style="list-style-type: none"> - Undertake building dilapidation surveys on all buildings located within the minimum work distances for vibration prior to commencement of activities with the potential to cause property damage.
Source controls	
Construction hours and scheduling	<ul style="list-style-type: none"> - Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time period.
Equipment selection	<ul style="list-style-type: none"> - Use quieter construction methods where feasible and reasonable - Ensure plant including the silencer is well maintained.
Use and siting of plant	<ul style="list-style-type: none"> - The offset distance between noisy plant and adjacent sensitive receivers is to be maximised - Plant used intermittently to be throttled down or shut down - Noise-emitting plant to be directed away from sensitive receivers - Only have necessary equipment on site.
Plan worksites and activities to minimise noise	<ul style="list-style-type: none"> - Locate compounds away from sensitive receivers and discourage access from local roads - Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site - Where additional activities or plant may only result in a marginal noise increase and speed up works, consider limiting duration of impact by concentrating noisy activities at one location and move to another as quickly as possible - Very noisy activities (such as concrete sawing and jackhammering) should be scheduled for normal working hours. If the work cannot be undertaken during the day, it should be completed before 12:00 am - Where practicable, work should be scheduled to avoid major student examination periods when students are studying for examinations such as before or during Higher School Certificate and at the end of higher education semesters - If programmed night work is postponed the work should be re-programmed and the approaches in the CNVG apply again.
Non-tonal and ambient sensitive reversing alarms	<ul style="list-style-type: none"> - 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 works - Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.
Minimise disturbance arising from delivery of goods to construction sites	<ul style="list-style-type: none"> - Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers - Select site access points and roads as far as possible away from sensitive receivers - Dedicated loading/unloading areas to be shielded if close to sensitive receivers - Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible - Avoid or minimise out-of-hours movements where possible.

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Action required	Details
Engine compression brakes	<ul style="list-style-type: none"> - Limit the use of engine compression brakes at night and in residential areas - Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'In-service test procedures' and standard.
Path controls	
Shield stationary noise sources such as pumps, compressors, fans, etc.	<ul style="list-style-type: none"> - Stationary noise sources should be enclosed or shielded where feasible and reasonable whilst ensuring that the occupational health and safety of workers is maintained.
Shield sensitive receivers from noisy activities	<ul style="list-style-type: none"> - Use structures to shield sensitive receivers from noise such as site shed placement and noise curtains - Temporary noise barriers should be setup around noisy works including concrete saw and jackhammering.

Additional noise management measures

The CNVG provides the following information regarding further mitigation measures for certain receivers exceeding noise management levels and are presented below in Table 4-10. Table 4-11 provides the trigger levels at which the additional mitigation measures are required as per the affected distances provided in Section 4.1.3. The additional mitigation measures matrices would be used to determine the additional measures after the application of standard mitigation measures where reasonable and feasible.

The distances provided by the construction noise estimator tool are considered conservative and are based on indicative construction scenarios and activity sound power levels. A more detailed assessment could be undertaken to refine the distances or predict construction noise levels at individual receivers.

Table 4-10: Additional management measures

Measure	Description	Abbreviation
Notification	Advanced warning of works and potential disruptions can assist in reducing the impact on the community. The notification may consist of a letterbox drop (or equivalent) detailing work activities, time periods over which these will occur, impacts and mitigation measures. Notification should be a minimum of 5 working days prior to the start of works. The approval conditions for proposals may also specify requirements for notification to the community about works that may impact on them.	N
Specific notifications	<p>Specific notifications are letterbox dropped (or equivalent) to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise objectives. The specific notification provides additional information when relevant and informative to more highly affected receivers than covered in general letterbox drops.</p> <p>The exact conditions under which specific notifications would proceed are defined in the relevant Additional Mitigation Measures (CNVG Tables C1 to C3). This form of communication is used to support periodic notifications, or to advertise unscheduled works.</p>	SN
Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Proposal representatives would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual	IB

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Measure	Description	Abbreviation
	briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the proposal. Where the resident cannot be met with individually then an alternative form of engagement should be used.	
Respite offers	<p>Respite Offers should be considered made where there are high noise and vibration generating activities near receivers. As a guide work should be carried out in continuous blocks that do not exceed 3 hours each, with a minimum respite period of one hour between each block. The actual duration of each block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers.</p> <p>The purpose of such an offer is to provide residents with respite from an ongoing impact. This measure is evaluated on a proposal-by-proposal basis, and may not be applicable to all proposals.</p>	RO
Respite period 1	Out of hours construction noise in out of hours period 1 shall be limited to no more than three consecutive evenings per week except where there is a Duration Respite. Work during these periods of work should be separated by not less than one week and no more than 6 evenings per month.	R1
Respite period 2	Night time construction noise in out of hours period 2 shall be limited to two consecutive nights except for where there is a Duration Respite. For night work these periods of work should be separated by not less than one week and 6 nights per month. Where possible, high noise generating works shall be completed before 11 pm.	R2
Duration respite	<p>Respite offers and respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration proposals. 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 through Duration Respite so that the proposal can be completed more quickly.</p> <p>The proposal team should engage with the community where noise levels are expected to exceed the NML to demonstrate support for Duration Respite.</p> <p>Where there are few receivers above the NML each of these receivers should be visited to discuss the proposal to gain support for Duration Respite.</p>	DR
Alternative accommodation	Alternative accommodation options may be offered to residents living in close proximity to construction works that are likely to experience highly intrusive noise levels (CNVG Tables C1-C3). The specifics of the offer will be identified on a proposal-by-proposal basis. Additional aspects for consideration shall include whether the highly intrusive activities occur throughout the night or before midnight.	AA
Verification	Please see CNVG Appendix F for more details about verification of Noise and Vibration levels as part of routine checks of noise levels or following reasonable complaints. This verification should include measurement of the background noise level and construction noise. Note this is not required for proposals less than three weeks unless to assist in managing complaints.	V

Table 4-11: Triggers for additional mitigation measures – airborne noise

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Perception	dBA above RBL	dBA above NML	AMM
All hours			
75 dBA or greater	-	-	N, V, RO
Standard hours: Mon to Fri (7am-6pm), Sat (8am-1pm), Sun / pub hol (no work)			
Noticeable	5 to 10	0	-
Clearly audible	11 to 20	1 to 10	-
Moderately intrusive	21 to 30	11 to 20	N, V
Highly intrusive	> 30	> 20	N, V
OOHW Period 1: Mon to Fri (6pm-10pm), Sat (7am-8am & 1pm-10pm), Sun / pub hol (8am-6pm)			
Noticeable	5 to 10	5 or lower	-
Clearly audible	11 to 20	6 to 15	N, R1, DR
Moderately intrusive	21 to 30	16 to 25	V, N, R1, DR
Highly intrusive	> 30	> 25	V, IB, N, R1, DR, SN
OOHW Period 1: Mon to Fri (10pm-7am), Sat (10pm-8am), Sun / pub hol (6pm-7am)			
Noticeable	5 to 10	5 or lower	N
Clearly audible	11 to 20	6 to 15	V, N, R2, DR
Moderately intrusive	21 to 30	16 to 25	V, IB, N, SN, R2, DR
Highly intrusive	> 30	> 25	AA, V, IB, N, SN, R2, DR

4.4.2 Construction vibration

A heritage sandstone wall was identified as being potentially within the construction footprint for the Southern works. If the heritage cosmetic damage safe working distances cannot be maintained, the structure should be inspected by a suitably qualified heritage consultant and structural engineer to determine if the heritage structure is structurally unsound. In the event that it is, a conservative cosmetic damage objective of 3 mm/s peak particle velocity level would be considered (based on German Standard DIN 4150-3 Structural Vibration – Part 3: Effects of vibration on structure (German Standards, 2016)).

When conducting vibration intensive works around buildings or structures that are within the relevant safe working distances, a smaller roller should be used, or less intensive vibratory methods should be conducted. Where the vibration safe working distances to nearby structures cannot be maintained, a building condition inspection reports should be undertaken.

The condition report should classify building structure and susceptibility to damage in accordance with the BS 7385-2:1993 *Evaluation and measurement for vibration in buildings: Guide for measurement of vibration and evaluation of their effects on building* (British Standard, 1993) classifications. The resulting building classifications are to be used for determination of the applicable BS 7385-2:1993 vibration criteria curves.

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Condition inspections are to identify high-risk buildings where additional vibration restrictions and more stringent criteria may apply.

Where construction activities generating vibration are to be undertaken at a distance less than those provided above in Table 4-8, alternative equipment of a smaller size should be employed to ensure properties are outside of the safe work buffer distances outlined. If residual impacts are still present, then initial vibration monitoring trials should be undertaken at the commencement of vibratory rolling activities. The initial vibration trials should include:

- determine the frequency dependent BS 7385-2:1993 vibration criteria from the vibration generating equipment dominant frequencies
- confirming safe working buffer distances for that equipment in that work area based on the frequency dependent BS 7385-2:1993 vibration criteria.

When vibration generating equipment is operating within the above confirmed buffer distances, additional vibration monitoring equipment should be deployed at the building foundation with a trigger level based on the frequency dependent BS 7385-2:1993 vibration criteria. If the vibration level on the equipment is reached a visual alarm should be triggered to alert the operators that the vibration criteria have been exceeded.

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5 OPERATIONAL IMPACT ASSESSMENT

To exceed the minor works relative increase criteria of 2.0 dB, a minimum increase in traffic volumes of 58% is required. The minor works are not anticipated to increase traffic volumes and therefore a 2.0 dB relative increase is not expected.

Additionally, the relative increase criteria can be exceeded when the new road alignment moves closer to sensitive receivers. A review of the proposed final road alignment was undertaken, and no potential exceedances of the relative increase criteria were identified as a result of changed road alignments.

Noise and Vibration Impact Assessment

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6 CONCLUSION

This noise and vibration impact assessment has been prepared to assess potential impacts from the proposed road works along the Wakehurst Parkway road corridor.

Potential noise impacts during the construction and operational phases of the project have been assessed in accordance with the following key guidelines:

- **Construction:** *Interim Construction Noise Guideline* (DECC, 2009) and the *Construction Noise and Vibration Guideline (for road and maritime works)* (TfNSW, 2022a)
- **Operation:** *Road Noise Criteria Guideline* (TfNSW, 2022b).

Existing background and road traffic noise levels were measured at two locations.

6.1 Construction noise

Construction works are proposed to be undertaken during and outside standard construction hours. Works outside standard hours would be required in order to provide a safe work environment, accommodate utility relocations and to minimise traffic disruptions on the local road network.

Distances for which additional mitigation measures are required for nearby sensitive receivers are provided in Table 4-5 for works in the Northern section and Table 4-6 for works in the Southern section.

Vibration safe working buffer distances were provided for construction equipment with the potential to have vibration intensive distances.

Construction noise and vibration management measures have been recommended in section 4.4.

6.2 Operational noise

The road project is considered a minor works project in accordance with the RNCG.

For the proposed design options, no exceedances of the operational relative increase noise criteria is predicted to occur.

Noise and Vibration Impact Assessment

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7 REFERENCES

- Australian Standards (2010), *AS2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites*.
- British Standard (1993), *BS 7385 Part 2 – 1993 Evaluation and measurement for vibration in buildings*.
- Department of Environment and Conservation (DEC) (2006), *Assessing Vibration: a technical guideline*.
- Department of Environment and Climate Change (DECC) (2009), *Interim Construction Noise Guideline*.
- Department of Environment, Climate Change and Water (DECCW) (2011), *Road Noise Policy*.
- German Standard (2016), *DIN4150-3:2016 Vibrations in buildings – Part 3: Effects on structures*.
- NSW EPA (2011), *Applying the NSW Road Noise Policy Application notes*.
- SustainJV (2023), *Construction Staging Strategy Report*.
- Transport for NSW (2016), *Construction Noise and Vibration Guideline*.
- Transport for NSW (2022a), *Construction Noise and Vibration Guideline (for road and maritime works)*.
- Transport for NSW (2022b), *Road Noise Criteria Guideline*.
- Transport for NSW (2022c), *Application Notes for the Road Noise Criteria Guideline*.

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APPENDIX A – BUILDINGS WITHIN VIBRATION SAFE WORKING DISTANCES

Addresses with buildings potentially within 25 metres of the construction footprint

Northern section

88 Wakehurst Parkway, North Narrabeen

92 Wakehurst Parkway, North Narrabeen

1 Elanora Road, Elanora Heights

3 Elanora Road, Elanora Heights

Southern section

4 Wakehurst Parkway, Oxford Falls

Addresses with buildings potentially within 100 metres of the construction footprint

Northern section

4 Elanora Road, Elanora Heights

30 Palm Terrace, North Narrabeen

6 Elanora Road, Elanora Heights

34 Palm Terrace, North Narrabeen

102 Wakehurst Parkway, Elanora Heights

36 Palm Terrace, North Narrabeen

104 Wakehurst Parkway, Elanora Heights

38 Palm Terrace, North Narrabeen

112 Wakehurst Parkway, Elanora Heights

40 Palm Terrace, North Narrabeen

120 Wakehurst Parkway, Elanora Heights

26A Palm Terrace, North Narrabeen

5 Carefree Road, North Narrabeen

42 Wakehurst Parkway, North Narrabeen

7 Carefree Road, North Narrabeen

44 Wakehurst Parkway, North Narrabeen

9 Carefree Road, North Narrabeen

46 Wakehurst Parkway, North Narrabeen

11 Carefree Road, North Narrabeen

48 Wakehurst Parkway, North Narrabeen

13 Carefree Road, North Narrabeen

64 Wakehurst Parkway, North Narrabeen

15 Carefree Road, North Narrabeen

66 Wakehurst Parkway, North Narrabeen

41 Carefree Road, North Narrabeen

68 Wakehurst Parkway, North Narrabeen

43 Carefree Road, North Narrabeen

70 Wakehurst Parkway, North Narrabeen

47 Carefree Road, North Narrabeen

72 Wakehurst Parkway, North Narrabeen

49 Carefree Road, North Narrabeen

74 Wakehurst Parkway, North Narrabeen

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Addresses with buildings potentially within 100 metres of the construction footprint

51 Carefree Road, North Narrabeen	76 Wakehurst Parkway, North Narrabeen
53 Carefree Road, North Narrabeen	78 Wakehurst Parkway, North Narrabeen
55 Carefree Road, North Narrabeen	80 Wakehurst Parkway, North Narrabeen
57 Carefree Road, North Narrabeen	82 Wakehurst Parkway, North Narrabeen
59 Carefree Road, North Narrabeen	84 Wakehurst Parkway, North Narrabeen
61 Carefree Road, North Narrabeen	86 Wakehurst Parkway, North Narrabeen
45A Carefree Road, North Narrabeen	88 Wakehurst Parkway, North Narrabeen
2 Mirrool Street, North Narrabeen	92 Wakehurst Parkway, North Narrabeen
3 Mirrool Street, North Narrabeen	42A Wakehurst Parkway, North Narrabeen
4 Mirrool Street, North Narrabeen	84A Wakehurst Parkway, North Narrabeen
6 Mirrool Street, North Narrabeen	43 Woorarra Avenue, North Narrabeen
8 Mirrool Street, North Narrabeen	45 Woorarra Avenue, North Narrabeen
10 Mirrool Street, North Narrabeen	47 Woorarra Avenue, North Narrabeen
28 Palm Terrace, North Narrabeen	49 Woorarra Avenue, North Narrabeen

Southern section

2 Dreadnought Road, Oxford Falls	2591 Oxford Falls Road, Oxford Falls
33 Dreadnought Road, Oxford Falls	1100 Oxford Falls Road, Oxford Falls
6/50 Meatworks Avenue, Oxford Falls	1078 Oxford Falls Road, Oxford Falls
4 Wakehurst Parkway, Oxford Falls	

Addresses with heritage buildings within 68 m of the construction footprint

Southern section

Oxford Falls Public School, Corner Dreadnought Road and Wakehurst Parkway OXFORD FALLS NSW 2100

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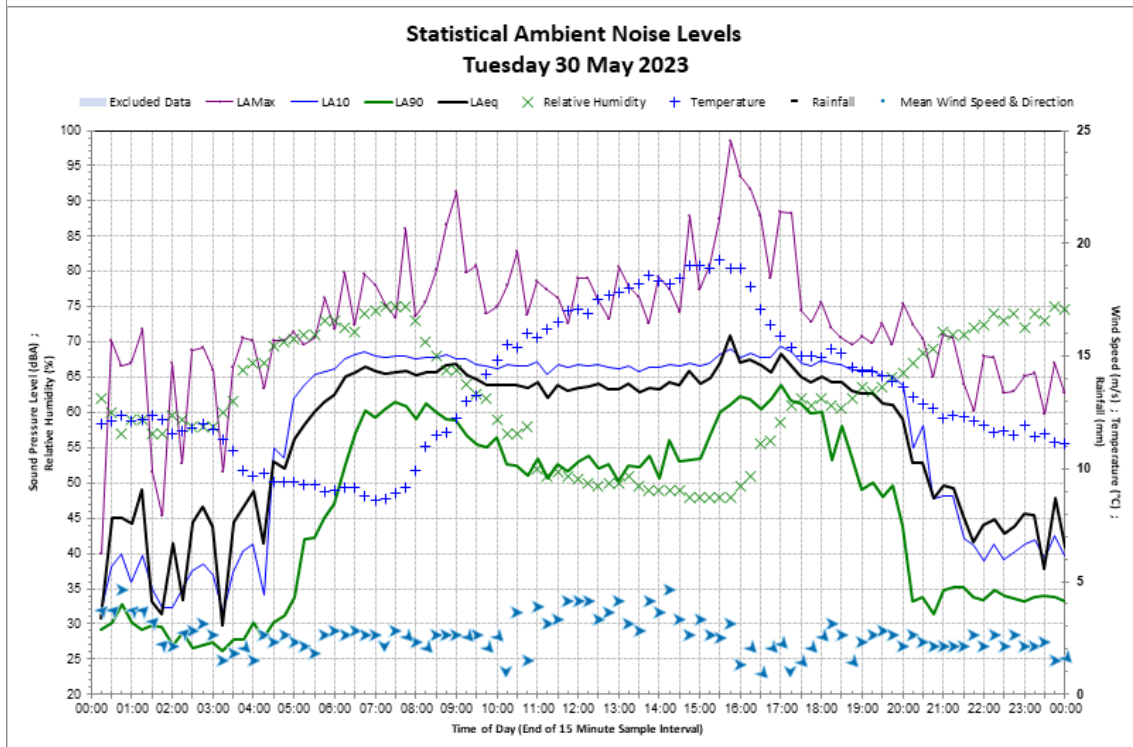
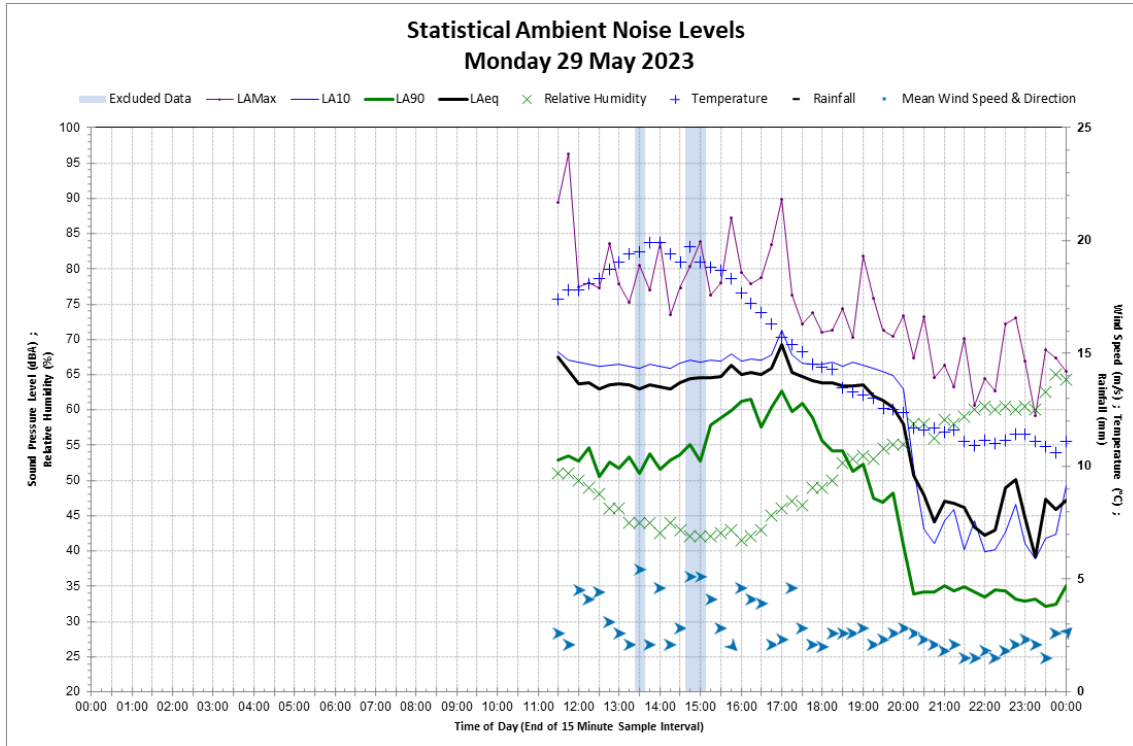
APPENDIX B– DAILY NOISE MONITORING CHARTS

NM1 – Northern Works – 76 Wakehurst Parkway, North Narrabeen

Date	ABL Day L90	ABL Evening L90	ABL Night L90	Leq Day	Leq Evening	Leq Night
Monday-29-May-23	51.7	33.9	26.9	64.9	59.4	57.8
Tuesday-30-May-23	52	33	27	65	60	58
Wednesday-31-May-23	52	34	24	65	60	57
Thursday-1-Jun-23	53	36	28	65	61	58
Friday-2-Jun-23	53	40	27	65	62	56
Saturday-3-Jun-23	52	42	36	65	60	57
Sunday-4-Jun-23	50	36	31	64	57	57
Monday-5-Jun-23	50	-	-	64	-	-
Overall	52	36	27	65	60	57

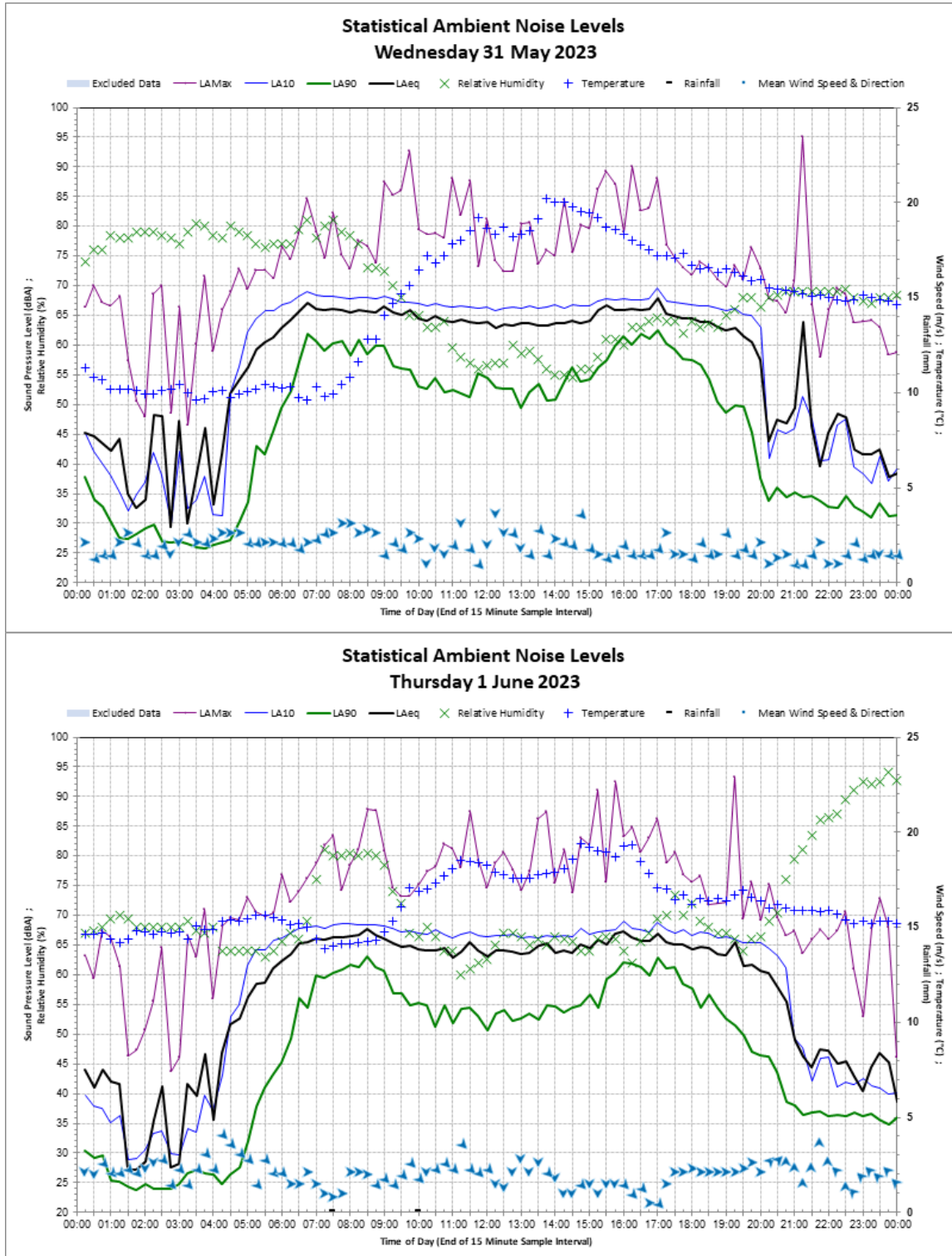
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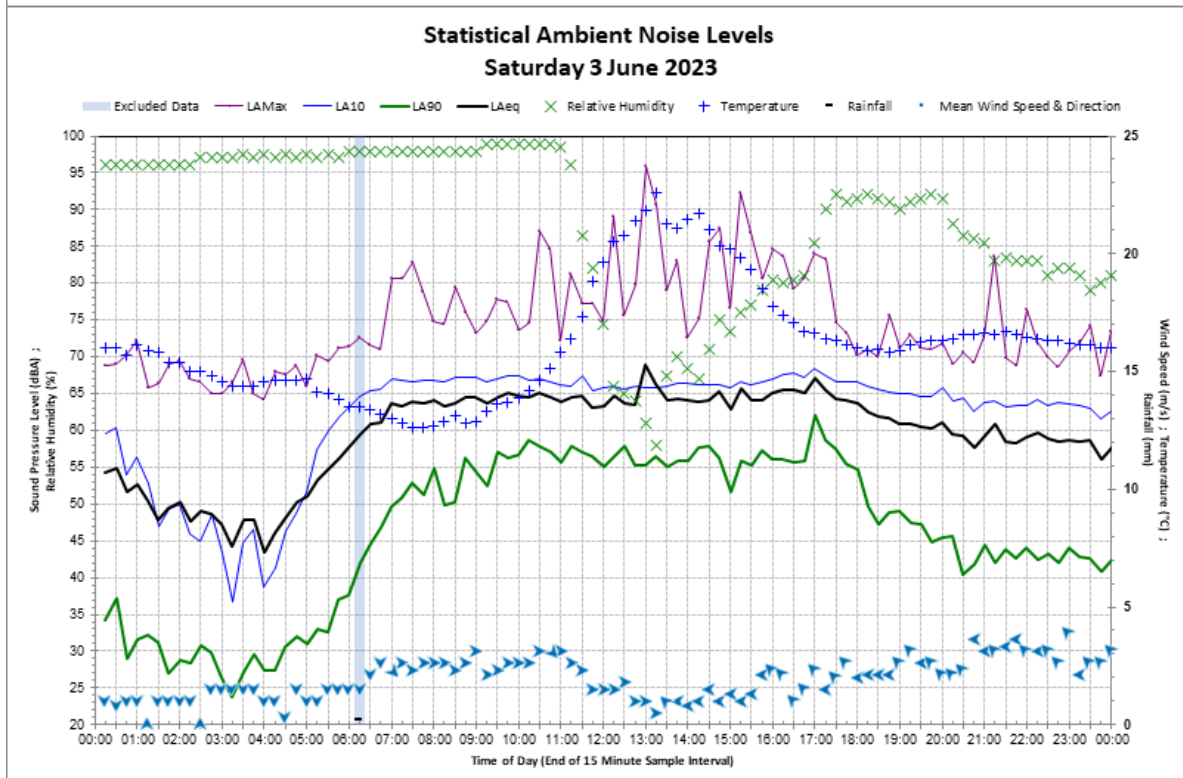
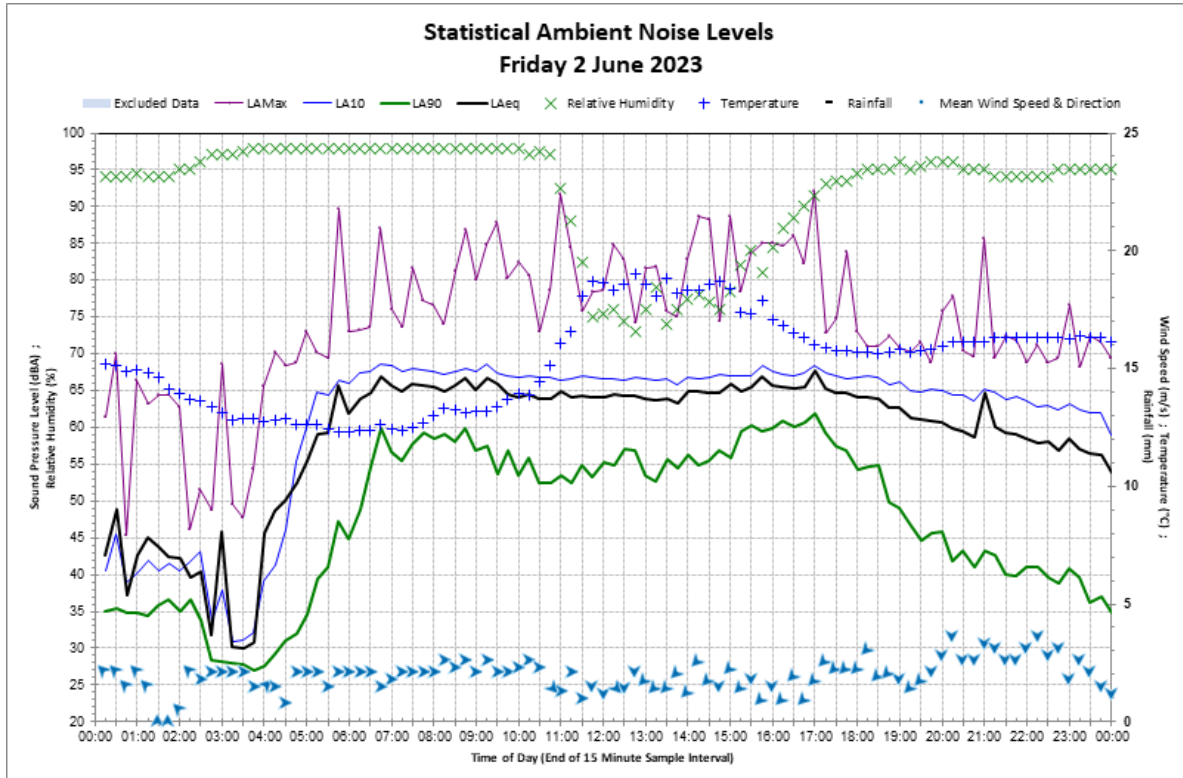
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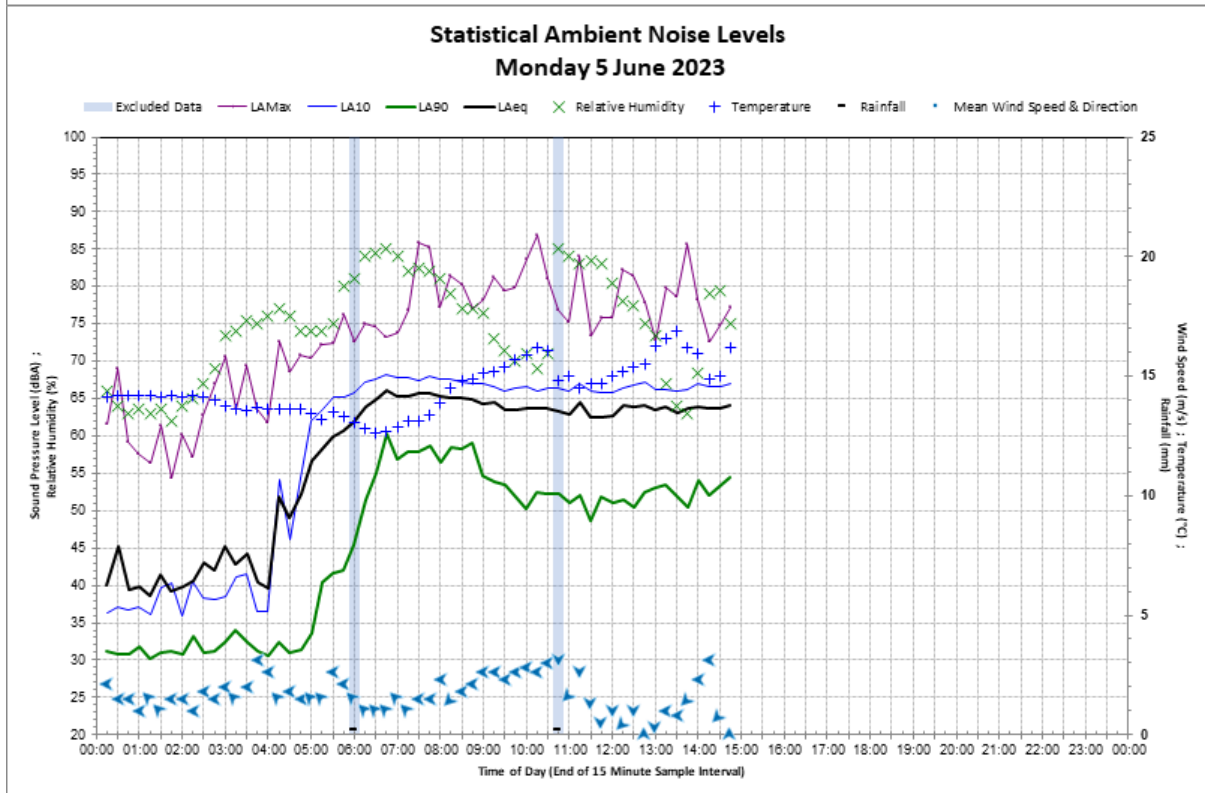
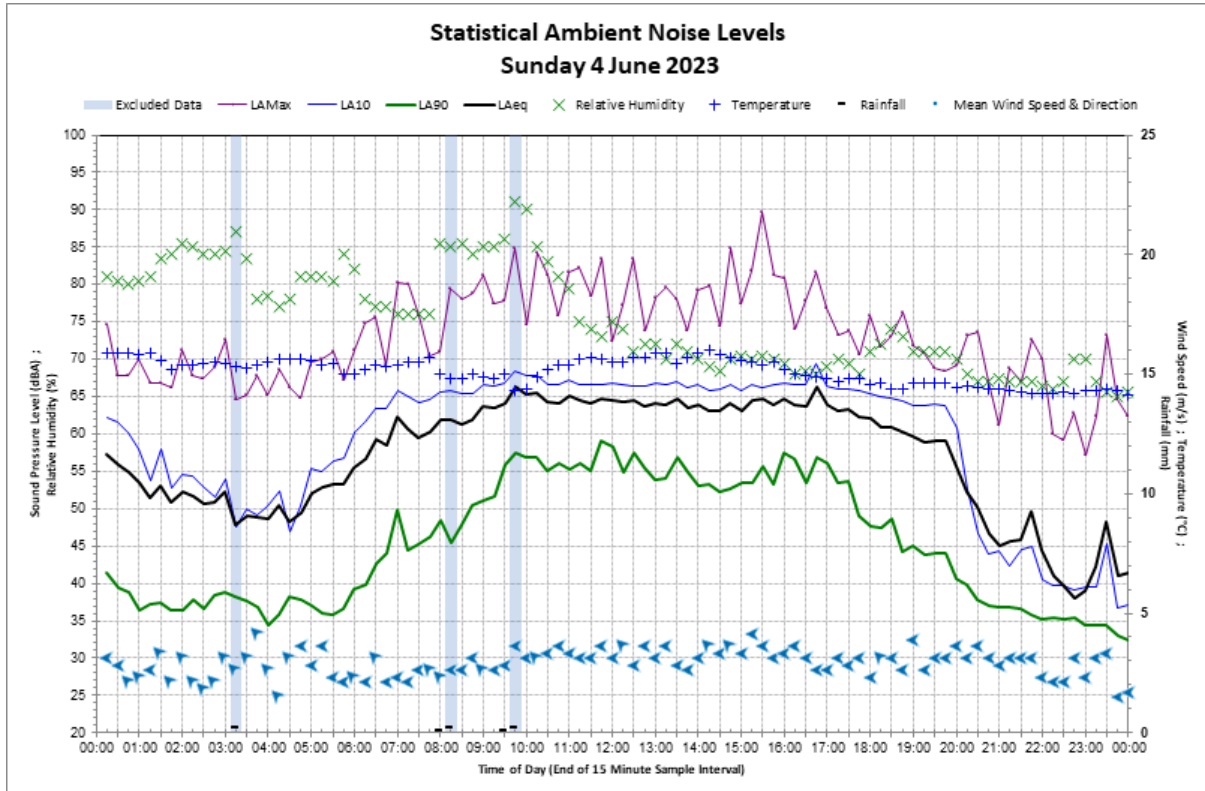
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NM2 – Southern Works – 2 Dreadnought Road, Oxford Falls

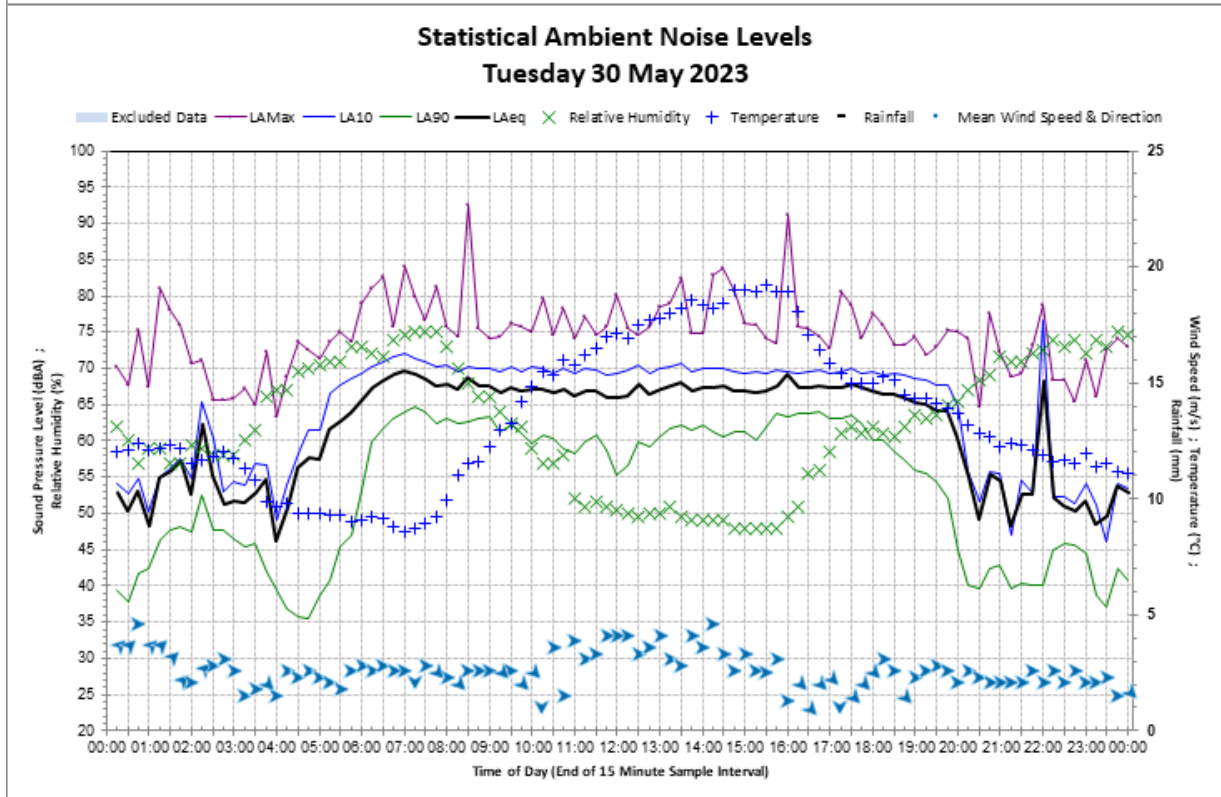
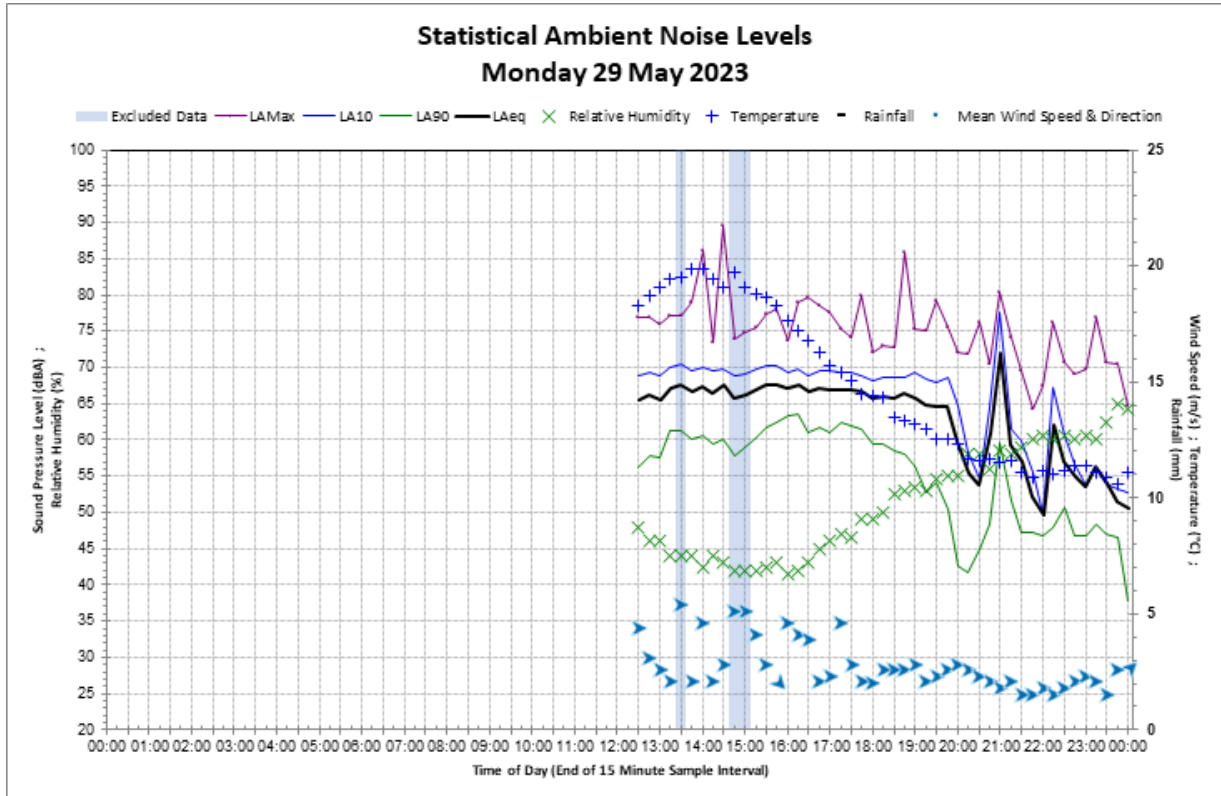
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Date	ABL Day L90	ABL Evening L90	ABL Night L90	Leq Day	Leq Evening	Leq Night
Monday-29-May-23	58	43	38	67	64	61
Tuesday-30-May-23	59	40	36	67	63	61
Wednesday-31-May-23	60	37	35	67	63	60
Thursday-1-Jun-23	61	38	34	68	63	60
Friday-2-Jun-23	60	49	27	67	64	59
Saturday-3-Jun-23	58	43	33	67	63	60
Sunday-4-Jun-23	58	36	31	67	61	60
Monday-5-Jun-23	59	-	-	67	-	-
Overall	59	40	34	67	63	60

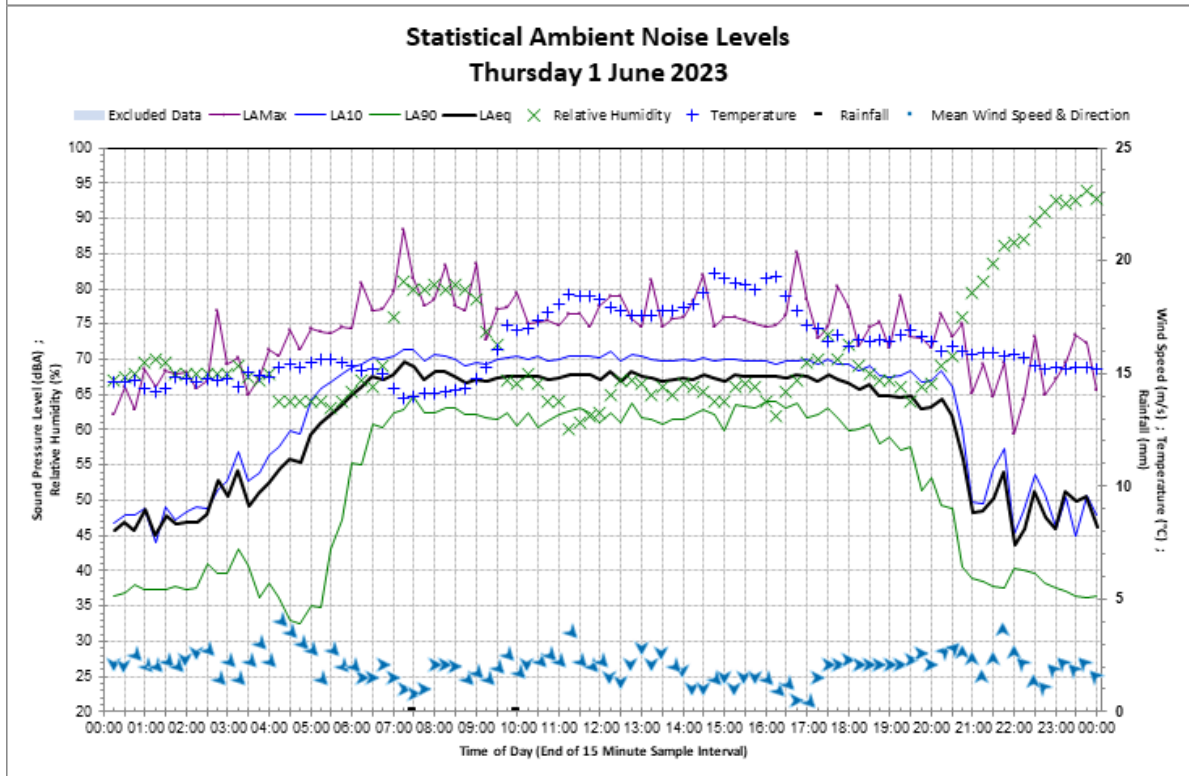
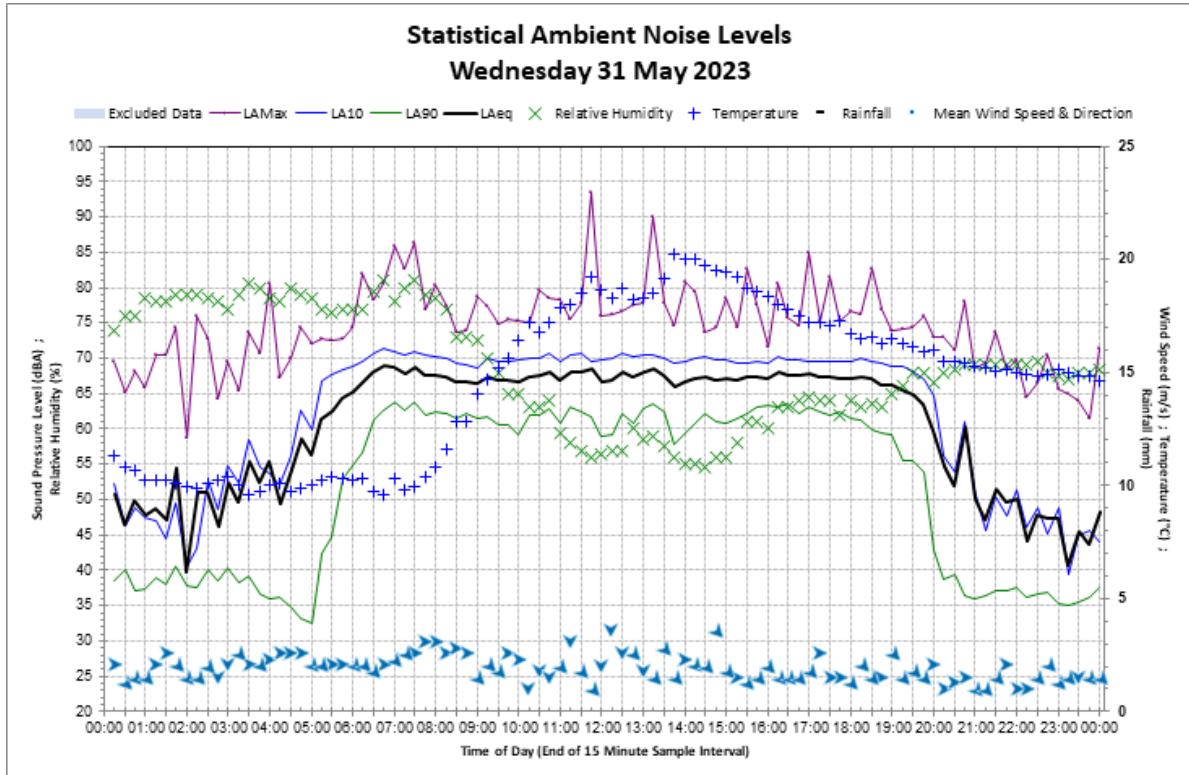
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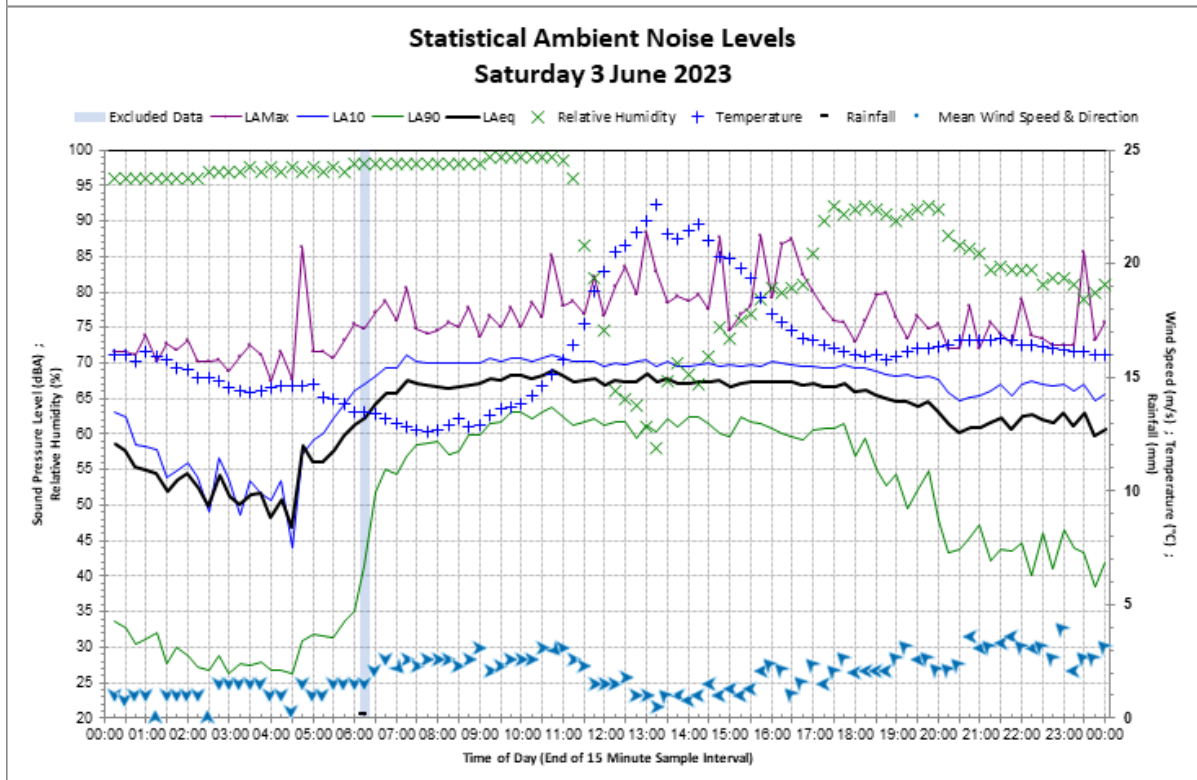
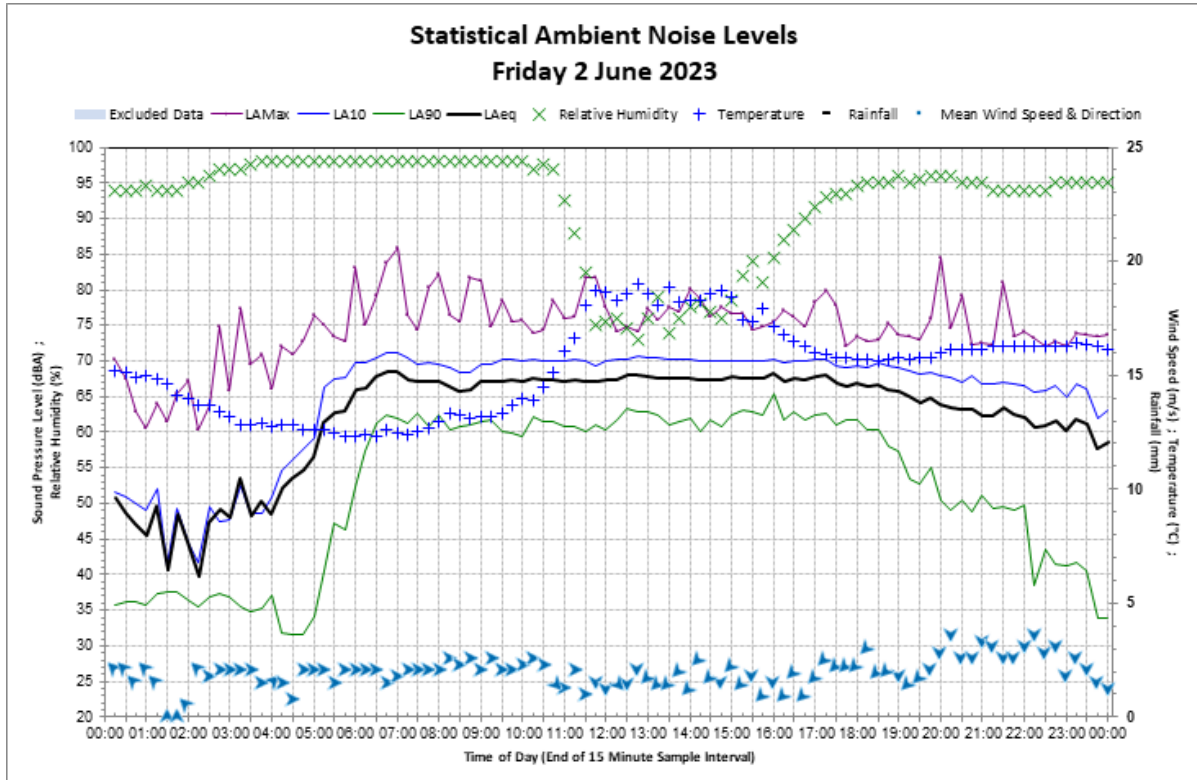
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