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DA Noise Impact Assessment

Oakdale West Estate

Bakers Lane, Kemps Creek

Report Number 610.15617-R2

7 June 2017

Goodman Property Services (Aust) Pty Limited
GPO Box 4703
Sydney NSW 2001

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Oakdale West Estate

Bakers Lane, Kemps Creek

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1 INTRODUCTION

1.1 Background

Goodman Property Services (Aust) Pty Limited (Goodman) proposes to develop the Oakdale West Estate (OWE) project site on Bakers Lane, Kemps Creek.

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Goodman to prepare a Noise Impact Assessment (NIA) of the noise impacts associated with the project. This report presents the results of the assessment and forms part of the Development Application (DA) for the proposal.

This report has been prepared to inform a State Significant Development Application (SSDA) for the staged development of the OWE. The aim of the report is to assess the potential noise impacts of the proposed development on nearby sensitive receivers and has been prepared in accordance with the guidelines outlined in **Section 1.2**. The report responds to the Secretary's Environmental Assessment Requirements (SEARs) as they relate to noise and vibration. This report supports an Environmental Impact Statement (EIS) prepared in respect of the proposal and should be read in conjunction with the EIS and development plans submitted with the SSDA.

The SEARs relevant to this report have been considered and are addressed as outlined in **Table 1**.

Table 1 Secretary's Environmental Assessment Requirements (SEARs)

Relevant SEARs	Response
Description of all potential noise sources such as construction, operational, on and off site traffic noise.	This report includes a description of potential noise sources associated with the development. Operational noise including traffic noise is addressed in **Section 4**. Construction noise and vibration is addressed in **Section 5**.
A noise impact assessment including a cumulative noise impact assessment in accordance with relevant Environment Protection Authority guidelines.	This assessment includes consideration of the cumulative noise impacts of the potential noise emissions from the development in accordance with relevant Environmental Protection Authority guidelines (refer to **Section 4.1.3.1**).
An assessment of impacts on any proposed residential zones.	An assessment of potential impacts on proposed nearby residential receivers has been undertaken for operational noise and construction noise in **Section 4** and **Section 5** respectively.

The SSDA for the OWE seeks approval for the following:

- A Master Plan to guide the staged development of the OWE including:
  - An Indicative Master Plan and Development Master Plan.
  - Development Controls.
  - Landscape Concept Plan.
  - Biodiversity Offsets.
- Stage 1 Development to be implemented in stages including:

  Estate works for the entire OWE comprising:
  - Site preparation and mobilisation including clearing of land and importation of fill material.
  - Earthworks and support structures (batters and retaining walls).
  - Estate stormwater management including construction of detention basins.
  - Realignment and rehabilitation of creek and riparian land.

- Landscaping and public domain works to estate roads, estate entrance and key nodes.
- Land stabilisation and rehabilitation.
- Environmental protection and management measures.
- Subdivision aligned with infrastructure and servicing.

Development of Stage 1 Precincts comprising:

- Construction of site access, estate roads and utility infrastructure and connection of services.
- On-lot stormwater, infrastructure and services.
- Construction and fit out of buildings.
- Construction of hardstand, loading and car parking.
- Landscaping and signage.
- Use of buildings for generic warehousing and distribution uses.

Future stages of development in the OWE would be subject to separate assessment and approval.

1.2 Relevant Guidelines

Noise from the operation of the proposal has been assessed in accordance with the NSW *Industrial Noise Policy* (INP), NSW EPA, 2000, with guidance on sleep disturbance criteria taken from the online Application Notes to the INP.

Construction noise has been assessed in accordance with the *Interim Construction Noise Guideline* (ICNG), DECC, 2009.

Vibration from operation and construction has been assessed in accordance with *Assessing Vibration: A Technical Guideline*, DEC, 2006.

1.3 Terminology

The assessment has used specific acoustic terminology. An explanation of common terms is included as **Appendix A**.

2 DEVELOPMENT DESCRIPTION

2.1 Proposed Development

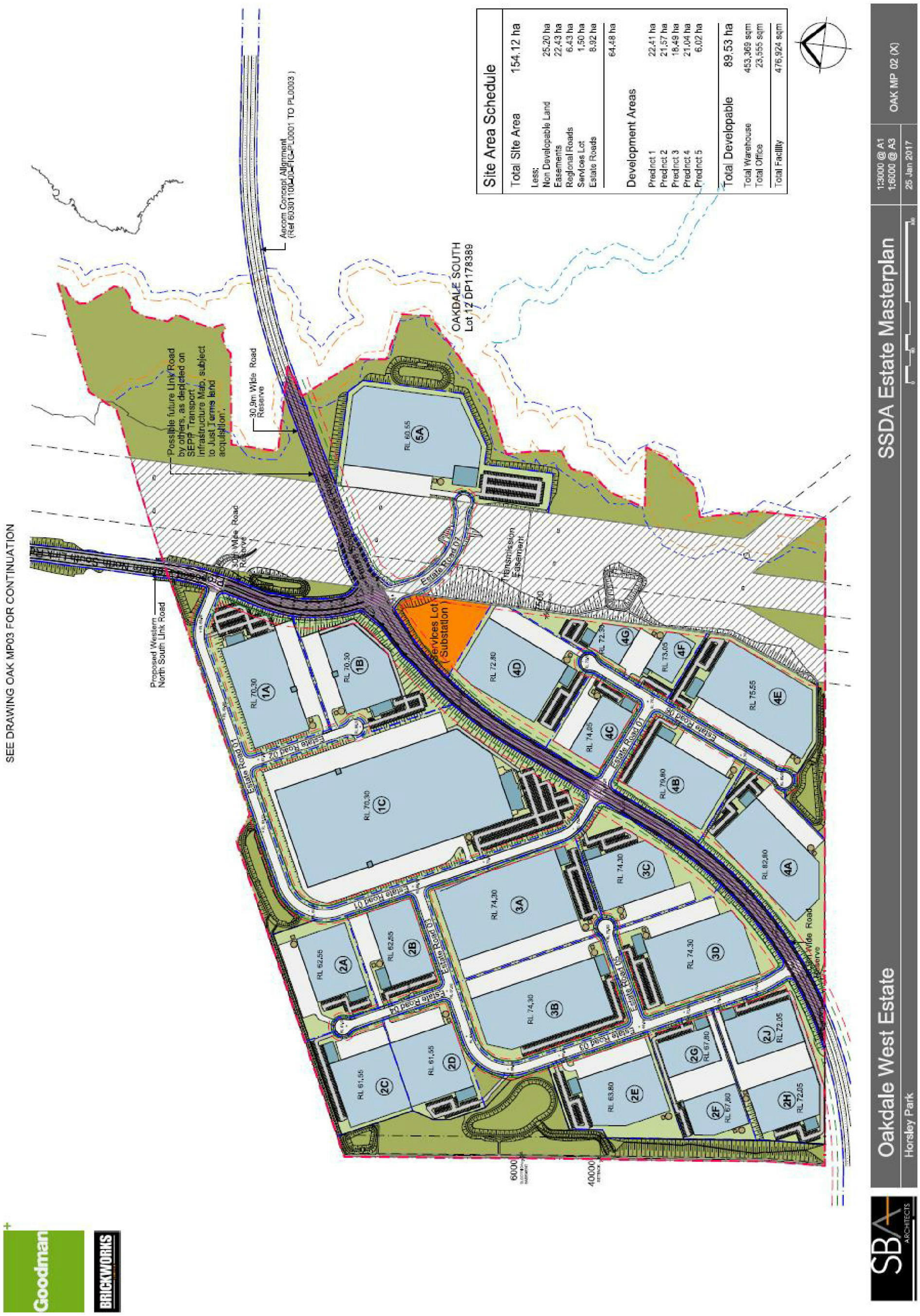
The OWE site is located on Bakers Lane, Kemps Creek. The project site is approximately 154 ha and is currently a rural property primarily consisting of paddocks for livestock. The primary access route to the site is currently via Bakers Lane. The site is located approximately 4.5 km west of the M7 Motorway. The development site is shown in blue in **Figure 1**.

Figure 1 Oakdale West Estate Site Location

Note 1: Project site depicted in blue.

The OWE consists of five precinct areas totalling approximately 89.53 ha of developable area. The total warehouse and office spaces are approximately 453,369 m^2 and 23,555 m^2 respectively. The OWE masterplan is provided in **Figure 2**.

Figure 2 Oakdale West Estate Masterplan



Note 1: Drawing provided by Goodman, dated 25/01/2017.

2.2 Hours of Operation

For the purpose of this assessment, it has been assumed that the development will operate 24 hours a day, 7 days a week. This means that the assessment covers the worst-case potential period of operation on the site.

2.3 Onsite Vehicle Movements

Estimated onsite vehicle movements were provided by the client.

Based on a Gross Floor Area (GFA) of approximately 477,000 m^2, the onsite vehicle movements included in this assessment are as follows:

- Approximately 750 vehicles per hour during AM peak hour.
- Approximately 750 vehicles per hour during PM peak hour.
- Approximately 225 vehicles per hour during night-time peak hour (30% of PM peak).
- Approximately 8,760 vehicles per day.
- Vehicles outside of the AM and PM peak hours are split evenly across each hour.
- Heavy vehicles make up approximately 25% of total vehicle movements.

3 DESCRIPTION OF THE EXISTING ENVIRONMENT

3.1 Existing Environmental Noise and Sensitive Receivers

The existing ambient noise environment surrounding the development site is typical of a rural environment, with the natural environment (insects, wind etc) dominating the background noise.

The nearest noise and vibration sensitive receivers are residential premises that lie to the west, south, southeast and north of the OWE.

Residences to the west of the OWE are situated in the Emmaus Village with the closest sensitive receiver building approximately 20 m to the west of the OWE site boundary

Residences to the south of the OWE are located in the Kemps Creek rural-residential area and are primarily situated on large rural properties with the closest dwelling approximately 20 m to the south of the OWE site boundary.

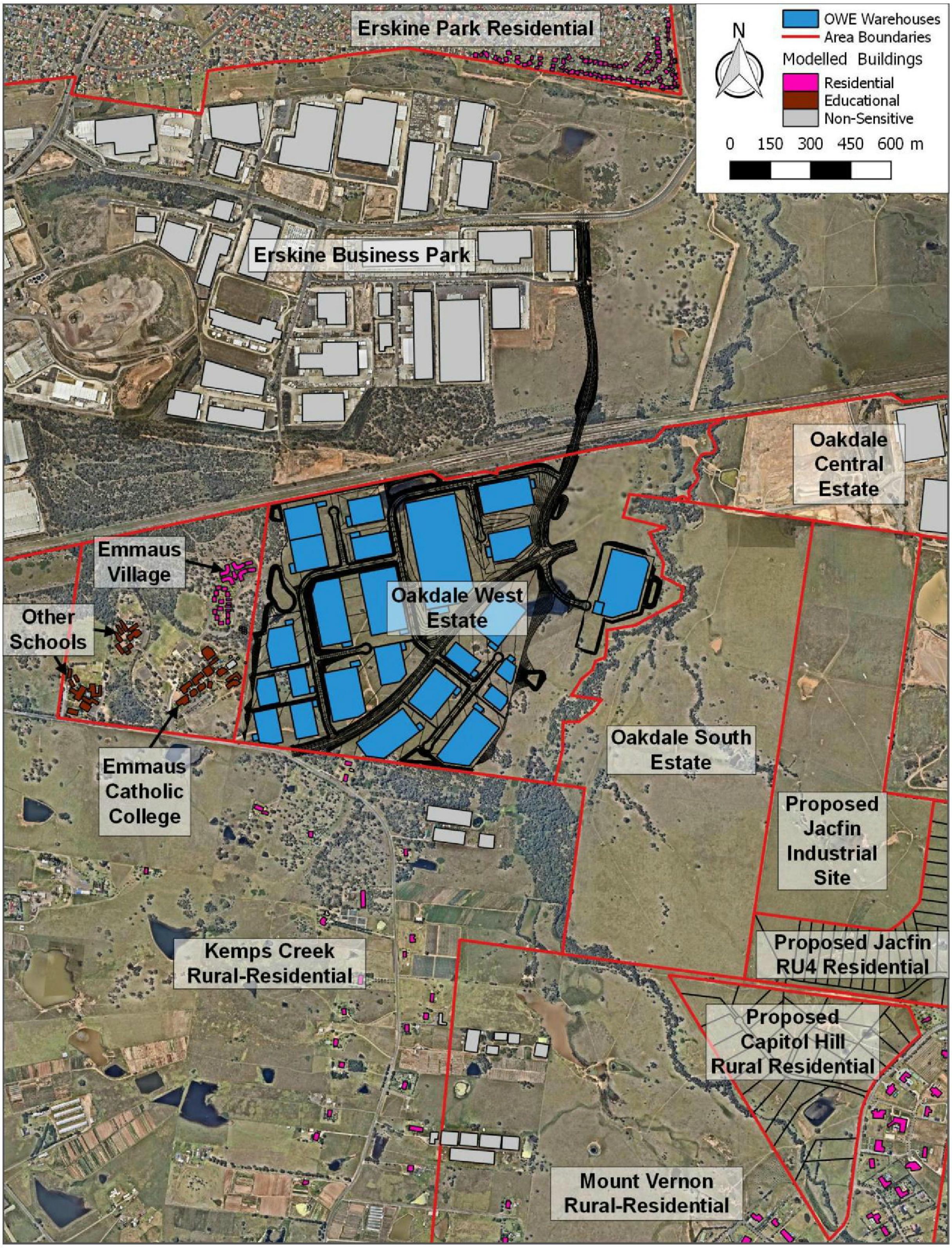
Residences to the southeast of the OWE include rural-residential in Mount Vernon and residential in Horsley Park, as well as the proposed Jacfin RU4 residential subdivision and the proposed Capitol Hill residential subdivision. The closest part of these residential lands is approximately 840 m to the southwest of the OWE site boundary

Residences to the north of the OWE are situated in the Erskine Park residential suburban area approximately 1,500 m to the north of the OWE site boundary.

Three schools and a childcare centre are situated to the west of the project site. Emmaus Catholic College, Trinity Primary School, Mamre Anglican School and Little Smarties Early Learning Centre are located approximately 10 m, 400 m, 500 m and 600 m to the west of the OWE site boundary respectively.

All receiver areas surrounding the OWE and the individually modelled buildings are shown in **Figure 3**.

Figure 3 Receiver Areas and Modelled Buildings



3.2 Ambient Noise Surveys and Monitoring Locations

To quantify and characterise the existing ambient noise environment around the project site a baseline noise survey was undertaken at locations on the site boundaries.

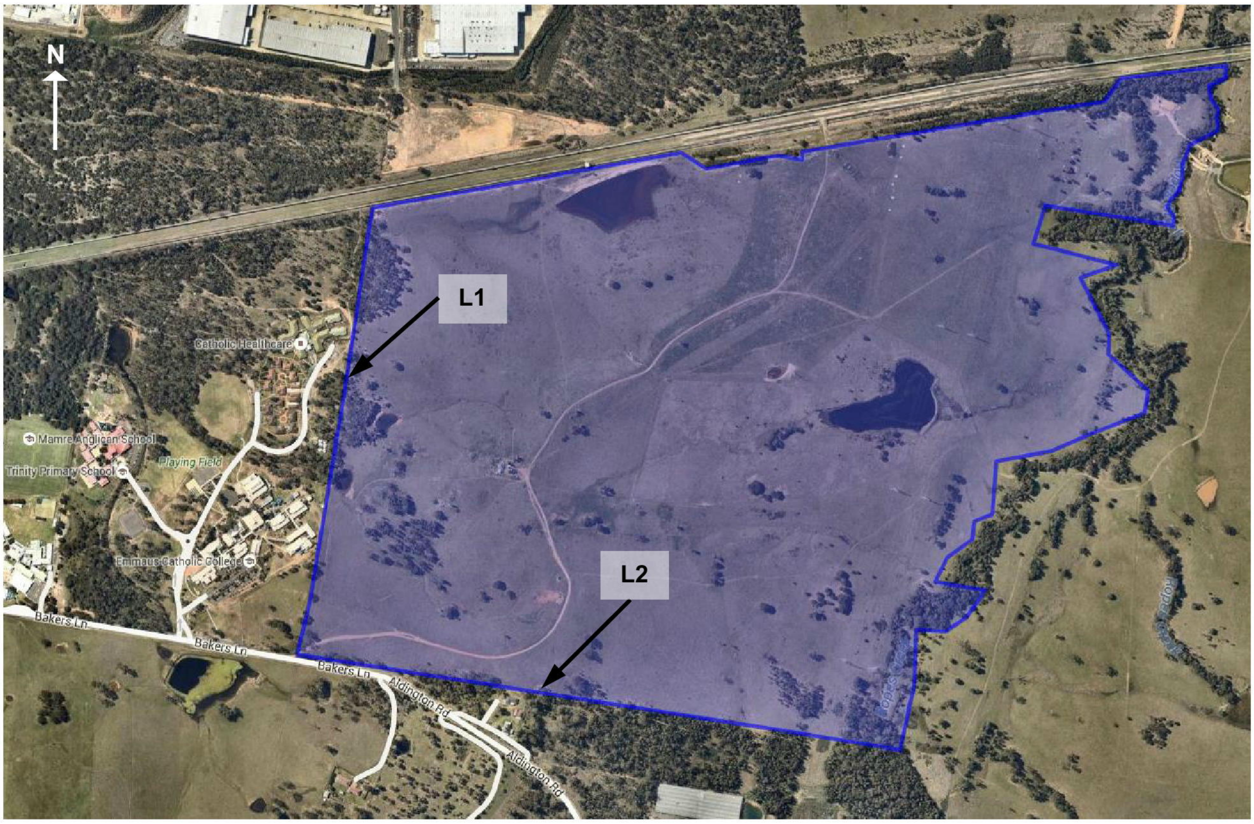
The noise monitoring locations detailed in **Table 2** were selected to be representative of the surrounding sensitive receivers potentially affected by the construction and operation of the development. The noise monitoring locations are indicated in **Figure 4**.

The measured noise levels have been used to establish appropriate noise goals for operation of the development and as a basis for assessing potential noise impacts during construction.

Table 2 Ambient Noise Monitoring Locations

Noise Monitoring Location ID	Noise Monitoring Location Details	Noise Monitoring Dates	Equipment Serial Number
L1	Northwestern site boundary – adjacent to Emmaus Village	9/11/15-17/11/15	27579
L2	Southern site boundary – adjacent to Aldington Rd residence	9/11/15-17/11/15	27578

Figure 4 Noise Monitoring Locations



Note 1: Project site depicted in blue.

3.3 Methodology for Unattended Noise Monitoring

The noise loggers continuously measured noise levels in 15 minute sampling periods to determine the existing L_{Aeq}, L_{A90} and other relevant statistical noise levels during the daytime, evening and night-time periods.

The noise monitoring was undertaken with Svantek 957 Noise Loggers. The equipment was set up with microphones at 1.5 m above the ground level. All microphones were fitted with wind shields.

All noise measurement instrumentation used in the survey was designed to comply with the requirements of Australian Standard AS IEC 61672.1-2004 - *Electroacoustics—Sound level meters, Part 1: Specifications* and carried appropriate and current manufacturer or National Association of Testing Authorities (NATA) calibration certificates. The calibration of the loggers was checked both before and after each measurement survey and the variation in calibration at all locations was found to be within acceptable limits at all times.

The results of the noise monitoring have been processed in accordance with the procedures contained in the INP to exclude noise identified as extraneous and/or data affected by adverse weather conditions (ie strong wind or rain) so as to establish representative noise levels in each area.

3.4 Unattended Noise Monitoring Results

The results of the unattended ambient noise surveys are presented in **Table 3** as the Rating Background Level (RBL) and L_{Aeq} (energy averaged) noise levels for the daytime, evening and night-time periods. The 24 hour daily noise levels at each monitoring location are graphically presented in **Appendix B**.

Table 3 Summary of Unattended Noise Logging Results

Noise Monitoring Location	Noise Level (dBA)[1]					
	Daytime		Evening		Night-time	
	RBL	LAeq	RBL	LAeq	RBL	LAeq
L1	39	47	38	46	36	45
L2	34	45	35	42	32	41

Note 1: The Rating Background Levels (RBL) and LAeq noise levels have been obtained using the calculation procedures documented in the INP.

Note 2: INP Governing Periods – Day: 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday; Evening: 6.00 pm to 10.00 pm; Night: 10.00 pm to 7.00 am Monday to Saturday, 10.00 pm to 8.00 am Sunday.

3.5 Attended Noise Measurements

Attended measurements of ambient noise have been used to determine the various noise sources that influence the existing noise environment. During each measurement the observer noted the various noise sources and the contributing noise level.

At each location the attended measurements were performed for 15 minutes using calibrated Brüel and Kjær 2260 Precision Sound Level Meters, serial numbers 2414604 and 2414605. Wind speeds were less than 5 m/s at all times, and all measurements were performed at a height of 1.5 m above ground level.

Calibration of the sound level meters was checked before and after each measurement and the variation in calibration at all locations was found to be within acceptable limits at all times.

The noise environment at each of the attended monitoring locations is described in **Table 4**.

Table 4 Attended Noise Monitoring Results

Measurement Details	Measured Noise Levels (dBA)			Description of Ambient Noise Source – Typical LAmax Levels
	LA90	LAeq	LAmax	
L1 9/11/2015 2:26 pm Wind: 0-1 m/s	44	47	63	Insects and birds: 43-46 dBA Birds: 52 dBA Aeroplanes: 50 dBA Light aircraft: 59-63 dBA Helicopter: 61 dBA Ride-on mower in Emmaus Village: 47-51 dBA
L1 17/11/2015 12:48 pm Wind: 0-1 m/s	42	47	59	Insects and birds: 40-46 dBA Birds: 51-59 dBA Aeroplanes: 50 dBA Light aircraft: 51 dBA Leaf-blower in Emmaus Village: 48-52 dBA Construction noise from the north barely audible Emmaus Catholic College students barely audible
L2 9/11/2015 3:13 pm Wind: 0-1 m/s	40	46	68	Insects and birds: 38-41 dBA Nearby insect: 45-51 dBA Birds: 68 dBA Light aircraft: 56 dBA Helicopter: 54-57 dBA Cars on Aldington Rd: 49 dBA
L2 17/11/2015 1:27 pm Wind: 0-1 m/s	34	46	65	Insects and birds: 33-40 dBA Birds: 50 dBA Aeroplanes: 53-55 dBA Light aircraft: 56-65 dBA Cars on Aldington Rd: 46 dBA

3.6 Prevailing Weather Conditions

Adverse weather conditions such as wind and temperature inversions have the potential to increase noise levels from industrial or road noise sources at nearby receivers.

In order to determine the prevailing weather conditions for the OWE, 12 months of weather data (January 2016 to December 2016) was obtained from the Bureau of Meteorology automatic weather station at Horsley Park, which is approximately 5 km to the southeast of the project site. This data was analysed to determine the frequency of noise enhancing wind and temperature inversion conditions which may affect noise levels at the site.

3.6.1 Wind

Wind has the potential to increase noise at a receiver when wind is light and stable, and blows from the direction of the source of noise to the receiver. At higher wind speeds, the noise produced by the wind can obscure noise generated from industrial and transport sources.

Wind effects need to be considered where wind is a feature of the project area. The INP states that where wind blows from the source to the receiver at speeds up to 3 m/s for more than 30% of the daytime, evening or night-time in any season, then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

The measured weather data was analysed to determine the frequency of occurrence of wind speeds up to 3 m/s in each period. The results of the wind analysis for the daytime, evening and night-time periods are presented in **Table 5**, **Table 6** and **Table 7**, respectively. In each table, the wind direction and percentage occurrence are those dominant during each season.

Table 5 Seasonal Frequency of Occurrence of Wind Speed Intervals in 2016 – Daytime

Season	Dominant Wind Direction	Frequency of Occurrence			
		Calm	0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s
Annual	N	10.2%	14.7%	5.7%	20.4%
Summer	NNE	11.2%	14.3%	7.3%	21.6%
Autumn	N	10.9%	15.9%	5.9%	21.8%
Winter	NW	12.8%	18.8%	5.6%	24.4%
Spring	NNW	6.0%	14.0%	5.3%	19.3%

Table 6 Seasonal Frequency of Occurrence of Wind Speed Intervals in 2016 – Evening

Season	Dominant Wind Direction	Frequency of Occurrence			
		Calm	0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s
Annual	ESE	17.8%	9.1%	6.1%	15.2%
Summer	E	9.5%	10.4%	10.3%	20.8%
Autumn	S	25.4%	12.1%	6.3%	18.4%
Winter	WSW	24.1%	15.3%	8.2%	23.5%
Spring	E	12.6%	10.4%	6.7%	17.0%

Table 7 Seasonal Frequency of Occurrence of Wind Speed Intervals in 2016 – Night-time

Season	Dominant Wind Direction	Frequency of Occurrence			
		Calm	0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s
Annual	SW	37.8%	17.9%	8.7%	26.6%
Summer	SSW	42.0%	18.7%	8.8%	27.5%
Autumn	SW, WSW	44.0%	21.0%, 20.7%	10.6%,9.7%	31.6%, 30.3%
Winter	WSW	32.1%	17.6%	9.9%	27.5%
Spring	SW	32.4%	17.5%	7.1%	24.6%

The above analysis of prevailing wind conditions indicates that during the daytime and evening periods, winds of up to 3 m/s did not exceed the 30% threshold during any season. However, the 30% threshold was exceeded during the night-time period in autumn, in both the SW and WSW directions.

Based on the prevailing wind analysis conducted for the 2016 weather data, assessment of adverse weather during the daytime and evening is not required. However, it should be noted that weather assessments conducted for the area in previous years found wind to be a feature of the area during the daytime and evening periods.

While wind was not a feature of the area during 2016, a conservative approach has been taken and adverse weather has been included in this assessment for all periods.

3.6.2 Temperature Inversions

Temperature inversions have the ability to increase noise levels by focusing sound waves towards sensitive receivers. Temperature inversions occur predominantly at night-time when the atmosphere is stable and temperatures are cooler. For a temperature inversion to be a significant characteristic of the area, the INP defines that it needs to occur for approximately 30% of the total night-time during winter. This equates to approximately two nights per week.

The Pasquill-Gifford assignment scheme identifies seven Stability Classes – A to G – to categorise the degree of atmospheric stability, as shown in **Table 8**.

Table 8 Description of Atmospheric Stability Classes

Atmospheric Stability Class	Category Description
A	Extremely unstable
B	Moderately unstable
C	Slightly unstable
D	Neutral
E	Slightly stable
F	Moderately stable
G	Extremely stable

The measured weather data has been analysed to determine the frequency of each stability class and is presented in **Table 9**. Noise enhancing temperature inversions are categorised as atmospheric stability Class F or Class G.

Table 9 Night-time Stability Class Distribution – 2016

Stability Class	Frequency of Occurrence				
	Annual	Summer	Autumn	Winter	Spring
A	0.0%	0.0%	0.0%	0.0%	0.0%
B	0.0%	0.0%	0.0%	0.0%	0.0%
C	0.0%	0.0%	0.0%	0.0%	0.0%
D	39.5%	37.4%	34.7%	45.2%	41.5%
E	12.0%	11.7%	10.5%	12.4%	13.6%
F	12.9%	11.2%	13.7%	14.0%	12.9%
G	35.5%	39.7%	41.1%	28.5%	32.0%
F+G	48.4%	50.9%	54.8%	42.4%	44.9%

The above analysis indicates that temperature inversions of Class F or Class G occur more than 30% of the night-time period during all four seasons. Therefore, temperature inversions should be included in the assessment of noise impacts during the night-time period.

4 OPERATIONAL NOISE IMPACT ASSESSMENT

4.1 Operational Noise Criteria

Responsibility for the control of noise emissions in New South Wales is vested in Local Government and the NSW Environment Protection Authority (EPA).

The EPA oversees the *NSW Industrial Noise Policy* (INP) which provides a framework and processes for deriving noise criteria. The INP criteria for industrial noise sources have two objectives:

- Controlling the intrusive noise impacts in the short term for residences; and
- Maintaining noise level amenity for particular land uses for residents and other sensitive receivers.

4.1.1 Area Classification

The INP, for the purposes of determining the appropriate noise amenity criteria, characterises a "Rural" noise environment as an acoustical environment that is dominated by natural sounds, having little or no road traffic. Such areas may include:

- an agricultural area, except those used for intensive agricultural activities
- a rural recreational area such as resort areas
- a wilderness area or national park
- an area generally characterised by low background noise levels (except in the immediate vicinity of industrial noise sources).

Based on this definition and the noise environment measured and observed on site the project will be assessed as per the *rural* noise amenity criterion.

4.1.2 Intrusiveness Criterion

For assessing intrusiveness, the background noise generally needs to be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5 dB above the measured Rating Background Level (RBL), over any 15 minute period.

4.1.3 Amenity Criterion

The amenity criterion is based on land use and associated activities (and their sensitivity to noise emission). The cumulative effect of noise from industrial sources needs to be considered in assessing the impact. The criteria relate only to industrial-type noise sources and do not include road, rail or community noise. The existing noise level from industry is measured. If it approaches the criterion value, then noise levels from new industrial-type noise sources, (including air-conditioning mechanical plant) need to be designed so that the cumulative effect does not produce total noise levels that would significantly exceed the criterion.

4.1.3.1 Cumulative Noise Impacts

Existing industrial noise from nearby industrial activities is accounted for in the determination of the amenity criterion as outlined above. However, it has been requested by the NSW Department of Planning that the assessment also consider the cumulative noise impacts from the operation of the approved developments at the Oakdale Central, Oakdale South and Jacfin industrial sites which are currently either partially operational, under construction or undergoing approval.

The Noise Impact Assessments for these developments have been reviewed in order to add their future contribution to industrial noise levels present in the environment. This allows the amenity criterion derived for the Oakdale West Estate to take into account the cumulative noise impacts from these approved developments.

Table 2.2 of the INP outlines modifications to the Acceptable Noise Level (ANL) to account for existing levels of industrial noise. Taking noise emissions from the Oakdale Central, Oakdale South and Jacfin sites into consideration, the existing industrial L_{Aeq} noise level at nearby residential receivers to the OWE site is more than 6 dB below the Acceptable Noise Level (ANL) during the daytime period, up to 6 dB below the ANL during the evening period, and up to 2 dB below the ANL during the night-time period. This correlates to a maximum allowable L_{Aeq} noise level at residential receivers from the OWE of equal to the ANL during the daytime period, the ANL minus 1 dB during the evening period, and the ANL minus 4 dB during the night-time period.

4.1.4 Sleep Disturbance

Intermittent noises, in particular those with short durations, due to activities such as impact noise or hydraulic brake releases are not directly addressed by the INP. A definitive noise level whereby sleep disturbance is likely to occur is not available and research in the area is ongoing.

As a screening assessment, in order to minimise the risk of sleep disturbance resulting from these sources, the online *INP Application Notes* recommend that the $L_{A1(60second)}$ noise level outside a bedroom window should not exceed the prevailing background L_{A90} noise level by more than 15 dB during the 10.00 pm to 7.00 am night-time period.

Additionally, the summary of research included in the EPA *Road Noise Policy* (RNP, 2011) concludes that:

- Maximum internal noise levels below 50-55 dBA are unlikely to awaken people.
- One or two noise events per night, with maximum internal noise levels of 65-70 dBA, are not likely to affect health and wellbeing significantly.

Corresponding external criteria of L_{Amax} 60-65 dBA and 75-80 dBA respectively result, if a 10 dB loss through open windows is adopted (as suggested in the policy).

The wide discrepancy in sleep disturbance screening criteria reflects the uncertainty regarding definitive noise levels and sleep disturbance. Nonetheless, this assessment considers the INP and RNP sleep disturbance screening criteria, as well as the frequency of exposure to the intermittent noise.

4.1.5 Project Specific Noise Goals

Having defined the type of area, the processed results of the unattended noise monitoring were used to determine the project specific noise criteria. The intrusive and amenity criteria for nearby sensitive receivers are presented in **Table 10**. These criteria are nominated for the purpose of assessing potential noise impacts from the proposed development.

For each assessment period, the more stringent of the amenity or intrusive criteria are adopted as marked in **bold** in **Table 10**. Where both the amenity and intrusiveness criteria are marked in **bold**, assessment against both criteria is needed to determine which is the more stringent.

Table 10 Operational Noise Criteria for Sensitive Receivers Surrounding the Development Site

Receiver	Applicable Noise Logging Location	Time of Day	ANL[1] LAeq(period) (dB)	Measured RBL[2] LA90 (15minute) (dB)	Existing Industrial Noise Levels LAeq(period) (dB)[3]	Criteria for New Sources (dB)[4]		
						Intrusive LAeq (15minute)	Amenity LAeq(period)	Sleep Disturbance (LAmax)
Emmaus Village Residential	L1	Day	50	39	Up to 42	**44**	50	n/a
		Evening	45	38	Up to 39	**43**	44[5]	n/a
		Night	40	36	Up to 38	**41**[8]	**36**[5]	**51**
Other Residential	L2	Day	50	34	Up to 42	**39**	50	n/a
		Evening	45	35	Up to 39	**39**[6]	44[5]	n/a
		Night	40	32	Up to 38	**37**[8]	**36**[5]	**47**
School classrooms	n/a	Noisiest 1-hour period when in use	35 internal[7]	n/a	n/a	n/a	**45** external	n/a
Industrial	n/a	When in use	70	n/a	n/a	n/a	**70**	n/a

Note 1: ANL = "Acceptable Noise Level" for sensitive receivers in a Rural area.

Note 2: RBL = "Rating Background Level".

Note 3: Existing industrial noise levels include the cumulative noise impacts from the approved developments at the Oakdale Central, Oakdale South and Jacfin industrial sites as outlined in **Section 4.1.3.1**.

Note 4: Criteria for new sources is an external criteria.

Note 5: ANL for evening and night-time periods have been modified to account for existing levels of industrial noise (refer to **Section 4.1.3.1**).

Note 6: Daytime RBL criteria adopted for the evening as the daytime is the lower of the two (refer to the INP Application notes)

Note 7: ANL for school classrooms is an internal criteria. On the basis that external noise levels are typically 10 dB higher than internal noise levels when windows are open, an external ANL of 45 dBA has been adopted for school classrooms.

Note 8: Adopted criteria are marked in **bold**. Where the amenity criteria is lower than the intrusive criteria, both of these criteria apply.

It should be noted that the 36 dBA $L_{Aeq(period)}$ night-time criteria for residential is based on the Amenity criterion. For future 15-minute compliance measurement purposes, the intrusive criteria of 41 dBA $L_{Aeq(15minute)}$ and 37 dBA $L_{Aeq(15minute)}$ should be adopted for Emmaus Village residential and other residential respectively.

4.2 Operational Noise Modelling

Noise modelling of the development site was undertaken using SoundPLAN V7.1 modelling software.

The noise model was constructed from a combination of aerial photography, existing ground topography, design ground topography and design masterplans for the development. The local terrain, design of the development, receiver buildings and structures have been digitised in the noise model to develop a three-dimensional representation of the operations of the development and surrounding environment.

Based on the analysis of prevailing weather conditions (refer to **Section 3.6**), the noise model was run with both neutral weather conditions and adverse weather conditions as outlined in the INP. Applicable adverse weather conditions are specified as a 3 m/s source to receiver wind during the daytime and evening periods, and an F-class temperature inversion with a 2 m/s source to receiver drainage flow during the night-time period.

4.2.1 Modelled Onsite Vehicle Movements

The estimated onsite vehicle movements are outlined in **Section 2.3**.

To assess against the intrusive noise criteria for the daytime, evening and night-time periods, peak 15 minute vehicles movements for the daytime, evening and night-time periods have been modelled throughout the development. In addition, the total vehicle movements during the night-time period have been modelled to assess against the amenity criteria for the night-time period

These vehicle movements have been modelled throughout the development, with their distribution based on the GFA of the buildings they service, ie more vehicles are modelled travelling to large buildings than to smaller buildings.

Gas-powered forklifts used for unloading activities have been modelled in the hardstand areas of the development. At least one forklift for each heavy vehicle onsite has been modelled and assumed to operate continuously, 24 hours a day.

Sound power levels for the modelled vehicle movements and speed assumptions are outlined in **Table 11**.

Table 11 Sound Power Levels for Onsite Vehicle Movements

Noise Source	Sound Power Level (SWL)	Average Speed
Heavy Vehicles	103 dBA[1]	25 km/h
Light Vehicles	96 dBA	40 km/h
Gas-powered Forklifts	93 dBA	n/a

Note 1: This sound power level is typical of trucks travelling at low speeds, such as within industrial estates.

In order to assess the possibility of sleep disturbance, in addition to the above noise sources, heavy vehicle brake releases and reverse alarms (non-tonal) have been modelled in the hardstand areas of the development with a sound power level (SWL) of 115 dBA.

4.2.2 Modelled Fixed Sources

Fixed noise sources such as mechanical plant have been modelled throughout the development. As details of specific items of plant and exact locations are not yet known, a conservative approach to modelling has been conducted.

The adopted approach assumes fixed noise sources with a cumulative sound power level of 90 dBA per warehouse have been modelled at rooftop locations around the development to indicate potential noise impacts on the surrounding sensitive receivers. Fixed plant has been assumed to operate continuously, 24 hours a day.

When specific plant is selected during the detailed design phase of the project, compliance against the criteria should be checked using the actual sound power level data for the equipment to be installed and the final locations of the various items of plant.

4.3 Predicted Operational Noise Impacts (Without Mitigation)

The predicted operational noise levels for the OWE are summarised in **Table 12**. Noise contour maps of the operational results for daytime neutral weather, daytime adverse weather, night-time neutral weather and night-time adverse weather are shown in **Figure 5**, **Figure 6**, **Figure 7** and **Figure 8** respectively. These maps show the noise contours corresponding to the relevant criteria for that time period.

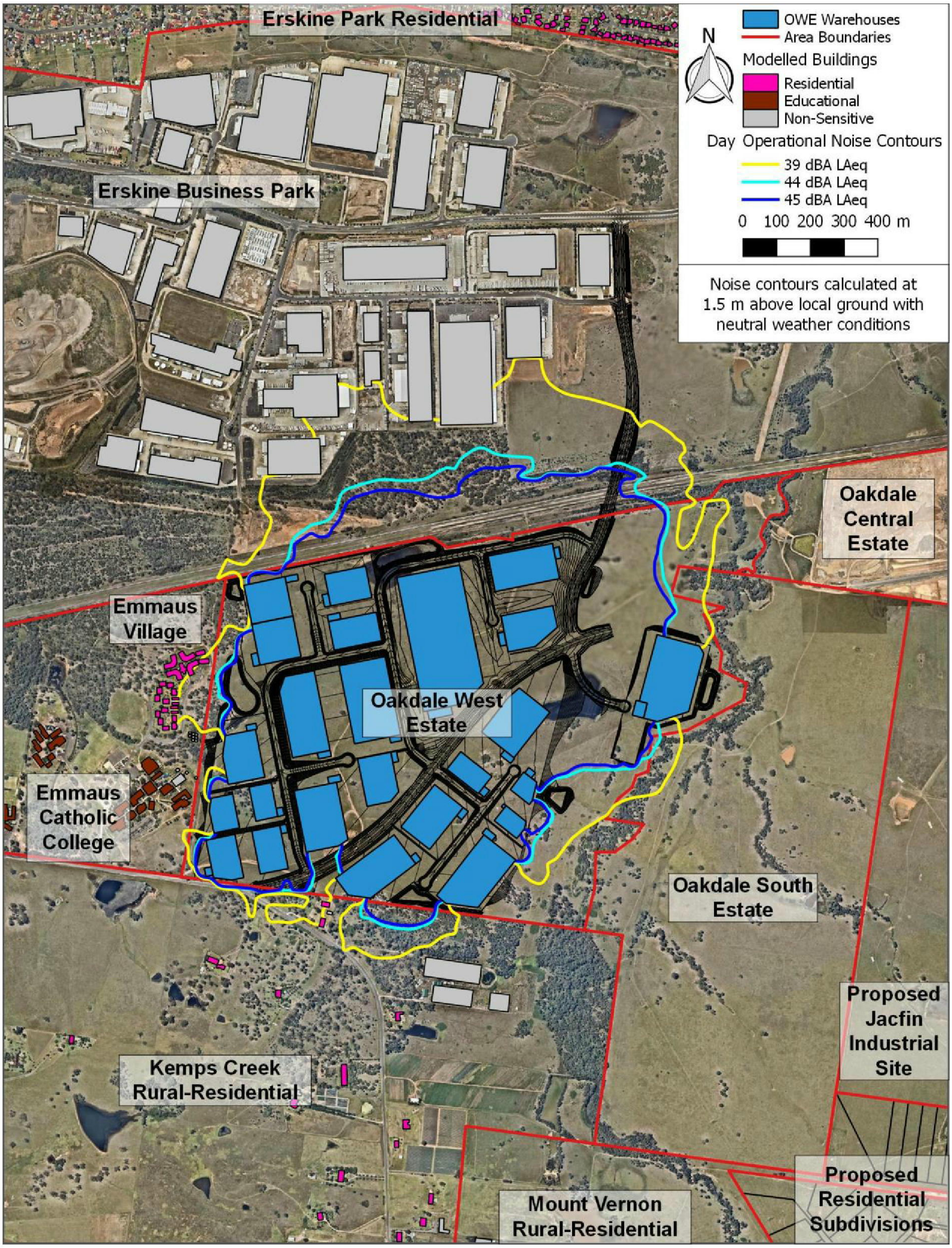
Table 12 Predicted Operational Noise Levels

Sensitive Receiver Area	Intrusive LAeq(15minute) Noise Criteria (dB)			Amenity LAeq(period) Noise Criteria (dB)	LAmax Noise Goals (dB)	Predicted Worst-case LAeq(15minute) Noise Levels (dB) [Number of Exceedances]						Predicted Worst-case LAeq(period) Noise Levels (dB) [Number of Exceedances]		Predicted Worst-case LAmax Noise Levels (dB) [Number of Exceedances]	
	Day	Eve	Night	Night	Sleep Disturbance	Day		Eve		Night		Night		Night	
						Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather
Emmaus Village Residential	44	43	41	36	51	Up to 41	**Up to 46 [3]**	Up to 41	**Up to 46 [8]**	Up to 36	Up to 40	Up to 30	Up to 35	Up to 47	Up to 50
Kemps Creek Residential	39	39	37	36	47	**Up to 41 [1]**	**Up to 46 [4]**	**Up to 41 [1]**	**Up to 46 [4]**	Up to 36	**Up to 40 [3]**	Up to 32	**Up to 37 [1]**	**Up to 48 [1]**	**Up to 52 [2]**
Mount Vernon & Horsley Park Residential	39	39	37	36	47	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30
Proposed Jacfin & Capitol Hill Residential	39	39	37	36	47	< 30	Up to 33	< 30	Up to 33	< 30	< 30	< 30	< 30	< 30	Up to 34
Erskine Park Residential	39	39	37	36	47	< 30	Up to 36	< 30	Up to 36	< 30	Up to 31	< 30	< 30	Up to 33	Up to 37
School classrooms	45	-	-	-	-	Up to 40	Up to 45	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Surrounding Commercial / Industrial	70	-	-	-	-	Up to 41	Up to 46	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Note 1: **Bold** text indicates noise levels that are above the criteria. Numbers in [brackets] indicate the number of receiver buildings where the criteria is exceeded.

Note 2: Applicable parameters for adverse weather are 3 m/s source to receiver wind during the daytime and evening, and F class temperature inversion with 2 m/s source to receiver drainage flow during the night-time.

Figure 5 Predicted Operational Noise Contours – Intrusive $L_{Aeq(15minute)}$ Day – Neutral Weather

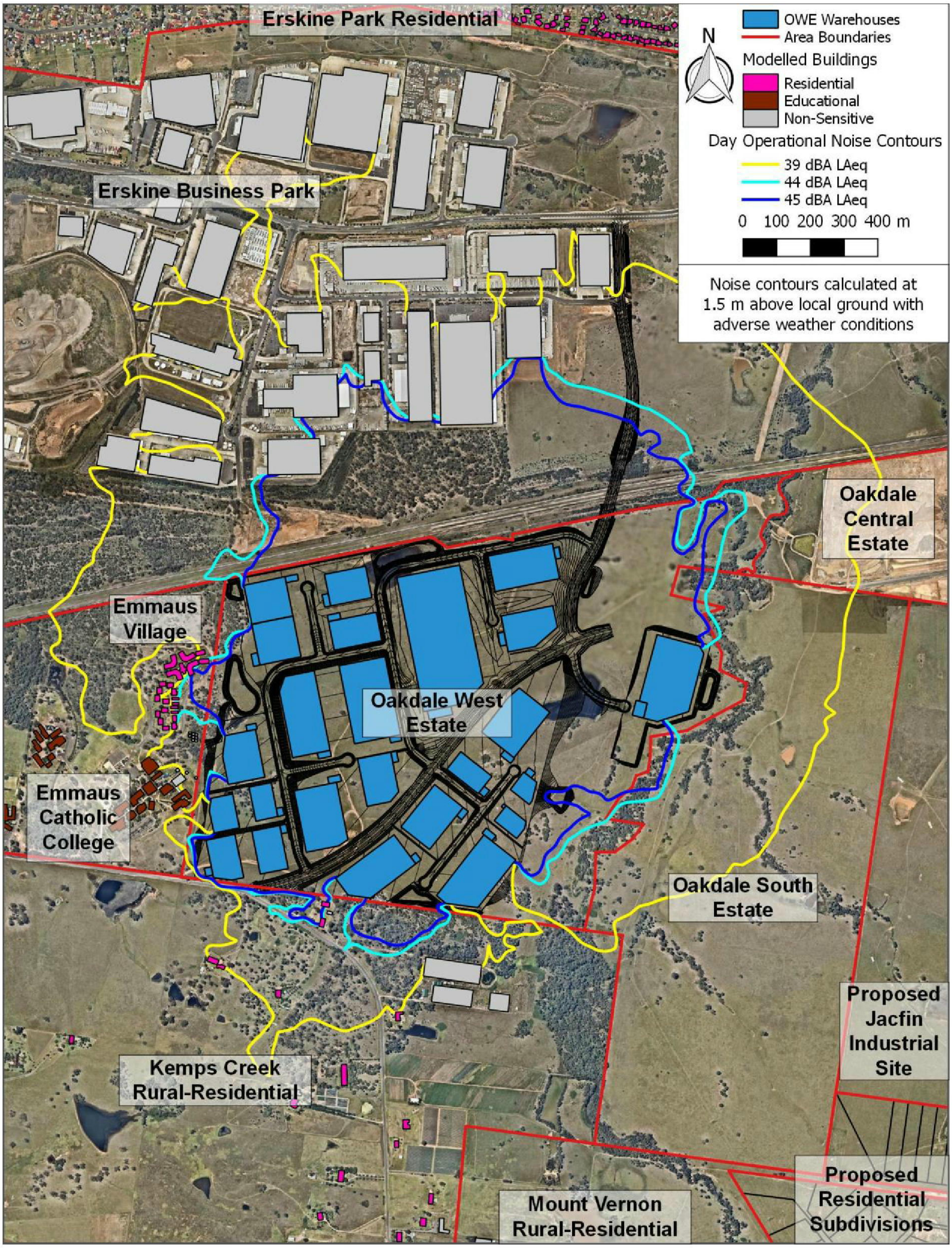


Note 1: 45 dBA LAeq noise contour (dark blue) corresponds to the noise criteria for school classrooms.

Note 2: 44 dBA LAeq noise contour (light blue) corresponds to the daytime intrusive noise criteria for residences in Emmaus Village.

Note 3: 39 dBA LAeq noise contour (yellow) corresponds to the daytime intrusive noise criteria for other residential receivers.

Figure 6 Predicted Operational Noise Contours – Intrusive LAeq(15minute) Day – Adverse Weather

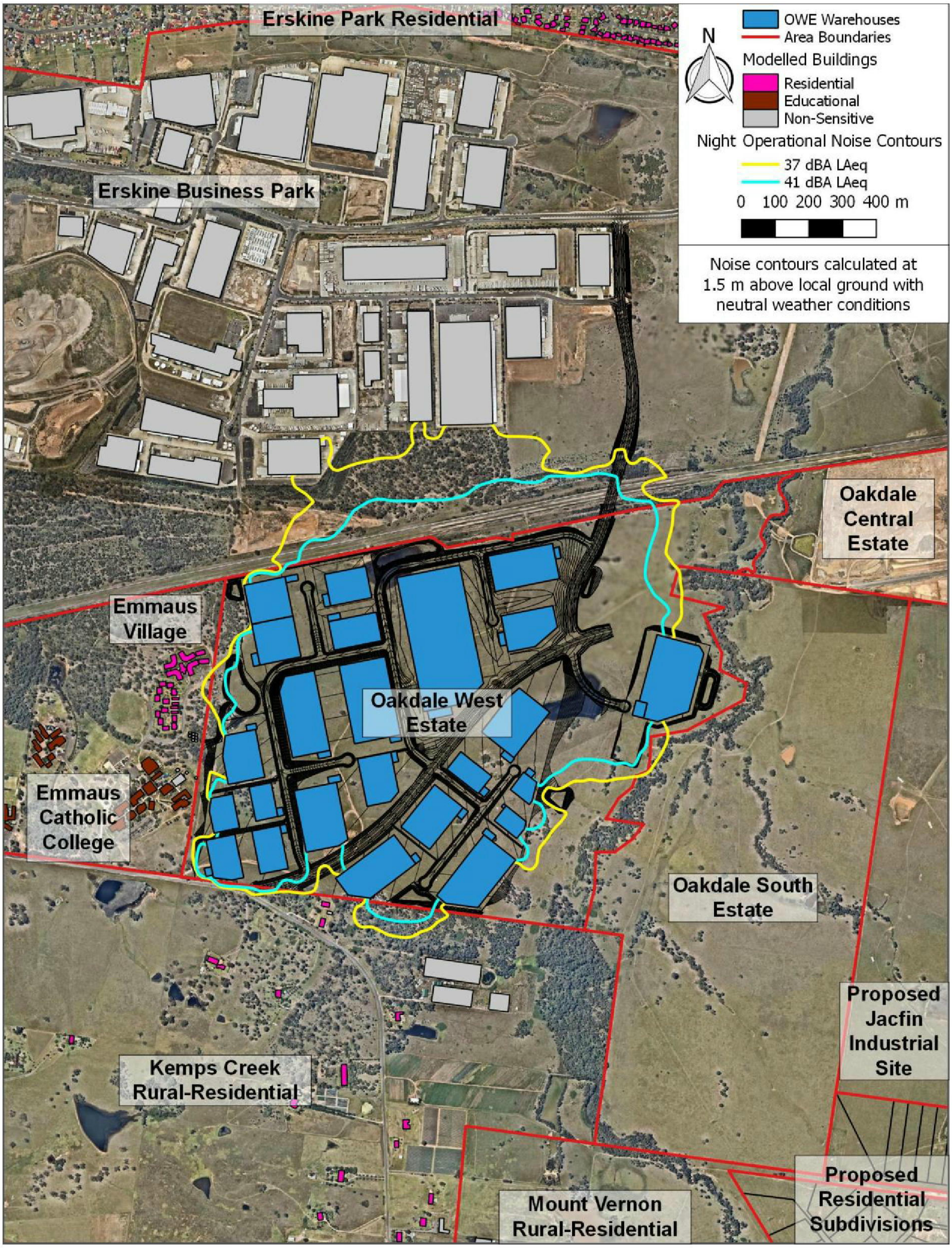


Note 1: 45 dBA LAeq noise contour (dark blue) corresponds to the noise criteria for school classrooms.

Note 2: 44 dBA LAeq noise contour (light blue) corresponds to the daytime intrusive noise criteria for residences in Emmaus Village.

Note 3: 39 dBA LAeq noise contour (yellow) corresponds to the daytime intrusive noise criteria for other residential receivers.

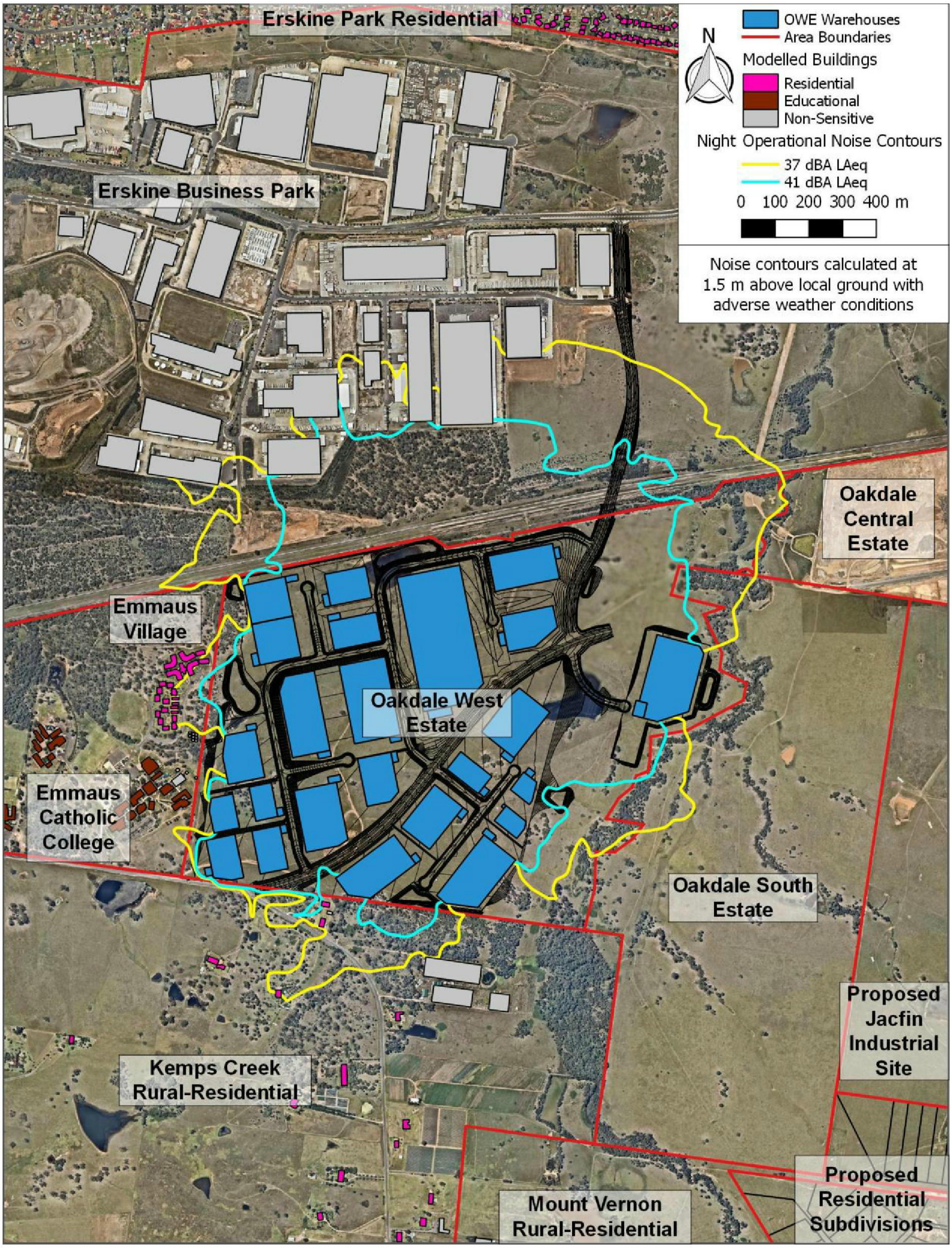
Figure 7 Predicted Operational Noise Contours – Intrusive LAeq(15minute) Night – Neutral Weather



Note 1: 41 dBA LAeq noise contour (light blue) corresponds to the night-time intrusive noise criteria for residences in Emmaus Village.

Note 2: 37 dBA LAeq noise contour (yellow) corresponds to the night-time intrusive noise criteria for other residential receivers.

Figure 8 Predicted Operational Noise Contours – Intrusive LAeq(15minute) Night – Adverse Weather



Note 1: 41 dBA LAeq noise contour (light blue) corresponds to the night-time intrusive noise criteria for residences in Emmaus Village.

Note 2: 37 dBA LAeq noise contour (yellow) corresponds to the night-time intrusive noise criteria for other residential receivers.

The above results indicate that the noise emissions from the operation of the OWE are predicted to be below the noise criteria at sensitive receivers under neutral weather conditions, with the exception of one residence in Kemps Creek. At this residence, noise levels are predicted to exceed the noise criteria by up to 2 dB during the daytime and evening periods during worst-case peak operations.

Under adverse weather conditions noise emissions are predicted to exceed the nominated noise criteria during the daytime and evening periods by up to 3 dB at eight residential receivers in Emmaus Village, and by up to 7 dB at four residential receivers in Kemps Creek. During the night-time period noise emissions are predicted to exceed the criteria by up to 3 dB at three residential receivers in Kemps Creek.

Noise emissions are predicted to exceed the night-time amenity criteria under adverse weather conditions by up to 1 dB at one residential receiver in Kemps Creek.

The L_{Amax} noise emissions are predicted to be up to 1 dB above the sleep disturbance screening criteria at one residential receiver in Kemps Creek under neutral weather conditions, and under the criteria at all other receivers. Under adverse weather conditions L_{Amax} noise emissions are predicted to be up to 5 dB above the sleep disturbance screening criteria at two residential receivers in Kemps Creek.

No exceedances of the noise criteria are predicted at the nearby schools under both neutral and adverse weather conditions.

Where noise emissions from the OWE are predicted to be above the noise criteria, feasible and reasonable noise mitigation measures should be considered in order to reduce noise impacts on the areas where exceedances are predicted. It is noted that the daytime and evening exceedances under adverse weather outlined above fall outside of the INP adverse weather assessment requirements (as discussed in **Section 3.6.1**). However, mitigation has been considered for these exceedances in order to minimise noise impacts at the potentially affected receivers.

4.4 Investigation of Indicative Mitigation Measures

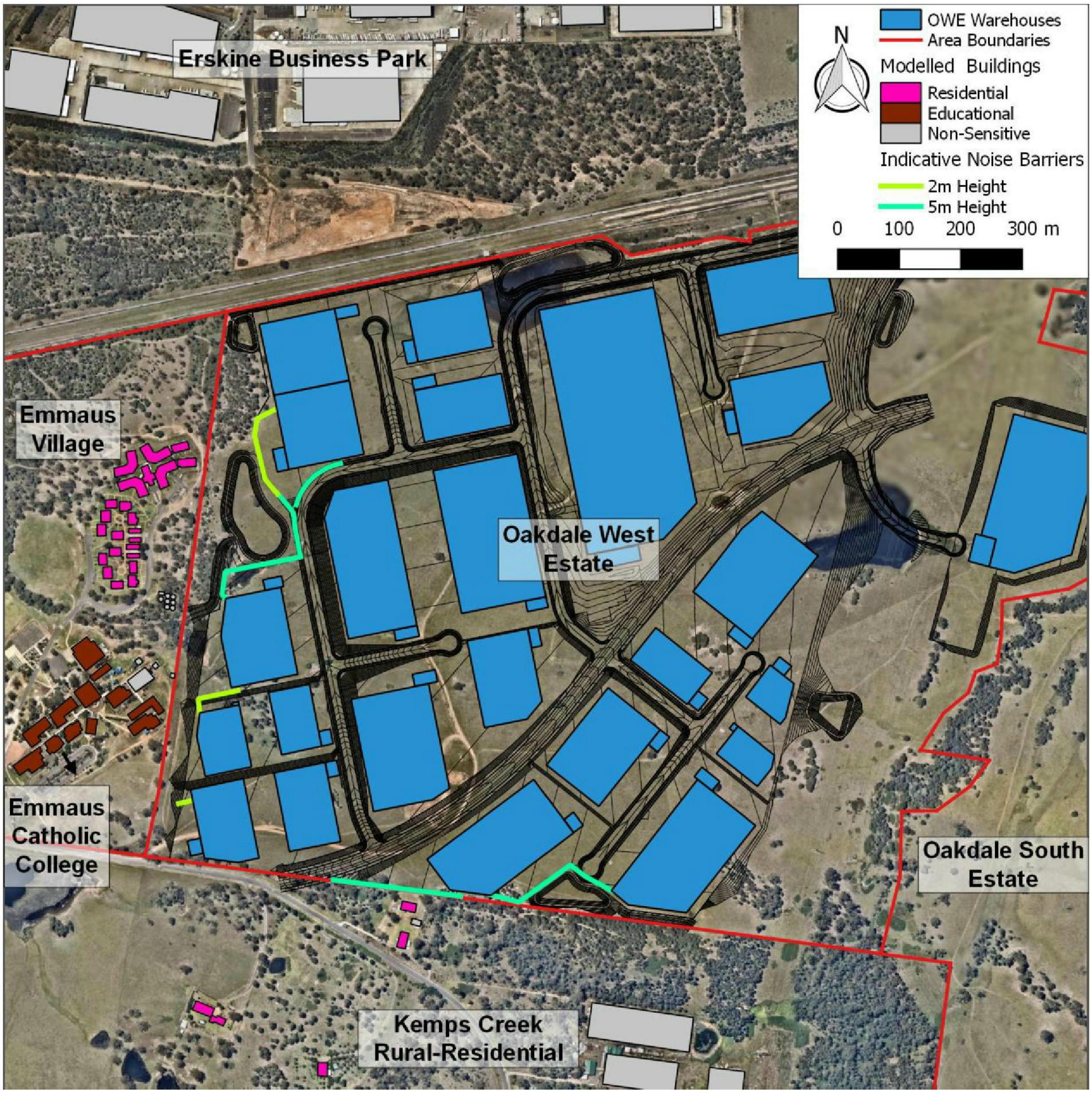
Noise mitigation measures may be required in order to reduce impacts on the most-affected receivers identified in **Section 4.3**.

Noise emissions from the OWE consist primarily of noise from heavy vehicles and unloading activities. Noise barriers are generally considered to be the most suitable mitigation measure for controlling noise from these sources as heavy vehicles are generally privately owned and operated, hence mitigation measures on the source (ie trucks) are generally not able to be implemented. Where practicable, noise reduction measures incorporated into the design / installation of fixed plant may reduce noise emissions from the site, however this would be determined upon specification of individual items of fixed plant at a later design stage.

Feasible and reasonable noise barriers in the vicinity of the impacted areas were investigated in order to determine the indicative location and height of any potential noise barriers. These included varying lengths and heights of noise barriers along the boundaries of the OWE adjacent to the most-affected receivers, and other locations such as the edge of hardstands and roadways. The indicative designs that produced the largest reduction in noise at the most-affected receivers consisted of a combination of 2 m high and 5 m high noise barriers located in the western and southern areas of the OWE.

The indicative locations and heights of the recommended noise barriers are shown in **Figure 9**. It should be noted that the locations and heights of the modelled noise barriers are indicative only and should be optimised during the detailed design phase of these sections of the OWE when more information is known.

Figure 9 Indicative Noise Barrier Locations and Heights



The predicted operational noise levels for the OWE with the inclusion of the indicative noise barriers are summarised in **Table 13**. Noise contour maps of the operational results for daytime neutral weather, daytime adverse weather, night-time neutral weather and night-time adverse weather are shown in **Figure 10**, **Figure 11**, **Figure 12** and **Figure 13** respectively. These maps show the noise contours corresponding to the relevant criteria for that time period.

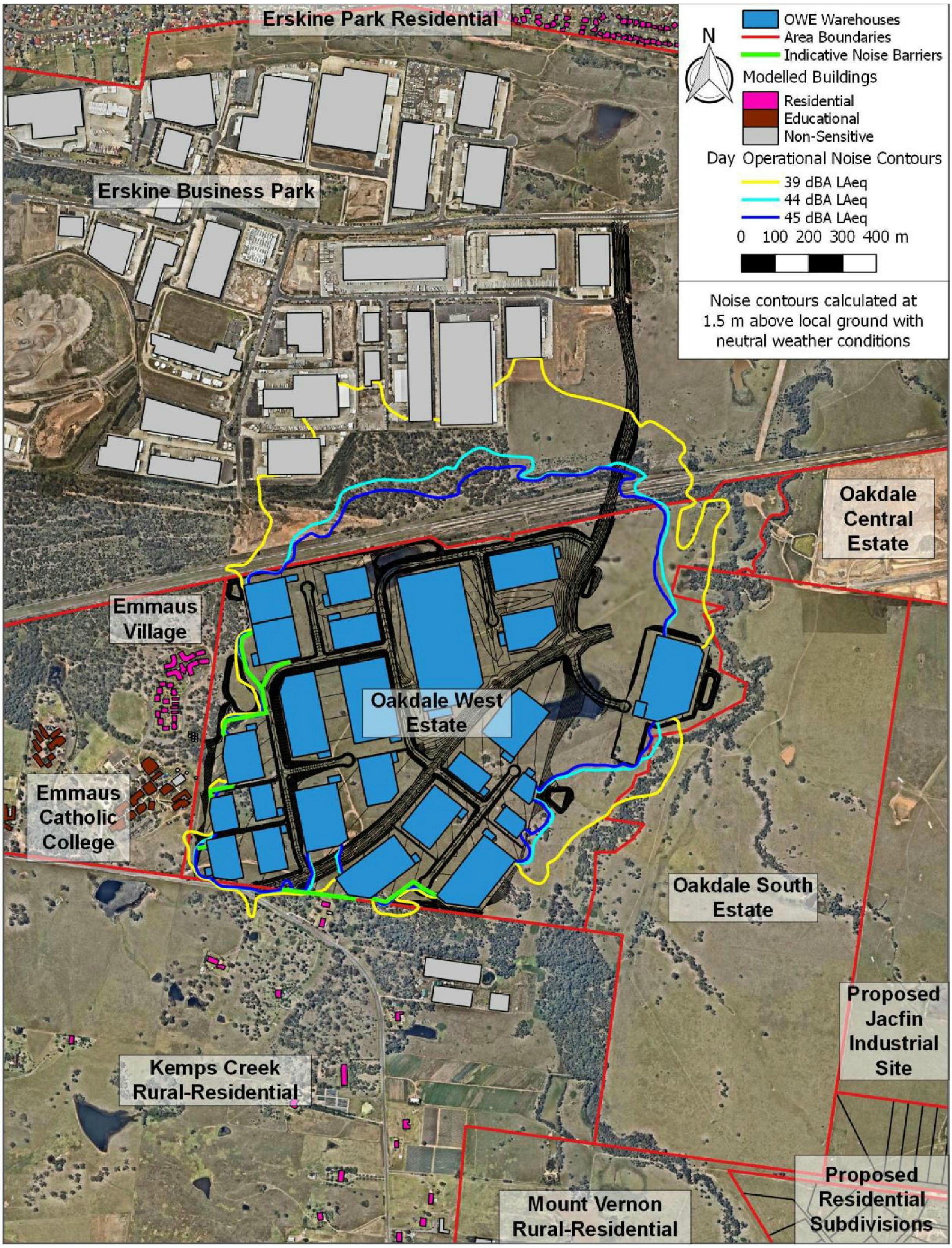
Table 13 Predicted Operational Noise Levels – With Indicative Noise Barriers

Sensitive Receiver Area	Intrusive LAeq(15minute) Noise Criteria (dB)			Amenity LAeq(period) Noise Criteria (dB)	LAmax Noise Goals (dB)	Predicted Worst-case LAeq(15minute) Noise Levels (dB) [Number of Exceedances]						Predicted Worst-case LAeq(period) Noise Levels (dB) [Number of Exceedances]		Predicted Worst-case LAmax Noise Levels (dB) [Number of Exceedances]	
	Day	Eve	Night	Night	Sleep Disturbance	Day		Eve		Night		Night		Night	
						Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather
Emmaus Village Residential	44	43	41	36	51	Up to 37	Up to 43	Up to 37	Up to 43	Up to 32	Up to 37	< 30	Up to 32	Up to 43	Up to 47
Kemps Creek Residential	39	39	37	36	47	Up to 37	**Up to 42 [3]**	Up to 37	**Up to 42 [3]**	Up to 32	Up to 37	< 30	Up to 34	Up to 45	**Up to 49 [2]**
Mount Vernon & Horsley Park Residential	39	39	37	36	47	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30
Proposed Jacfin & Capitol Hill Residential	39	39	37	36	47	< 30	Up to 33	< 30	Up to 33	< 30	< 30	< 30	< 30	< 30	Up to 34
Erskine Park Residential	39	39	37	36	47	< 30	Up to 36	< 30	Up to 36	< 30	Up to 31	< 30	< 30	Up to 33	Up to 37
School classrooms	45	-	-	-	-	Up to 40	Up to 45	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Surrounding Commercial / Industrial	70	-	-	-	-	Up to 41	Up to 46	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Note 1: **Bold** text indicates noise levels that are above the criteria. Numbers in [brackets] indicate the number of receiver buildings where the criteria is exceeded.

Note 2: Applicable parameters for adverse weather outlined in the INP are 3 m/s source to receiver wind during the daytime and evening, and F class temperature inversion with 2 m/s source to receiver drainage flow during the night-time.

Figure 10 Predicted Operational Noise Contours – Intrusive LAeq(15minute) Day – Neutral Weather – With Indicative Noise Barriers

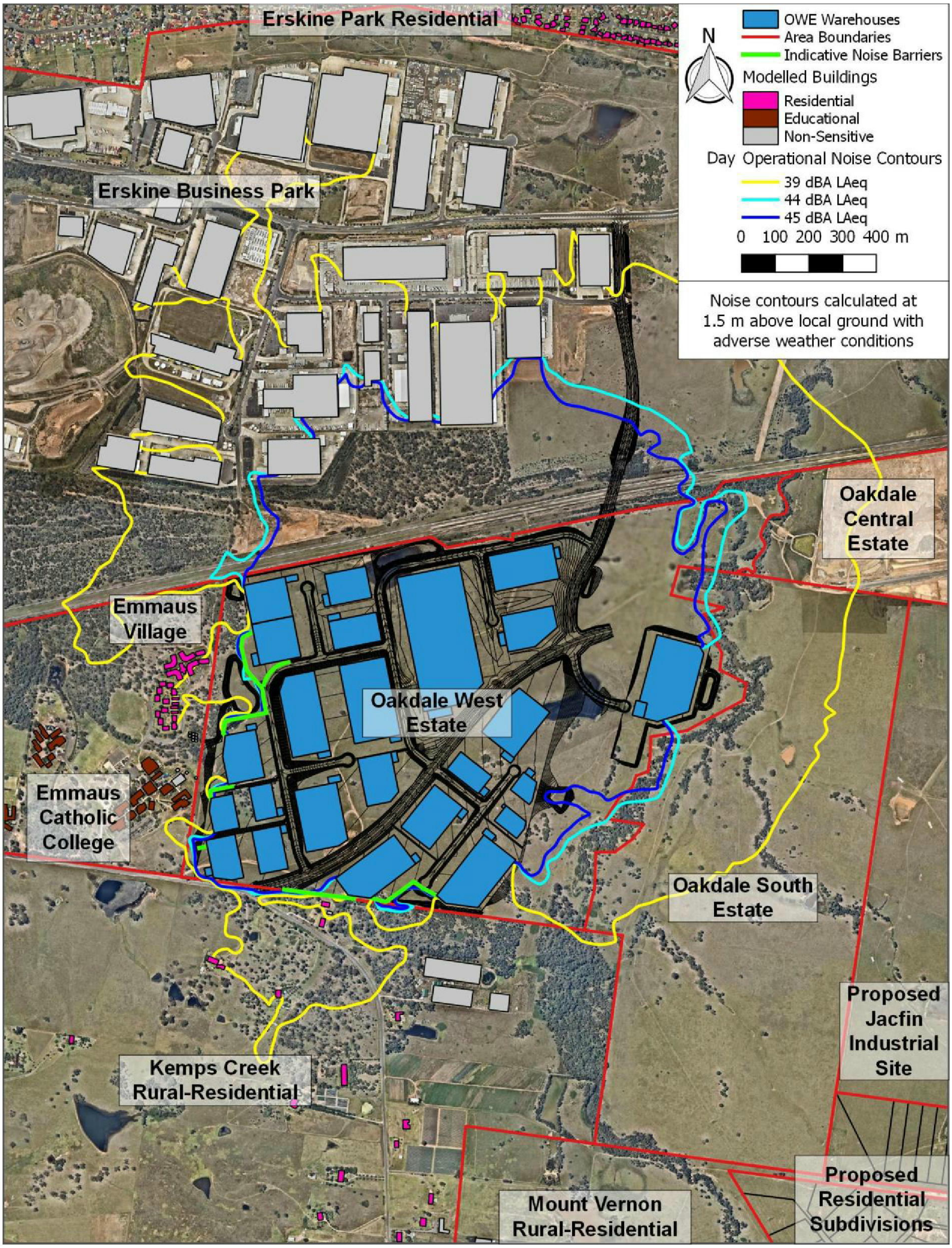


Note 1: 45 dBA LAeq noise contour (dark blue) corresponds to the noise criteria for school classrooms.

Note 2: 44 dBA LAeq noise contour (light blue) corresponds to the daytime intrusive noise criteria for residences in Emmaus Village.

Note 3: 39 dBA LAeq noise contour (yellow) corresponds to the daytime intrusive noise criteria for other residential receivers.

Figure 11 Predicted Operational Noise Contours – Intrusive LAeq(15minute) Day – Adverse Weather – With Indicative Noise Barriers

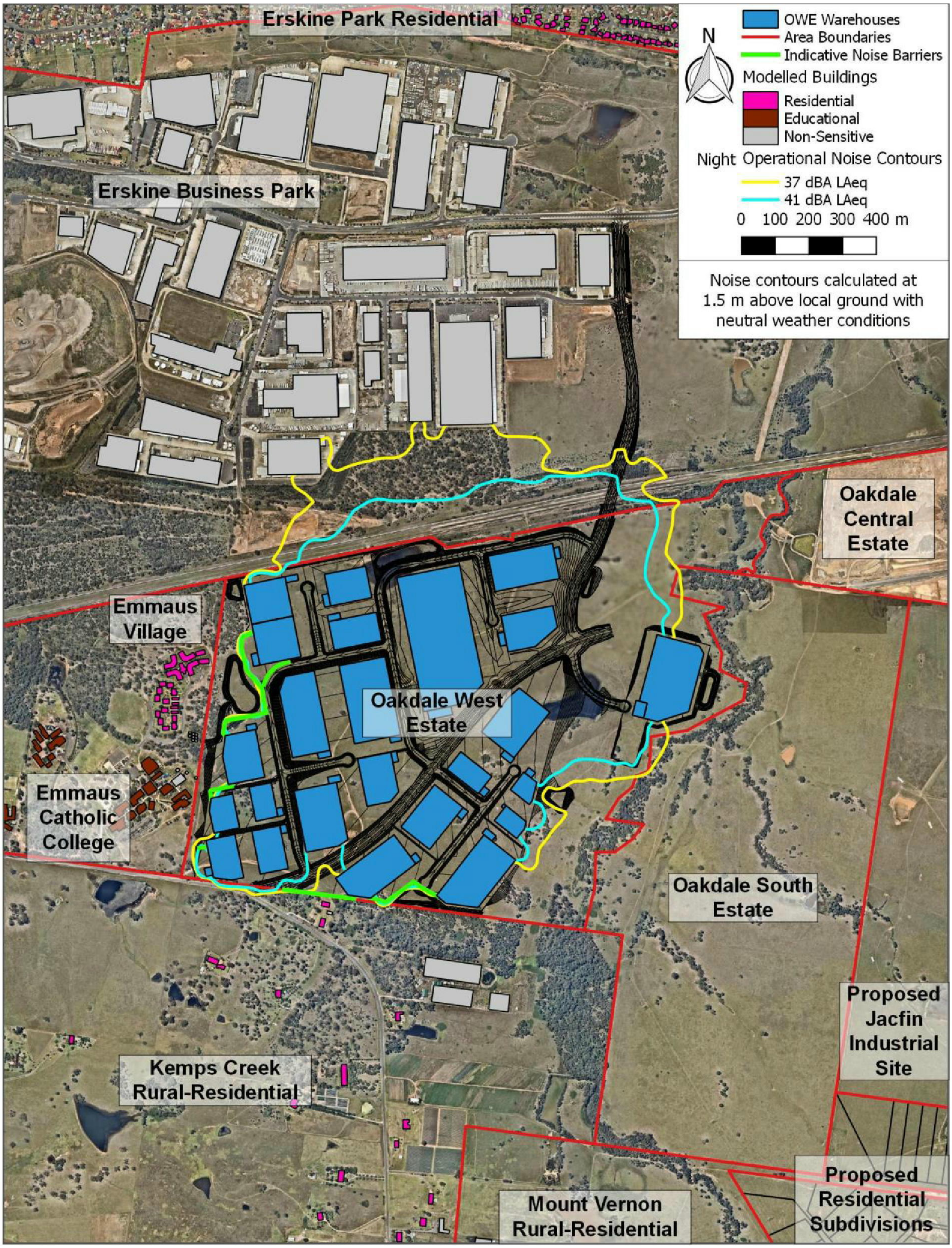


Note 1: 45 dBA LAeq noise contour (dark blue) corresponds to the noise criteria for school classrooms.

Note 2: 44 dBA LAeq noise contour (light blue) corresponds to the daytime intrusive noise criteria for residences in Emmaus Village.

Note 3: 39 dBA LAeq noise contour (yellow) corresponds to the daytime intrusive noise criteria for other residential receivers.

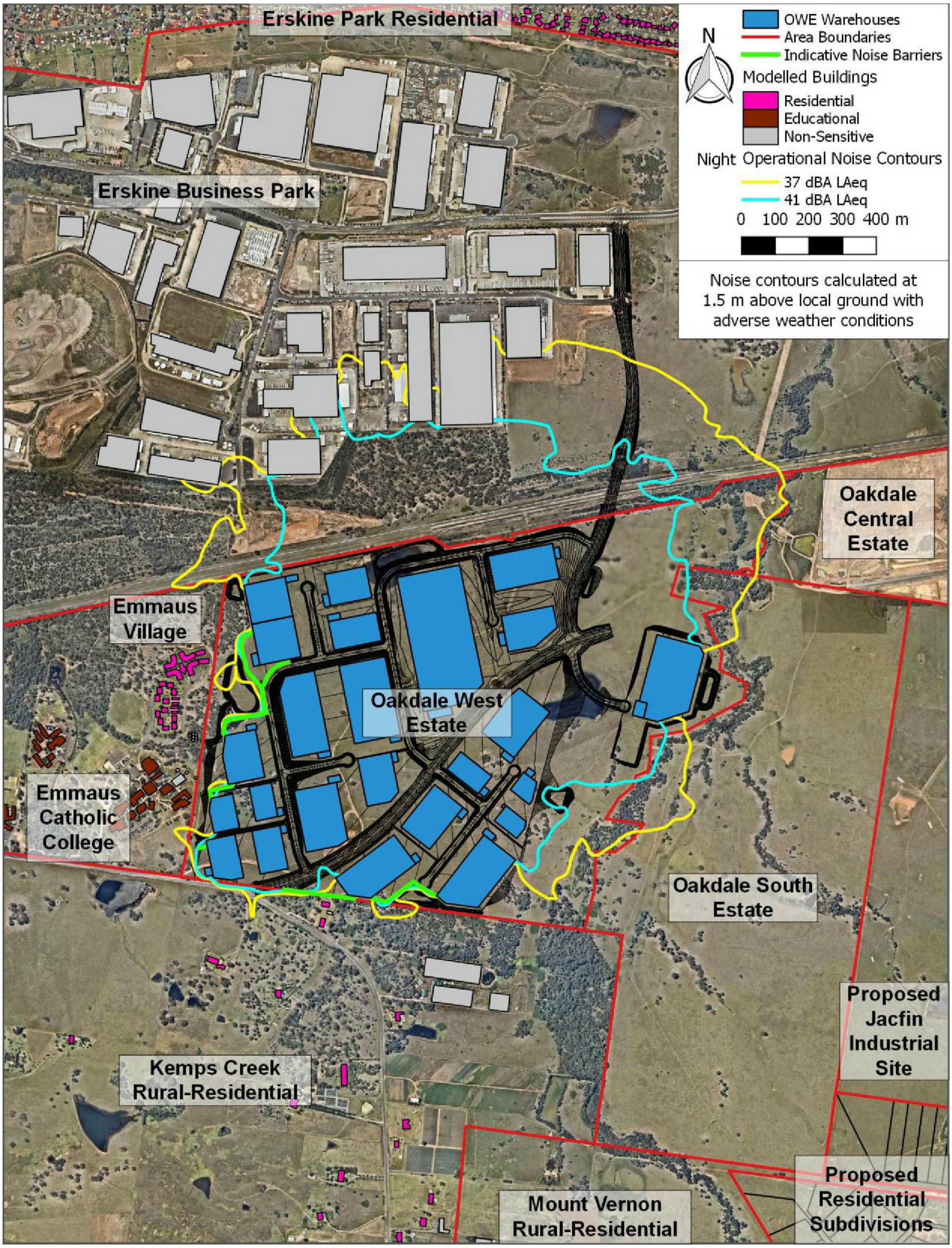
Figure 12 Predicted Operational Noise Contours – Intrusive LAeq(15minute) Night – Neutral Weather – With Indicative Noise Barriers



Note 1: 41 dBA LAeq noise contour (light blue) corresponds to the night-time intrusive noise criteria for residences in Emmaus Village.

Note 2: 37 dBA LAeq noise contour (yellow) corresponds to the night-time intrusive noise criteria for other residential receivers.

Figure 13 Predicted Operational Noise Contours – Intrusive LAeq(15minute) Night – Adverse Weather – With Indicative Noise Barriers



Note 1: 41 dBA LAeq noise contour (light blue) corresponds to the night-time intrusive noise criteria for residences in Emmaus Village.

Note 2: 37 dBA LAeq noise contour (yellow) corresponds to the night-time intrusive noise criteria for other residential receivers.

The above results indicate that with the inclusion of the indicative noise barriers, noise emissions from the operation of the OWE are predicted to be below the noise criteria at all sensitive receivers under neutral weather conditions

Under adverse weather conditions noise emissions are predicted to be reduced by the indicative noise barriers, however residual impacts are predicted to exceed the nominated noise criteria by up to 3 dB at three residential receivers in Kemps Creek during the daytime and evening periods.

Noise emissions are predicted to be below the night-time amenity criteria under both neutral and adverse weather conditions at all receivers.

The L_{Amax} noise emissions are predicted to be below the sleep disturbance screening criteria at all receivers under neutral weather conditions with the inclusion of the indicative noise barriers. Under adverse weather conditions residual L_{Amax} noise impacts are predicted to be up to 2 dB above the sleep disturbance screening criteria at two residential receivers in Kemps Creek.

4.4.1 Residual Noise Impacts

Residual noise impacts at Emmaus Village residential receivers after the inclusion of the indicative noise barriers are predicted to be below the nominated criteria during worst-case peak noise emissions during all periods under both neutral and adverse weather conditions.

Residual noise impacts of up to 3 dB are predicted at the three most-affected residential receivers in Kemps Creek during worst-case peak noise emissions only under adverse weather conditions. It is noted that no exceedances are predicted under neutral weather conditions, and the amenity criteria is not exceeded during any periods at these receivers.

The indicative noise barriers at the southern site boundary only produce a minor reduction in noise levels at receivers to the south of the OWE due to the raised location of the dwellings compared to the development site, and the limited opportunity to block line of sight completely with noise barriers. It is understood these receivers are located within the greater Western Sydney Employment Area (WSEA) of which the OWE is a part of. As such, it may be preferable to enter discussions with the landholders to come to an agreement on suitable mitigation measures for this location. Goodman has commenced discussions with these residents and these discussions indicate that the residents are open to alternative mitigation measures.

It is also noted that the modelled noise emissions are based on a worst-case scenario of maximum peak vehicle movements in every precinct of the OWE occurring concurrently, however the contribution from individual precincts does not exceed the noise criteria under adverse weather conditions. While the worst-case peak-hour vehicle movements may occur across the development when the OWE is fully operational, it is unlikely that maximum peak 15-minute vehicle movements would occur simultaneously in every precinct of the OWE, and, should this unlikely situation occur, the predicted exceedances occur only under adverse weather conditions. It is noted that the daytime and evening exceedances under adverse weather outlined above fall outside of the INP adverse weather assessment requirements (as discussed in **Section 3.6.1**). However, mitigation has been considered for these exceedances in order to minimise noise impacts at the potentially affected receivers.

On the basis of the above, the proposed operation of the OWE is considered unlikely to result in a significant adverse noise impact on nearby sensitive receivers.

4.5 Operation of Precinct 1 of the Oakdale West Estate

Operations associated with Precinct 1 of the OWE are proposed to commence before construction of the later stages of the OWE are complete. Operational noise emissions from Precinct 1 only have been modelled to determine if the mitigation measures outlined above for the masterplan design are required for Precinct 1 operations. The predicted operational noise levels for Precinct 1 of the OWE with no noise barriers are summarised in **Table 14**.

Table 14 Predicted Operational Noise Levels – Precinct 1 Only – No Noise Barriers

Sensitive Receiver Area	Intrusive LAeq(15minute) Noise Criteria (dB)			Amenity LAeq(period) Noise Criteria (dB)	LAmax Noise Goals (dB)	Predicted Worst-case LAeq(15minute) Noise Levels (dB) [Number of Exceedances]						Predicted Worst-case LAeq(period) Noise Levels (dB) [Number of Exceedances]		Predicted Worst-case LAmax Noise Levels (dB) [Number of Exceedances]	
	Day	Eve	Night	Night	Sleep Disturbance	Day		Eve		Night		Night		Night	
						Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather
Emmaus Village Residential	44	43	41	36	51	Up to 31	Up to 37	Up to 31	Up to 37	< 30	Up to 32	< 30	< 30	Up to 35	Up to 41
Kemps Creek Residential	39	39	37	36	47	Up to 30	Up to 36	Up to 30	Up to 36	< 30	Up to 31	< 30	< 30	Up to 33	Up to 40
Mount Vernon & Horsley Park Residential	39	39	37	36	47	< 30	< 30	< 30	< 30	< 30	< 30	< 30	<30	< 30	< 30
Proposed Jacfin & Capitol Hill Residential	39	39	37	36	47	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30
Erskine Park Residential	39	39	37	36	47	< 30	Up to 32	< 30	Up to 32	< 30	< 30	< 30	< 30	< 30	Up to 34
School classrooms	45	-	-	-	-	< 30	Up to 34	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Surrounding Commercial / Industrial	70	-	-	-	-	Up to 38	Up to 43	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Note 1: **Bold** text indicates noise levels that are above the criteria. Numbers in [brackets] indicate the number of receiver buildings where the criteria is exceeded.

Note 2: Default parameters for adverse weather outlined in the INP are 3 m/s source to receiver wind during the daytime and evening, and F class temperature inversion with 2 m/s source to receiver drainage flow during the night-time.

The above results indicate that noise emissions from the operation of Precinct 1 of the OWE are predicted to be below the nominated noise criteria at all sensitive receivers under both neutral and adverse weather conditions. Therefore, it is considered acceptable that the operation of Precinct 1 may commence prior to construction of the mitigation measures recommended for the masterplan design.

4.6 Off-site Operational Traffic Movements

While light and heavy vehicle movements within the OWE are classified as part of the operational site noise, once they move off the OWE site and onto public roads they are assessed under the *NSW Road Noise Policy* (RNP).

The RNP requires noise mitigation where new land use developments increase road traffic noise by more than 2 dB. An increase of greater than 2 dB requires an increase in traffic volumes of approximately 60% or higher.

The main access route to the development site is via the proposed Western North-South Link Road (WNSLR) then the arterial road of Lenore Drive. The forecast traffic daily traffic volumes on Lenore Drive at opening of the WNSLR is approximately 28,000 vehicles (refer to SLR Report 610.16083-R1), including vehicle movements from the OWE. The daily traffic volume from the OWE is estimated to be approximately 8,760 vehicles, which equates to an increase in traffic volumes of approximately 45%. Therefore, an increase in traffic noise due to the OWE of greater than 2 dB is not considered likely. No mitigation is likely to be required as a result.

The WNSLR is proposed as a new road and is subject to a separate road traffic noise assessment (SLR Report 610.16083-R1).

5 CONSTRUCTION NOISE AND VIBRATION IMPACT ASSESSMENT

People are usually more tolerant to noise and vibration during the construction phase of proposals than during normal operation. This response results from recognition that the construction emissions are of a temporary nature – especially if the most noise-intensive construction impacts occur during the less sensitive daytime period. For these reasons, acceptable noise and vibration levels are normally higher during construction than during operations.

Construction often requires the use of heavy machinery which can generate high noise and vibration levels at nearby buildings and receivers. For some equipment, there is limited opportunity to mitigate the noise and vibration levels in a cost-effective manner and hence the potential impacts should be minimised by using feasible and reasonable management techniques.

At any particular location, the potential impacts can vary greatly depending on factors such as the relative proximity of sensitive receivers, the overall duration of the construction works, the intensity of the noise and vibration levels, the time at which the construction works are undertaken and the character of the noise or vibration emissions.

The following section details the assessment of potential noise and vibration impacts associated with the construction of the proposal. Construction noise goals have been determined based on the relevant government guidelines and industry standards. Potential noise levels have been predicted at sensitive receivers for expected activities and where levels are above the goals, feasible and reasonable noise mitigation measures are considered.

5.1 Proposed Construction Activities

5.1.1 Proposed Works

This report provides an assessment of the potential noise and vibration impacts associated with the proposed activities required to construct the proposal.

The construction noise and vibration assessment has considered the following construction activities:

- Site clearing and earthworks.
- Construction of roadways.
- Pad and hardstand works including concrete pours.
- Construction of warehouse and office structures.

5.1.2 Construction Hours

Where possible, works would be completed during the standard daytime construction hours of Monday to Friday 7.00 am to 6.00 pm and Saturday 8.00 am to 1.00 pm.

Where Out-of-Hours Works (OOHWs) are required (for emergency works, oversized equipment delivery, etc) it is likely that they would require separate approval.

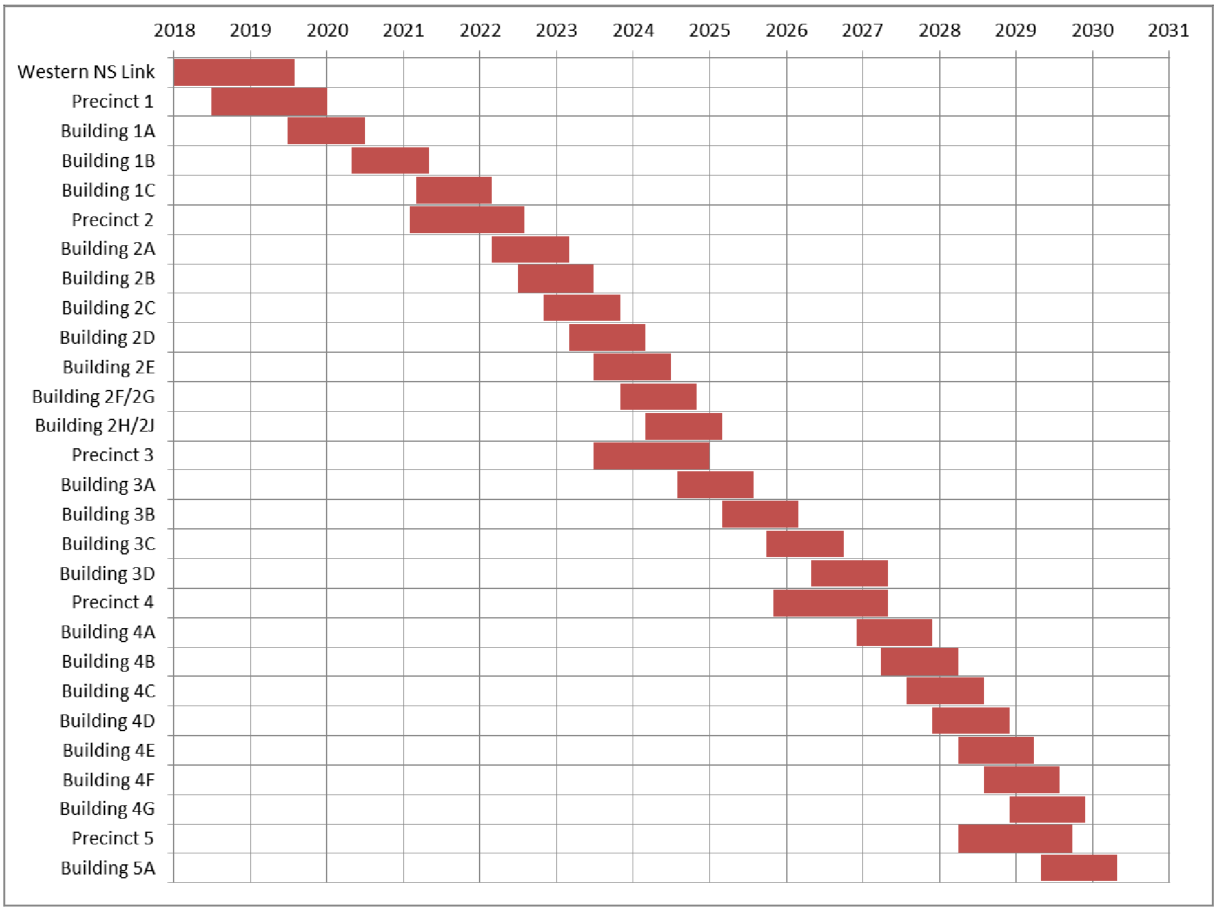
5.1.3 Construction Schedule

A staged approach to construction of the OWE is proposed. The indicative schedule of construction is shown in **Table 15** and graphically in **Figure 14**.

Table 15 Construction Staging

Construction Area	Start Date	End Date	Duration
Western NS Link	1 January 2018	31 July 2019	19 months
Precinct 1	30 June 2018	31 December 2019	18 months
Building 1A	30 June 2019	30 June 2020	12 months
Building 1B	30 April 2020	30 April 2021	12 months
Building 1C	28 February 2021	28 February 2022	12 months
Precinct 2	31 January 2021	31 July 2022	18 months
Building 2A	28 February 2022	28 February 2023	12 months
Building 2B	30 June 2022	30 June 2023	12 months
Building 2C	31 October 2022	31 October 2023	12 months
Building 2D	28 February 2023	29 February 2024	12 months
Building 2E	30 June 2023	30 June 2024	12 months
Building 2F & 2G	31 October 2023	31 October 2024	12 months
Building 2H & 2J	29 February 2024	28 February 2025	12 months
Precinct 3	30 June 2023	31 December 2024	18 months
Building 3A	31 July 2024	31 July 2025	12 months
Building 3B	28 February 2025	28 February 2026	12 months
Building 3C	30 September 2025	30 September 2026	12 months
Building 3D	30 April 2026	30 April 2027	12 months
Precinct 4	31 October 2025	30 April 2027	18 months
Building 4A	30 November 2026	30 November 2027	12 months
Building 4B	31 March 2027	31 March 2028	12 months
Building 4C	31 July 2027	31 July 2028	12 months
Building 4D	30 November 2027	30 November 2028	12 months
Building 4E	31 March 2028	31 March 2029	12 months
Building 4F	31 July 2028	31 July 2029	12 months
Building 4G	30 November 2028	30 November 2029	12 months
Precinct 5	31 March 2028	30 September 2029	18 months
Building 5A	30 April 2029	30 April 2030	12 months

Figure 14 Construction Staging



5.2 Construction Noise Criteria

The NSW EPA *Interim Construction Noise Guideline* (ICNG) requires project 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, all feasible and reasonable work practices are investigated to minimise noise emissions.

Having investigated all feasible and reasonable work practices, if construction noise levels are still predicted to exceed the NMLs then the potential noise impacts would be managed via site specific construction noise management plans, to be prepared in the detailed design phase.

5.2.1 Residential Receivers

The ICNG provides an approach for determining $L_{Aeq(15minute)}$ NMLs at residential receivers surrounding the development site by applying the measured $L_{A90(15minute)}$ background noise levels, as described in **Table 16**.

Table 16 Determination of NMLs for Residential Receivers

Time of Day	NML $L_{Aeq(15minute)}$	How to Apply
Standard hours Monday to Friday 7.00 am to 6.00 pm Saturday 8.00 am to 1.00 pm No work on Sundays or public holidays	RBL + 10 dB	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 management level, the proponent should apply all feasible and reasonable work practises 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 dB	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 + 5 dB	• 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 practises have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1: Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Adopting the measured background noise levels in **Table 3**, the NMLs derived for the project are detailed in **Table 17**.

Table 17 Construction NMLs for Residential Receivers

Receiver	Applicable Noise Logging Location	Time of Day	$L_{Aeq(15minute)}$ Construction NMLs (dB)[1]		
			Standard Hours	Out-of-Hours	Highly Noise Affected
Emmaus Village Residential	L1	Daytime	49	44	75
		Evening	n/a	43	75
		Night-time	n/a	41	75
Other Residential	L2	Daytime	44	39	75
		Evening	n/a	39	75
		Night-time	n/a	37	75

5.2.2 Other Sensitive Receivers

The ICNG provides NMLs for other sensitive land uses such as schools. The NMLs applicable to this project are shown in **Table 18**.

Table 18 Constructions NMLs for Other Sensitive Receivers

Land Use	NML $L_{Aeq(15minute)}$ (Applicable when the property is in use)
Classrooms at schools and other educational institutions	Internal noise level 45 dB

For sensitive receivers such as schools, the NMLs presented in **Table 18** are based on internal noise levels. On the basis that external noise levels are typically 10 dB higher than internal noise levels when windows are open, an external $L_{Aeq(15minute)}$ NML of 55 dB has been adopted.

5.3 Construction Noise Modelling

Noise modelling of the development site was undertaken using SoundPLAN V7.1 modelling software.

The noise model was constructed from a combination of aerial photography, existing ground topography, design ground topography and design masterplans for the development. The local terrain, receiver buildings and structures have been digitised in the noise model to develop a three-dimensional representation of the construction works and surrounding environment.

Maximum sound power levels (SWLs) for the typical operation of construction equipment applied in the modelling are listed in **Table 19**.

Table 19 Sound Power Levels for Construction Equipment

Construction Activity	Equipment	Operating minutes in 15-min period	No of items in same location	Sound Power Level (dB)		
				Maximum L_{Aeq}		L_{Amax}
				Item	Activity	Activity
Site Clearing and Earthworks	Dozer	15	1	110	116	119
	Dump Truck (approx 15 tonne)	15	3	100		
	Excavator (25 tonne)	15	1	102		
	Front End Loader (FEL) 962	15	1	112		
	Grader	15	1	108		
Construction of Roadways	Asphalt Milling Machine[1]	15	1	111	115	119
	Bitumen Spray Truck	15	1	100		
	Line Marking Plant	15	1	98		
	Paving Machine	15	1	104		
	Plate Compactor	5	1	108		
	Road Profiler	15	1	107		
	Vibratory Roller (10-12 tonne)[1]	15	1	109		

Construction Activity	Equipment	Operating minutes in 15-min period	No of items in same location	Sound Power Level (dB)		
				Maximum LAeq		LAmax
				Item	Activity	Activity
Pad and Hardstand Works	Concrete Pump	7.5	1	106	113	117
	Concrete Truck / Agitator	7.5	1	106		
	Concrete Vibrator	15	1	102		
	Paving Machine	15	1	104		
	Plate Compactor	5	1	108		
	Vibratory Roller (10-12 tonne)[1]	15	1	109		
Construction of Warehouse and Office Structures	Elevated Working Platform	15	2	97	107	109
	Flatbed Truck	15	1	100		
	Hand Tools (electric)	15	4	96		
	Mobile Crane (100 tonne)	15	1	101		
	Welding Equipment	15	1	97		

Note 1: In accordance with the ICNG, for activities identified as particularly annoying (such as jackhammering, rock breaking and power saw operations), a 5 dB 'penalty' is added to the source sound power level when predicting noise using the quantitative method.

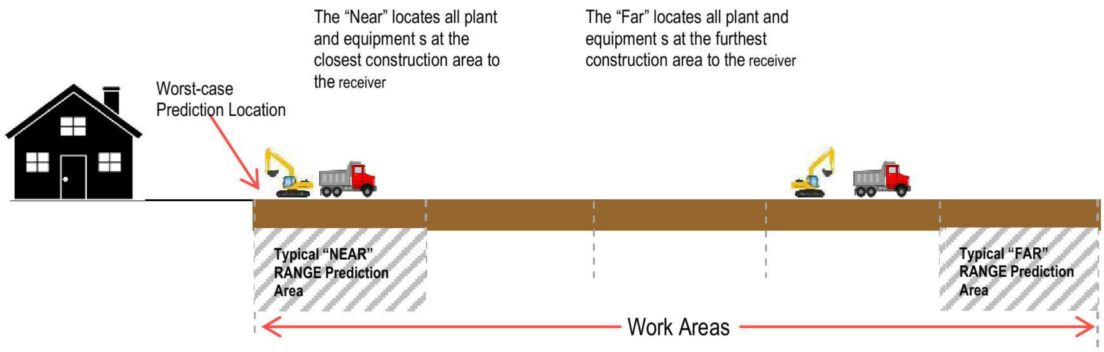
5.4 Assessment Methodology

Consistent with the requirements of the ICNG, and to inform prioritisation of mitigation and management measures during the detailed design phase, this assessment provides a worst-case noise impact assessment for construction scenarios. The ICNG recommends that the realistic worst-case noise levels from the source should be predicted for assessment locations representing the most noise-exposed residences or other sensitive land uses. For each receiver area, the noise levels are predicted at the most noise-exposed location, which would usually be the closest receiver.

In reality at any particular location, the potential construction noise impacts can vary greatly depending on factors such as the position of the construction works within the site and distance to the nearest sensitive receiver, the overall duration of the construction works, the intensity of the noise levels, the time at which the construction works are undertaken, and the character of the noise or vibration emissions.

To achieve this, this assessment refers to the **'Near'** and **'Far'** $L_{Aeq(15minute)}$ noise levels expected during construction works for a given activity. This is representative of the construction noise levels likely to be experienced by a receiver as works progress through the areas of the site. This is presented as an upper and lower receiver noise level, typically due to the near and far areas of the site respectively. This approach represents a worst case prediction for the works in the given area as it assumes that all equipment is running simultaneously within each works area.

Figure 15 Illustration of Noise Descriptors



Furthermore, other receivers within each receiver area would generally experience lower noise levels compared to the most noise-exposed location as construction work is undertaken at greater separation distance from receivers. To provide an indication of the likely reduction in construction noise levels, the following can be assumed:

- A doubling of the distance between the source and receiver would provide an approximate 6 dB reduction in noise level. For example the sound pressure levels from most items of plant would decrease by around 6 dB as the distance increases from 10 m to 20 m.
- Buildings and other solid structures located between the construction noise source and sensitive receivers would act as barriers and would typically reduce noise levels by up to 15 dB. For example, in a residential area adjoining a construction site the first row of houses would provide an effective shield to the second and subsequent rows with resulting noise levels up to 10 dB lower than would otherwise be experienced in the absence of the first row.

5.5 Predicted Construction Noise Impacts

In the area surrounding the development site, the noise impacts have been quantitatively assessed for several construction activities. The activities considered are described in **Table 19**.

The typical maximum and typical minimum $L_{Aeq(15minute)}$ noise levels at the most-affected sensitive receiver in each of the areas surrounding the OWE are provided in **Table 20**, **Table 21**, **Table 22** and **Table 23** for the construction activities and are representative of the 'noisiest' construction periods allowing for the simultaneous operation of noise intensive construction plant in close proximity.

Exceedances of the standard construction hours daytime NMLs are shown with the following colour coding:

Colour	Exceedance	Perception
(green)	Below NML	May be noticeable at times
(blue)	<10 dB above NML	Clearly audible
(orange)	10 dB to 20 dB above NML	Moderately intrusive
(red)	>20 dB above NML	Highly intrusive

Graphs showing the distribution of construction noise levels for each construction area are provided for the most affected receivers in Emmaus Village, Kemps Creek and Emmaus Catholic College in **Figure 16**, **Figure 17** and **Figure 18** respectively.

Table 20 Predicted Construction Noise Levels – Most-Affected Receiver – Site Clearing and Earthworks

Receiver	Standard Construction Hours - Daytime NML (dBA)	Precinct 1		Precinct 2						Precinct 3		Precinct 4						Precinct 5	
		1A-1C		2A-2D		2E & Basin		2F-2J		3A-3D		4A & Basin		4B-4D		4E-4F		5A	
		Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near
Emmaus Village	49	43	49	51	71	51	71	44	51	45	59	38	46	42	46	38	44	36	40
Kemps Creek	44	41	48	44	48	47	53	52	59	45	59	53	70	44	53	47	54	41	44
Horsley Park/Mt Vernon	44	33	36	31	33	31	32	31	32	32	34	33	35	35	37	35	37	38	39
Erskine Park	44	35	39	34	37	30	34	30	33	31	36	32	33	33	37	32	35	36	38
School	55	41	46	46	54	54	70	49	70	45	56	40	49	42	46	39	43	35	38

Table 21 Predicted Construction Noise Levels – Most-Affected Receiver – Construction of Roadways

Receiver	Standard Construction Hours - Daytime NML (dBA)	Precinct 1		Precincts 2 & 3		Precinct 4		Precinct 5	
		Far	Near	Far	Near	Far	Near	Far	Near
Emmaus Village	49	42	49	46	57	43	44	39	39
Kemps Creek	44	40	49	45	60	48	53	43	43
Horsley Park/Mt Vernon	44	31	34	31	32	34	35	36	36
Erskine Park	44	34	38	31	35	32	33	36	36
School	55	39	47	46	55	42	43	39	39

Table 22 Predicted Construction Noise Levels – Most-Affected Receiver – Pad and Hardstand Works

Receiver	Standard Construction Hours - Daytime NML (dBA)	Precinct 1						Precinct 2														Precinct 3	
		1A		1B		1C		2A		2B		2C		2D		2E		2F & 2G		2H & 2J		3A	
		Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near
Emmaus Village	49	40	42	41	42	42	47	48	50	49	51	52	57	53	59	50	54	46	48	43	45	47	50
Kemps Creek	44	39	41	40	42	41	46	41	42	42	43	41	43	43	44	47	49	50	52	49	56	45	49
Horsley Park/Mt Vernon	44	31	42	32	33	30	32	<30	<30	<30	30	<30	<30	<30	<30	<30	<30	<30	<30	<30	30	30	31
Erskine Park	44	35	41	34	35	32	35	33	34	33	33	32	33	32	32	30	30	<30	30	<30	<30	31	32
School	55	37	42	39	41	40	44	43	44	42	45	45	46	46	49	54	59	54	62	49	56	45	48

Continued

Receiver	Standard Construction Hours - Daytime NML (dBA)	Precinct 3						Precinct 4														Precinct 5	
		3B		3C		3D		4A		4B		4C		4D		4E		4F		4G		5A	
		Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near
Emmaus Village	49	49	54	45	46	44	49	41	43	42	43	42	42	40	42	37	40	40	40	40	41	33	38
Kemps Creek	44	46	49	49	52	50	57	53	64	49	52	46	47	43	45	47	51	46	47	44	46	38	41
Horsley Park/Mt Vernon	44	<30	30	31	31	30	30	31	32	32	32	32	33	33	33	32	33	33	33	33	33	34	35
Erskine Park	44	<30	32	30	31	<30	30	<30	30	30	31	31	32	32	33	<30	31	31	31	31	32	33	35
School	55	48	52	46	48	48	52	42	45	42	44	40	42	40	42	34	38	36	38	38	40	34	38

Table 23 Predicted Construction Noise Levels – Most-Affected Receiver – Construction of Warehouse and Office Structures

Receiver	Standard Construction Hours - Daytime NML (dBA)	Precinct 1						Precinct 2														Precinct 3	
		1A		1B		1C		2A		2B		2C		2D		2E		2F & 2G		2H & 2J		3A	
		Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near
Emmaus Village	49	34	36	35	36	38	40	42	43	43	44	47	51	49	53	44	45	41	42	37	38	41	44
Kemps Creek	44	33	34	34	35	35	39	35	36	36	37	36	37	37	38	42	43	44	45	43	50	39	42
Horsley Park/Mt Vernon	44	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Erskine Park	44	<30	30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
School	55	32	34	33	34	35	37	37	38	36	38	40	40	41	43	49	53	51	56	44	46	39	41

Continued

Receiver	Standard Construction Hours - Daytime NML (dBA)	Precinct 3						Precinct 4														Precinct 5	
		3B		3C		3D		4A		4B		4C		4D		4E		4F		4G		5A	
		Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near
Emmaus Village	49	44	48	39	40	38	41	35	37	37	37	36	36	35	36	32	34	34	34	34	34	31	32
Kemps Creek	44	40	43	44	45	47	51	48	58	43	46	41	41	37	39	41	44	40	40	39	39	32	34
Horsley Park/Mt Vernon	44	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Erskine Park	44	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
School	55	42	45	40	41	43	46	38	39	37	38	35	36	35	36	<30	32	31	31	34	34	30	31

Figure 16 Construction Noise Levels Distribution – Most-Affected Receiver – Emmaus Village Residential

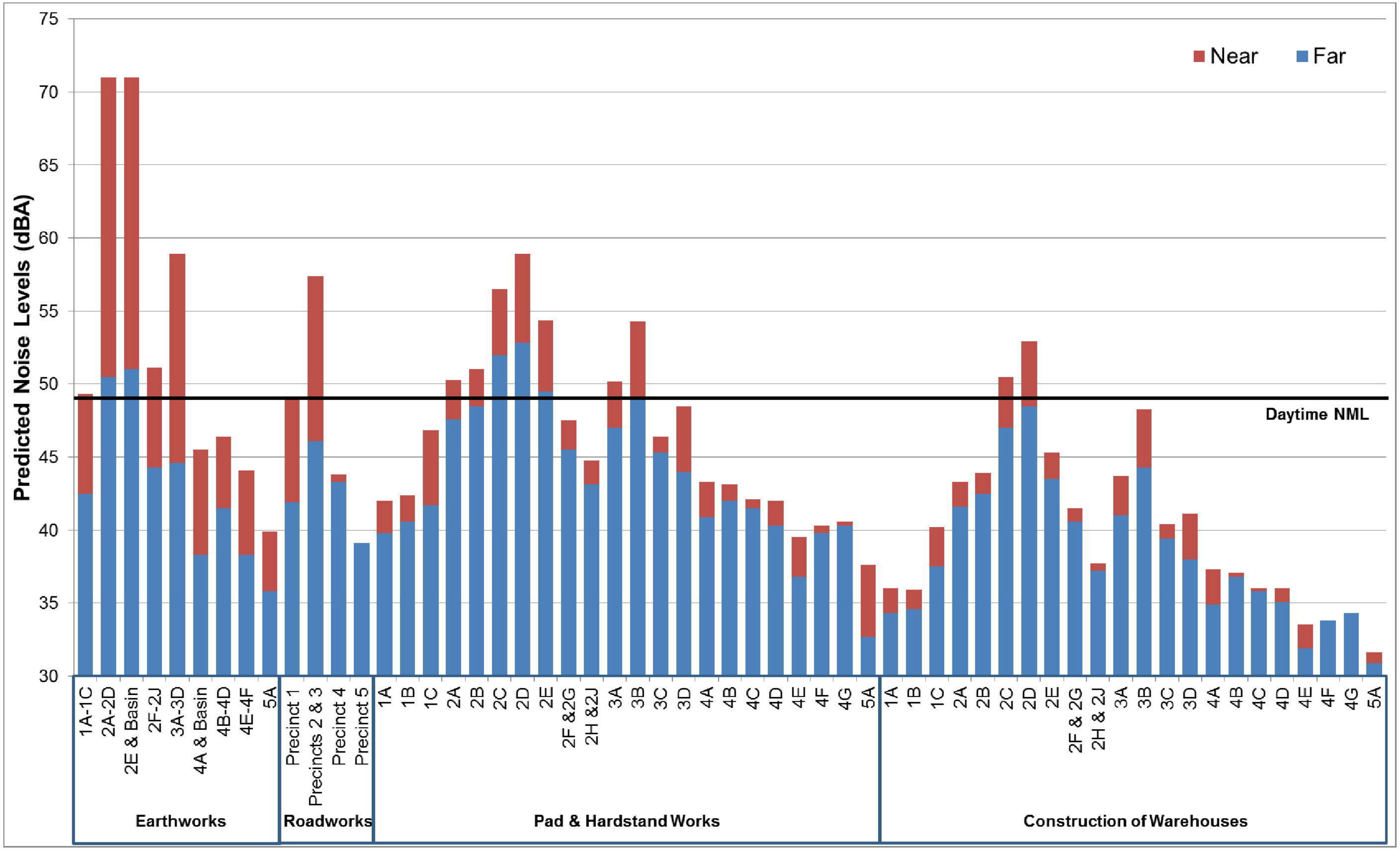


Figure 17 Construction Noise Levels Distribution – Most-Affected Receiver – Kemps Creek Residential

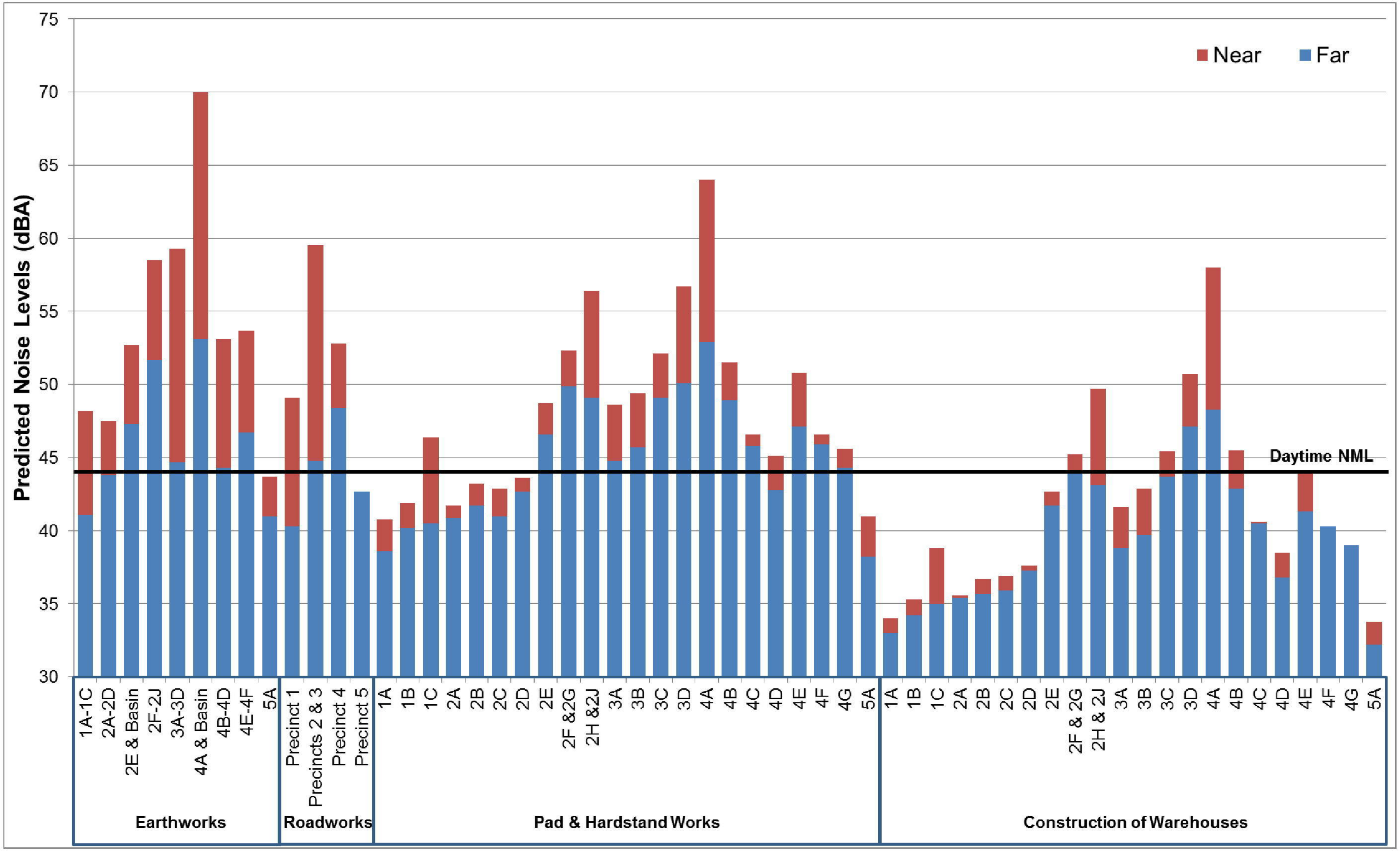
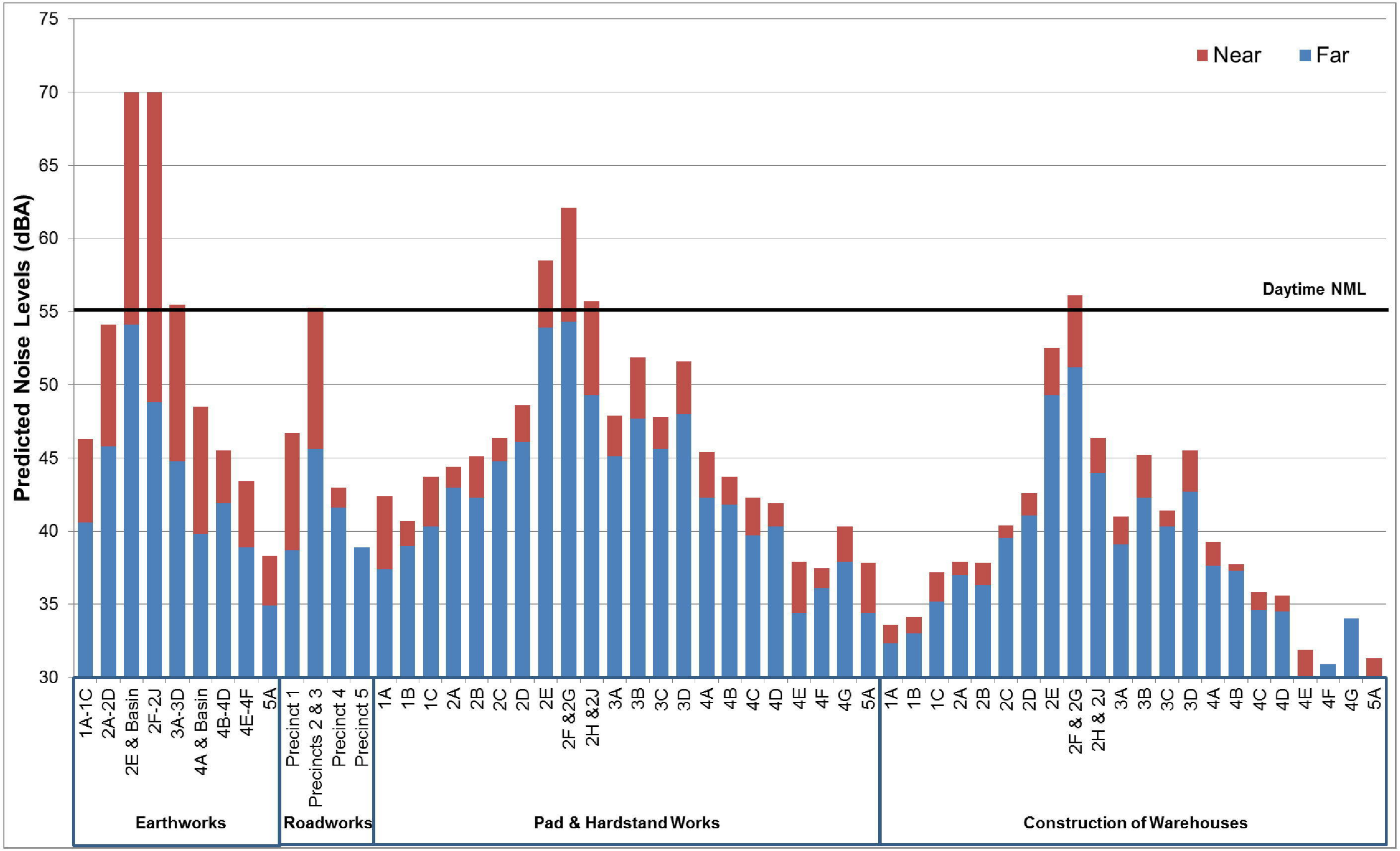


Figure 18 Construction Noise Levels Distribution – Most-Affected Receiver – Emmaus Catholic College



Site Clearing and Earthworks

During standard construction hours, exceedance of the NMLs is predicted at the most-affected receivers in Emmaus Village during site clearing and earthworks in Precinct 2 and Precinct 3. The highest impacts are predicted when construction is occurring in the vicinity of Lots 2D and 2E and the basin between them, adjacent to sensitive receivers.

Exceedance of the NMLs is predicted at the most-affected receivers in Kemps Creek during site clearing and earthworks in Precinct 1, Precinct 2, Precinct 3 and Precinct 4. The highest impacts are predicted when construction is occurring in the vicinity of Lots 2H/2J, 3D and 4A, adjacent to sensitive receivers.

No exceedance of the NMLs is predicted at sensitive receivers in Horsley Park, Mt Vernon or Erskine Park during site clearing and earthworks.

Exceedance of the NMLs is predicted at the most-affected receivers in Emmaus Catholic College during site clearing and earthworks in Precinct 2. The highest impacts are predicted when construction is occurring in the vicinity of Lots 2E, 2F/2G and 2H/2J, adjacent to sensitive receivers.

Construction of Roadways

During standard construction hours, exceedance of the NMLs is predicted at the most-affected receivers in Emmaus Village during roadworks in Precinct 2 and Precinct 3. The highest impacts are predicted when construction is occurring in the western area of Precinct 2, adjacent to sensitive receivers.

Exceedance of the NMLs is predicted at the most-affected receivers in Kemps Creek during roadworks in Precinct 1, Precinct 2, Precinct 3 and Precinct 4. The highest impacts are predicted when construction is occurring in the southern area of Precinct 2, adjacent to sensitive receivers.

No exceedance of the NMLs is predicted at sensitive receivers in Horsley Park, Mt Vernon, Erskine Park or Emmaus Catholic College during construction of roadways.

Construction impacts associated with the WNSLR are assessed in a separate road traffic noise report (SLR Report 610.16083-R1).

Pad and Hardstand Works

During standard construction hours, exceedance of the NMLs is predicted at the most-affected receivers in Emmaus Village during pad and hardstand works in Precinct 2 and Precinct 3. The highest impacts are predicted when construction is occurring in the vicinity of Lots 2C and 2D, adjacent to sensitive receivers.

Exceedance of the NMLs is predicted at the most-affected receivers in Kemps Creek during pad and hardstand works in Precinct 1, Precinct 2, Precinct 3 and Precinct 4. The highest impacts are predicted when construction is occurring in the vicinity of Lots 2H/2J, 3D and 4A, adjacent to sensitive receivers.

No exceedance of the NMLs is predicted at sensitive receivers in Horsley Park, Mt Vernon or Erskine Park during pad and hardstand works.

Exceedance of the NMLs is predicted at the most-affected receivers in Emmaus Catholic College during pad and hardstand works in Precinct 2. The highest impacts are predicted when construction is occurring in the vicinity of Lots 2E and 2F/2G and 2H/2J, adjacent to sensitive receivers.

Construction of Warehouse and Office Structures

During standard construction hours, exceedance of the NMLs is predicted at the most-affected receivers in Emmaus Village during warehouse construction in Precinct 2. The highest impacts are predicted when construction is occurring in the vicinity of Lots 2C and 2D, adjacent to sensitive receivers.

Exceedance of the NMLs is predicted at the most-affected receivers in Kemps Creek during warehouse construction in Precinct 2, Precinct 3 and Precinct 4. The highest impacts are predicted when construction is occurring in the vicinity of Lots 2H/2J, 3D and 4A, adjacent to sensitive receivers.

No exceedance of the NMLs is predicted at sensitive receivers in Horsley Park, Mt Vernon or Erskine Park during warehouse construction.

Exceedance of the NMLs is predicted at the most-affected receivers in Emmaus Catholic College during warehouse construction in Precinct 2. The highest impacts are predicted when construction is occurring in the vicinity of Lot 2F/2G, adjacent to sensitive receivers.

5.6 Construction Noise Mitigation

It is important to note that the above exceedances are based on a worst-case assessment of all equipment for each activity operating simultaneously at the closest point of the site to the most-affected receiver. These worst-case exceedances would not be expected to occur often, as the majority of works would be at a greater distance relative to the most-affected receivers, and the occurrence of all plant operating simultaneously would be low.

However, where exceedances of the NMLs are predicted, construction noise mitigation should be considered to reduce the potential noise impacts on the surrounding sensitive receivers. The ICNG describes strategies for construction noise mitigation and control that are applicable to this proposal. The strategies are designed to minimise, to the fullest extent practicable, noise during construction.

Where reasonable and feasible, preference should be given to scheduling construction works within the standard construction hours of:

- Monday to Friday 7.00 am to 6.00 pm.
- Saturday 8.00 am to 1.00 pm

Typically any OOHWs would be subject to separate approval on a case-by-case basis.

Where construction noise levels are predicted to exceed the NMLs it is recommended that construction noise mitigation measures should be considered, where reasonable and feasible. Typical construction noise mitigation measures include the following:

- Avoiding the coincidence of noisy plant working simultaneously close together would result in reduced noise emissions.
- Equipment which is used intermittently is to be shut down when not in use.
- Where possible, equipment with directional noise emissions should be oriented away from sensitive receivers.
- Regular compliance checks on the noise emissions of all plant and machinery used for the proposal would indicate whether noise emissions from plant items were higher than predicted. This also identifies defective silencing equipment on the items of plant.
- Where possible, heavy vehicle movements should be limited to standard construction hours.
- Non-tonal reversing alarms should be used on all items of plants and heavy vehicles used for construction.

- Permanent noise walls should be constructed as early as practicable during the construction phase of the OWE to assist in reducing construction noise impacts.
- Where practicable, temporary acoustic hoarding should be installed as close to the noise source as feasible aiming to block direct line of sight between the receiver position and the noise source. This measure typically suits dominant single items of plant such as rockbreakers, concrete saws and jackhammers where the source of noise is typically near the ground.

5.7 Construction Traffic Noise on the Public Network

5.7.1 Construction Road Traffic Noise Goals

The ICNG does not provide specific guidance in relation to acceptable noise levels associated with construction traffic. For assessment purposes, guidance is taken from the RNP, however, it is noted that these are taken as noise goals only and are not mandatory.

One of the objectives of the RNP is to apply relevant permissible noise increase criteria to protect sensitive receivers against excessive decreases in amenity as the result of a proposal. In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

On this basis, construction traffic NMLs set at 2 dB above the existing road traffic noise levels during the daytime and night-time periods are considered appropriate to identify the onset of potential noise impacts. Where the road traffic noise levels are predicted to increase by more than 2 dB as a result of construction traffic, consideration would be given to applying feasible and reasonable noise mitigation measures to reduce the potential noise impacts and preserve acoustic amenity.

In considering feasible and reasonable mitigation measures where the relevant noise increase is greater than 2 dB, consideration would also be given to the actual noise levels associated with construction traffic and whether or not these levels comply with the following road traffic noise criteria in the RNP:

- 60 dBA $L_{Aeq(15hour)}$ day and 55 dBA $L_{Aeq(9hour)}$ night for existing freeway / arterial / sub-arterial roads.

5.7.2 Construction Traffic Noise Assessment

The main construction traffic access route to the OWE site during the first stage of construction would be along Bakers Lane. Following completion of the construction of the Western North-South Link Road (WNSLR), construction traffic would use the WNSLR to access the OWE site.

Traffic counts were conducted on Bakers Lane in March / April 2016. For the purpose of the construction traffic noise assessment, only traffic volumes during standard construction hours have been used to assess the increase in road traffic noise due to construction traffic. It should also be noted that a significant proportion of weekday traffic occurs during the AM and PM peaks, corresponding to school zone times. The measured traffic volumes are reproduced in **Table 24**.

Table 24 Existing Traffic Volumes – Bakers Lane – 2016 Traffic Count

Traffic Count Period	Light Vehicles	Heavy Vehicles
Standard Construction Hours	3,050	166
AM Peak 1 hour	1,034	45
PM Peak 1 hour	714	54
Outside Peak Periods (ie 7 am to 8 am, 10 am to 2 pm, and 4 pm to 6 pm)	842	45

Construction traffic volumes for the OWE and WNSLR are forecast as follows:

- OWE construction traffic: 50 light vehicles and 50 heavy vehicles per day.
- WNSLR construction traffic: 30 light vehicles and 100 heavy vehicles per day.

The above forecast volumes are one direction flows. The assessment assumes all movements require an additional return trip.

Construction traffic on Bakers Lane from the OWE and WNSLR sites is predicted to increase daytime road traffic noise levels by 0.5 dBA to 1 dBA at the nearest sensitive receivers. If construction traffic was restricted from accessing Bakers Lane during the peak school zone periods (ie, 8 am to 10 am, and 2 pm to 4 pm), the increase in road traffic noise levels due to construction traffic on Bakers Lane is predicted to be 1.5 dBA to 2 dBA at the nearest sensitive receivers.

In both of these situations, construction traffic is not predicted to increase road traffic noise levels by more than 2 dBA. Therefore, construction road traffic noise mitigation or management measures are not considered to be required.

5.8 Construction Vibration 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.

5.8.1 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 25**.

Table 25 Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$) (*Assessing Vibration: a technical guideline*)

Location	Daytime[1]		Night-time[1]	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Critical areas[2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

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

Note 2: Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas.

Source: British Standard BS 6472-1992

5.8.2 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.

5.8.3 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* (AS 2187) and British Standard BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings Part 2* (BS 7385).

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 are shown in **Table 26**. These levels are judged to give a minimum risk of vibration-induced damage, where minimal risk is usually taken as a 95% probability of no effect.

Table 26 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

5.8.4 Safe Working Distances for Vibration Intensive Plant

The propagation of vibration emitted from a source would be site specific with the level of vibration potentially experienced at a receiver dependent upon the vibration energy generated by the source, the predominant frequencies of vibration, the localised geotechnical conditions and the interaction of structures and features which can dampen vibration.

The recommended safe working distances for construction plant in **Table 27** are referenced from the TfNSW *Construction Noise Strategy*.

Consistent with the British Standard and the Assessing Vibration guideline, the recommendations are for the practical management of potential vibration to minimise the likelihood of cosmetic damage to buildings and disturbance or annoyance in humans. The human comfort safe working distances are conservative, developed with reference to the more stringent objectives for continuous vibration for typical residential building constructions.

Table 27 Recommended Safe Working Distances for Vibration Intensive Plant

Plant Item	Rating / Description	Safe Working Distance	
		Cosmetic Damage[1]	Human Response[2]
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	15 m to 20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	20 m
	< 200 kN (Typically 4-6 tonnes)	12 m	40 m
	< 300 kN (Typically 7-13 tonnes)	15 m	100 m
	> 300 kN (Typically 13-18 tonnes)	20 m	100 m
	> 300 kN (> 18 tonnes)	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
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 m to 100 m
Pile Boring	≤ 800 mm	2 m (nominal)	N/A
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Note 1: Referenced from British Standard BS 7385 Part 2-1993.
Note 2: Referenced from *Assessing Vibration: A Technical Guideline*.

5.8.5 Predicted Construction Vibration Impacts

Vibration intensive items of plant proposed for use during the construction of the development would include plate compactors and vibratory rollers. These items of equipment are proposed to be used during pad and hardstand works and construction of roadways.

The nearest vibration sensitive receivers to the development construction works are approximately 20 m from the nearest point of the OWE and are located in Emmaus Village, Emmaus Catholic School and immediately adjacent to the southern boundary in Kemps Creek.

Cosmetic Damage Assessment

Vibratory rollers and plate compactors have the potential to be operated within the recommended safe working distances of structures in Emmaus Village, Emmaus Catholic School and immediately adjacent to the southern boundary in Kemps Creek. The separation distance from these buildings should be maximised where reasonable and feasible. Attended vibration monitoring or vibration trials should be undertaken when proposed works are within 100 m of vibration sensitive receivers to ensure that levels remain below the criterion. Building condition surveys should also be completed both before and after the works at any potentially affected structures within safe working distances to identify existing damage and any project related damage.

Human Comfort Vibration Assessment

In relation to human comfort (response), the safe working distances in **Table 27** 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 BS 6472-1.

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

Based on the general work zones, some items of proposed construction equipment have the potential to be operated within the recommended safe working distances. There is potential for ground vibration levels to exceed the human comfort criteria depending on the duration and nature of the construction activity. The required locations for vibration intensive equipment should be reviewed during the preparation of the site-specific CNVMPs for construction works adjacent to the most affected receivers.

5.8.6 Construction Vibration Mitigation

Where vibration intensive construction activities are proposed within 100 m of sensitive receivers, these works should be confined to less sensitive periods where practicable. The potential impacts from vibration are to be considered in the site-specific CNVMPs, to be developed for construction works adjacent to the most affected receivers. In general, mitigation measures that should be considered are summarised as follows:

- Relocate vibration generating plant and equipment to other areas within the site in order to lower the vibration impacts.
- Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment.
- Use lower vibration generating items of plant and equipment where possible e.g. smaller capacity vibratory rollers.
- If vibration intensive works are required within the safe working distances, vibration monitoring or attended vibration trials would be undertaken to ensure that levels remain below the cosmetic damage criterion.
- Where buildings are located within the safe working distances for cosmetic damage, building condition surveys would be completed both before and after the works to identify existing damage and any damage due to the works.

6 SUMMARY OF IMPACTS

It should be noted that the recommendations made in this report are based on 24 hour operation of warehouse and distribution facilities in the site. As such, this is considered a worst-case assessment of potential impacts. Typical impacts are likely to be lower than the worst-case predicted impacts.

6.1 Operational Noise Impacts

Masterplan Operations

An operational noise impact assessment has been conducted for the Oakdale West Estate masterplan design. Operational noise criteria have been determined in accordance with the processes outlined in the NSW *Industrial Noise Policy*.

Without noise mitigation, noise emissions from the OWE are predicted to be above the nominated noise criteria at the most affected sensitive receivers in Emmaus Village and Kemps Creek during worst-case peak operations under adverse weather conditions. Noise levels are predicted to be below the nominated noise criteria at sensitive receivers in all other residential areas, educational facilities and commercial / industrial buildings under both neutral and adverse weather conditions.

Feasible and reasonable noise mitigation measures have been investigated to reduce the noise impacts on the most-affected receivers. Indicative noise barriers with heights of 2 m to 5 m, located near the most affected receivers (refer to **Figure 9** for indicative heights and locations) were recommended. Inclusion of the indicative noise barriers was found to eliminate all predicted exceedances of the noise criteria at the identified receivers under neutral weather conditions.

With the recommended indicative noise barriers, residual noise goal exceedances of up to 3 dB are predicted at three residential receivers in Kemps Creek, under adverse weather conditions only.

It is noted that with the recommended indicative noise barriers, the amenity criteria is not exceeded at any identified sensitive receivers during any periods.

It is understood the receivers to the south of the OWE where residual noise impacts are predicted are located within the greater Western Sydney Employment Area (WSEA) which includes the OWE. As such, it may be preferable to enter discussions with the landholders regarding suitable mitigation measures for this location. Goodman has commenced discussions with these residents and these discussions indicate that the residents are open to alternative mitigation measures.

It is noted that the modelled noise emissions are based on a worst-case scenario of maximum peak vehicle movements in every precinct of the OWE occurring concurrently, however it is noted that the contribution from individual precincts does not exceed the noise criteria under adverse weather conditions. While the worst-case peak-hour vehicle movements may occur across the development when the OWE is fully operational, it is unlikely that maximum peak 15-minute vehicle movements would occur simultaneously in every precinct of the OWE, and, should this unlikely situation occur, the predicted exceedances occur only under adverse weather conditions.

It is also noted that the daytime and evening exceedances under adverse weather outlined above fall outside of the INP adverse weather assessment requirements (as discussed in **Section 3.6.1**). However, mitigation has been considered for these exceedances in order to minimise noise impacts at the potentially affected receivers.

The proposed operation of the OWE is considered unlikely to result in a significant adverse noise impact on nearby sensitive receivers.

Precinct 1 Operations

Operations associated with Precinct 1 of the Oakdale West Estate are proposed to commence before construction of the later stages of the OWE are complete. An operational noise impact assessment has been conducted for Precinct 1 only to determine if the mitigation measures outlined for the masterplan design are required for Precinct 1 operations.

Without noise mitigation, noise emissions from Precinct 1 of the OWE are predicted to be below the nominated noise criteria at all identified receivers under both neutral and adverse weather conditions. As such, it is considered acceptable that the operation of Precinct 1 may commence prior to construction of the mitigation measures recommended for the masterplan design.

Off-site Operational Traffic

The main access route to the Oakdale West Estate is via the proposed Western North-South Link Road (WNSLR), then the arterial road of Lenore Drive. The WNSLR is proposed as a new road and is subject to a separate road traffic noise assessment.

The forecast daily traffic volumes on Lenore Drive at the opening of the WNSLR have been compared to the estimated traffic movements from the OWE. The increase in traffic noise due to the OWE is not considered likely to result in a significant increase in noise levels at the nearest sensitive receivers. No mitigation is likely to be required as a result.

6.2 Construction Noise and Vibration Impacts

A construction noise and vibration impact assessment has been conducted for the Oakdale West Estate. Construction noise and vibration criteria have been determined in accordance with the relevant guidelines.

Construction Noise

Construction noise impacts have been predicted for several construction activities during the various stages of construction of the OWE.

The worst impacts are predicted during site clearing and earthworks in the vicinity of Lots 2D, 2E and 4A, when works are adjacent to the nearest sensitive receivers in Emmaus Village, Emmaus Catholic College and Kemps Creek.

Typical noise impacts during construction of the OWE are predicted to result in no exceedance to minor exceedances of the NMLs.

No receivers are considered to be Highly Noise Affected, ie with predicted noise levels exceeding 75 dB LAeq.

No exceedance of the NMLs is predicted at sensitive receivers in Horsley Park, Mt Vernon or Erskine Park during construction of the OWE.

It is important to note that the above exceedances are based on a worst-case assessment of all equipment for each activity operating simultaneously at the closest point of the site to the most-affected receiver. These worst-case exceedances would not be expected to occur often, as the majority of works would be at a greater distance relative to the most-affected receivers, and the occurrence of all plant operating simultaneously would be low. Additionally, receivers in each area which are further from the works than the most-affected receiver would be subject to lower noise levels than those predicted for the most-affected receiver.

Where exceedances of the NMLs are predicted, construction noise mitigation should be considered to reduce the potential noise impacts on the surrounding sensitive receivers. Typical construction noise mitigation measures have been recommended in **Section 5**.

Construction impacts associated with the WNSLR are assessed in a separate report.

Construction traffic on Bakers Lane from the OWE and WNSLR sites is not predicted to increase daytime road traffic noise levels by more than 2 dBA at the nearest sensitive receivers. Construction road traffic noise mitigation or management measures are therefore not considered to be required.

Construction Vibration

Vibratory rollers and plate compactors have the potential to be operated within the recommended safe working distances of structures in Emmaus Village, Emmaus Catholic School and immediately adjacent to the southern boundary in Kemps Creek.

Vibration at the nearest receivers is likely to be perceptible at times during the works when vibration intensive equipment is operated adjacent to the nearest receivers.

There is potential for ground vibration levels to exceed the cosmetic damage criteria and human comfort criteria depending on the duration and nature of the construction activity. The required locations for vibration intensive equipment should be reviewed during the preparation of the site-specific CNVMPs for construction works adjacent to the most affected receivers.

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. Indicative construction noise and vibration mitigation measures have been recommended in **Section 5** which includes vibration monitoring during the works.

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 x 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 4000 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 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA 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

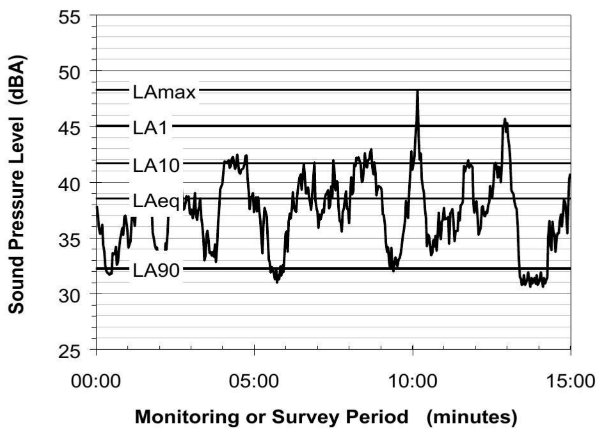
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or L_W, or by the reference unit 10^{-12} W.

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 exceed 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

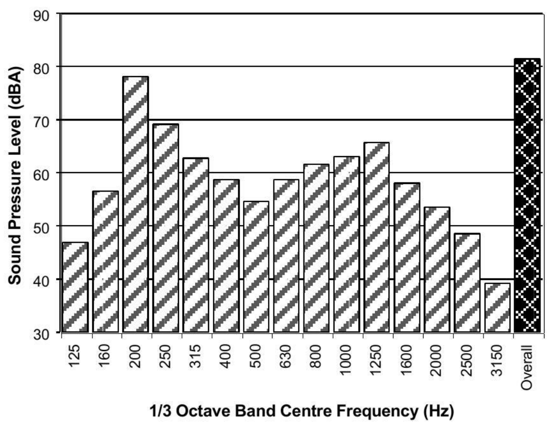
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

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 organizations.

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

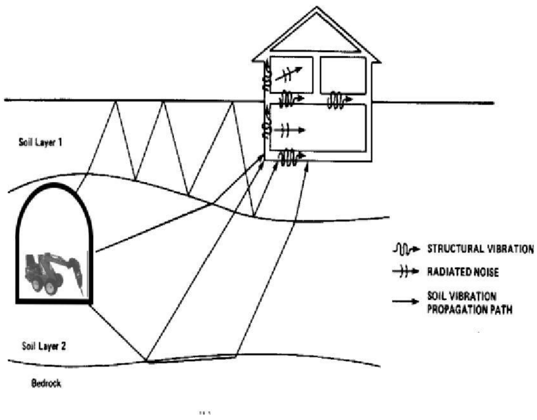
The term 'over-pressure' is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

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.

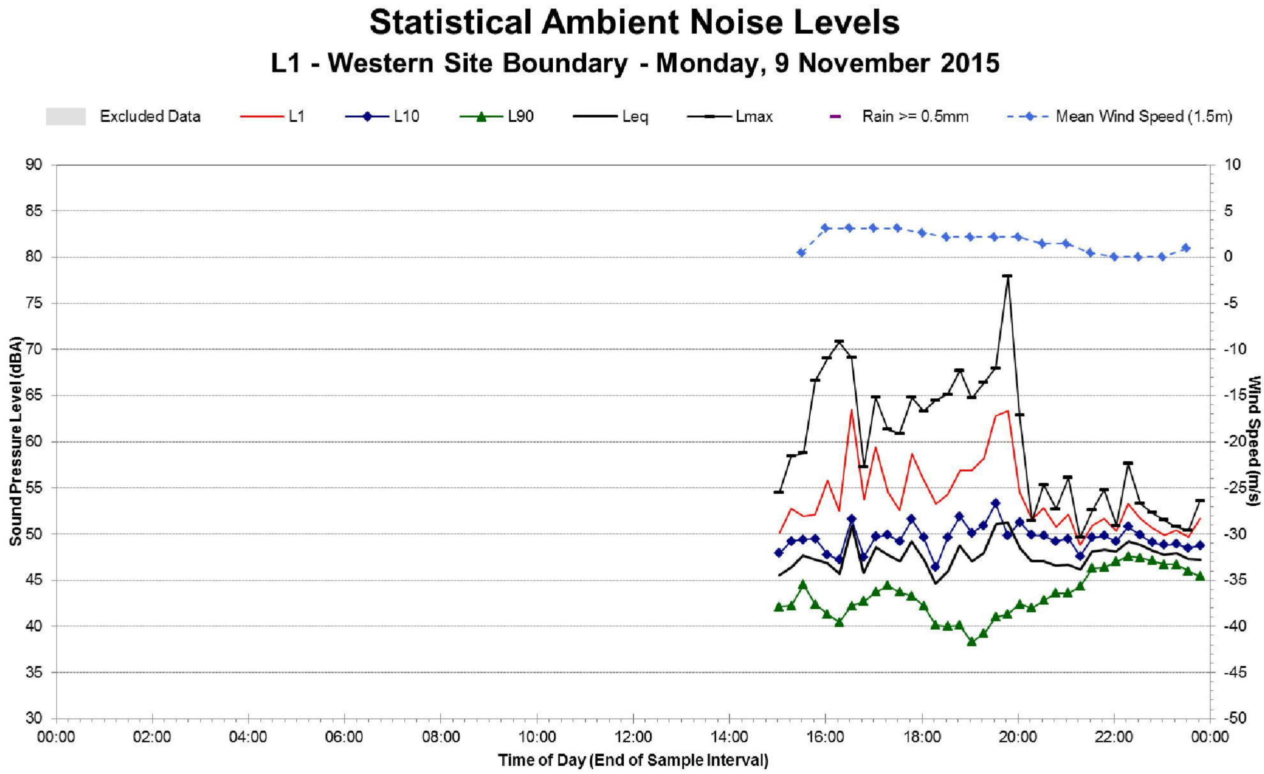
Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

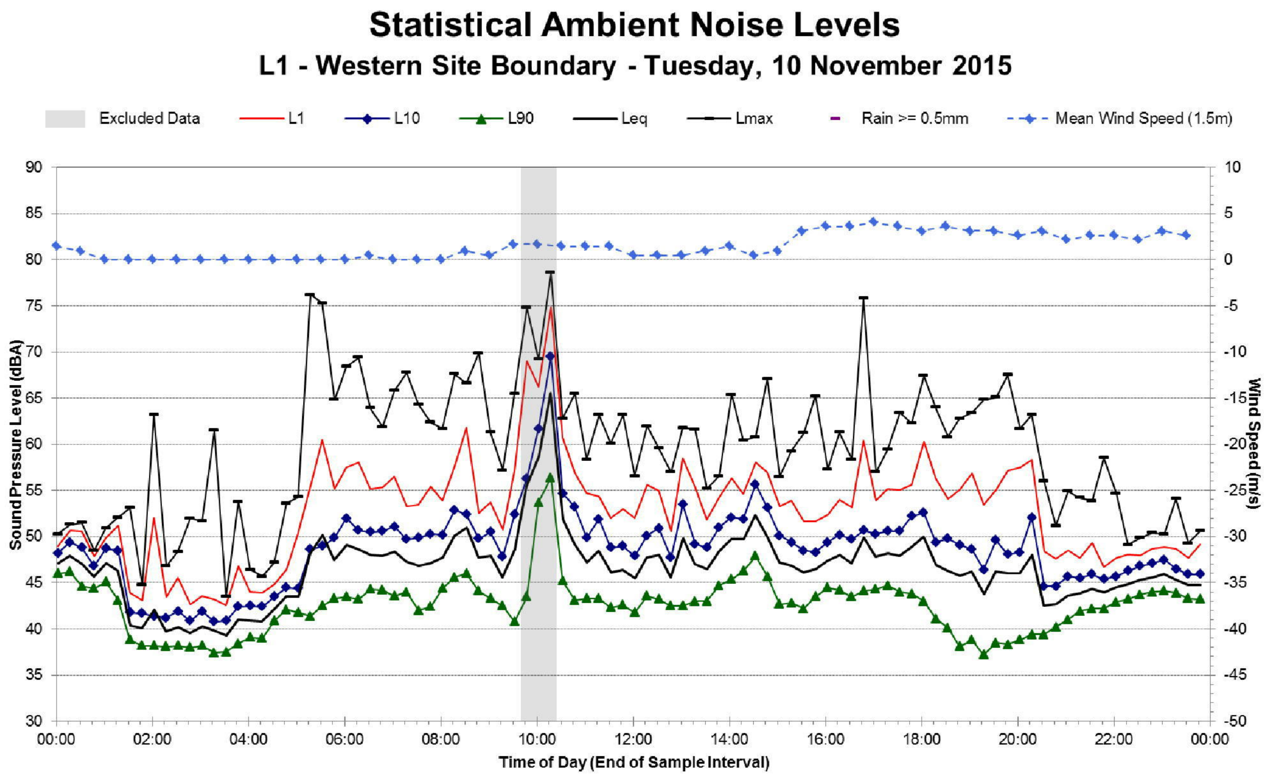
The following figure presents the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



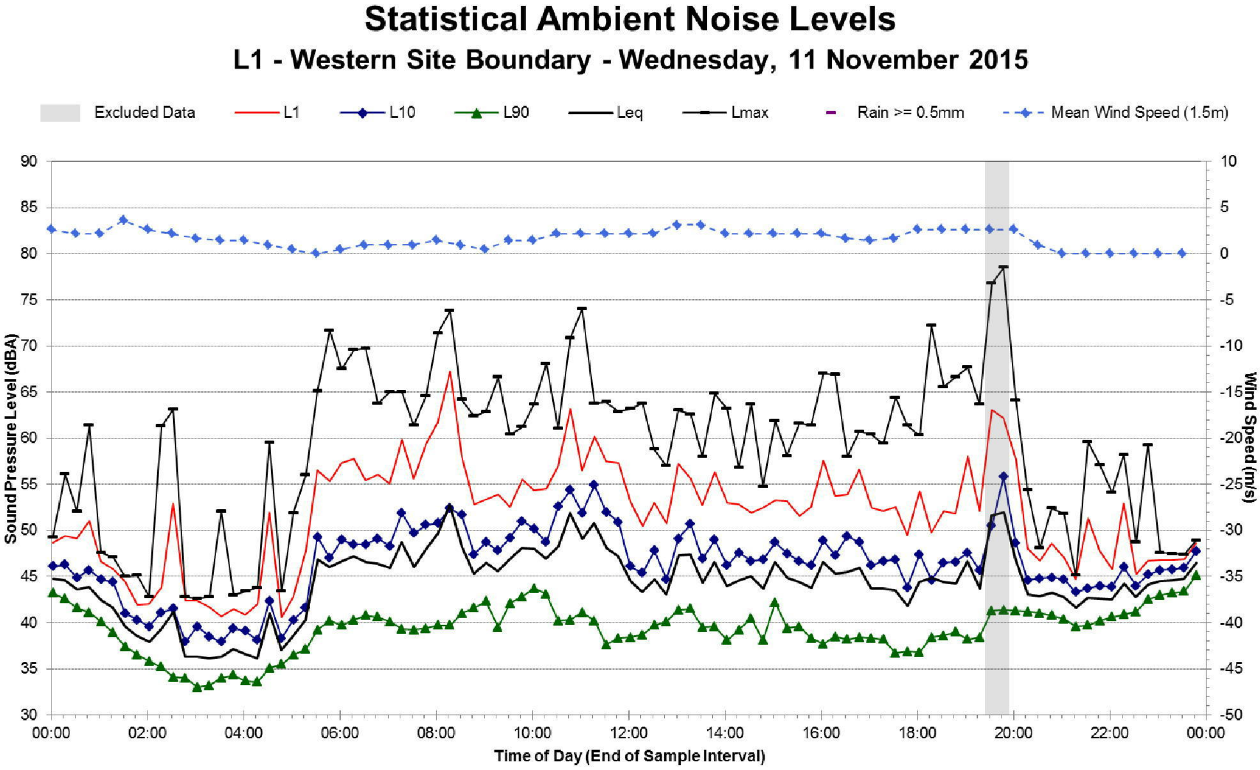
The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect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

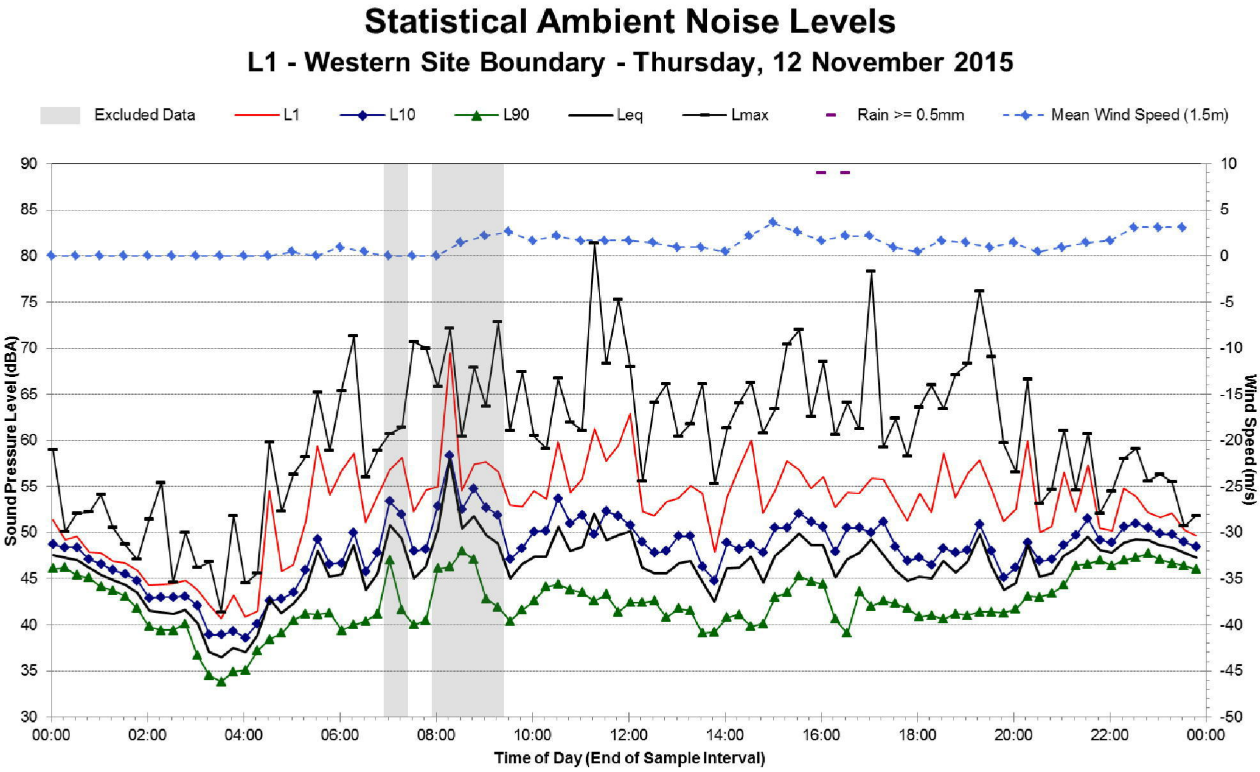
L1 - Western Site Boundary - Ambient Noise Monitoring Results





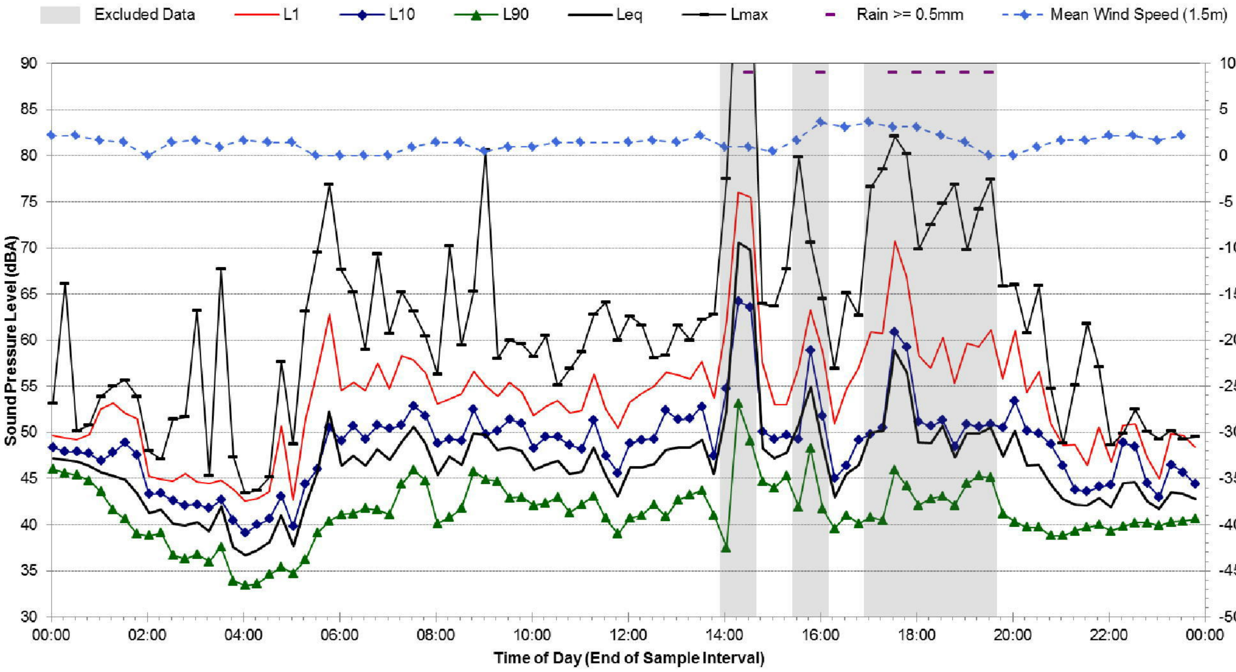
L1 - Western Site Boundary - Ambient Noise Monitoring Results



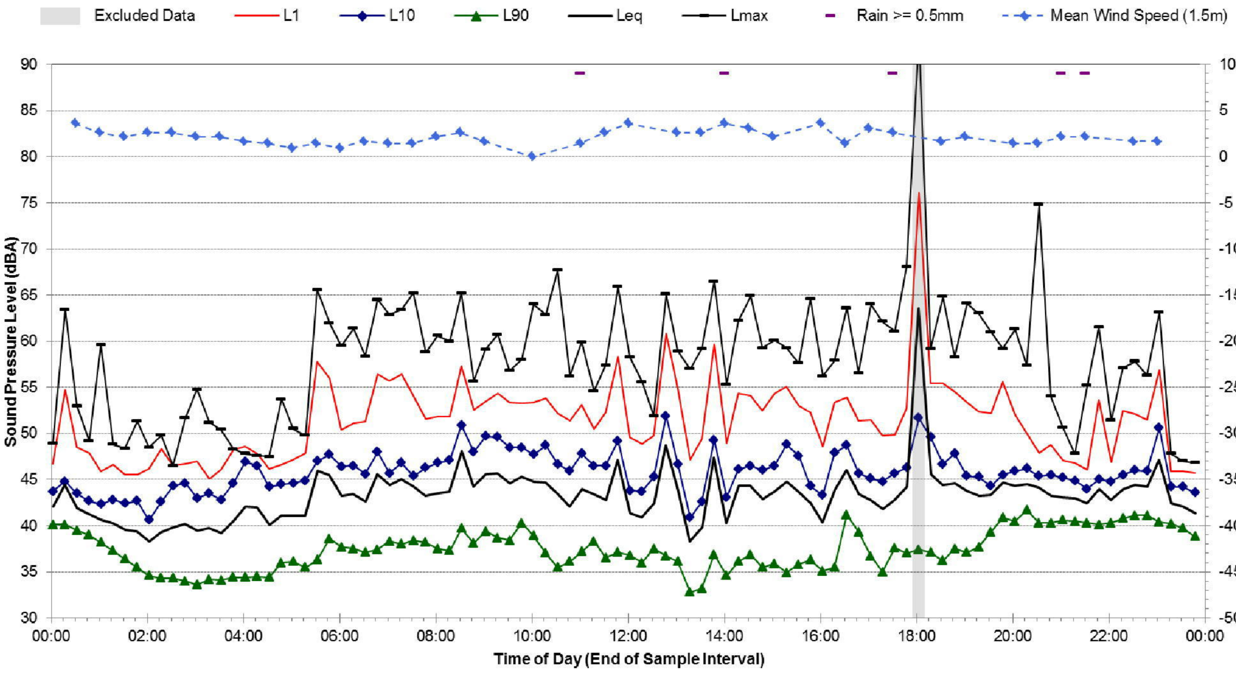


L1 - Western Site Boundary - Ambient Noise Monitoring Results

Statistical Ambient Noise Levels
L1 - Western Site Boundary - Friday, 13 November 2015



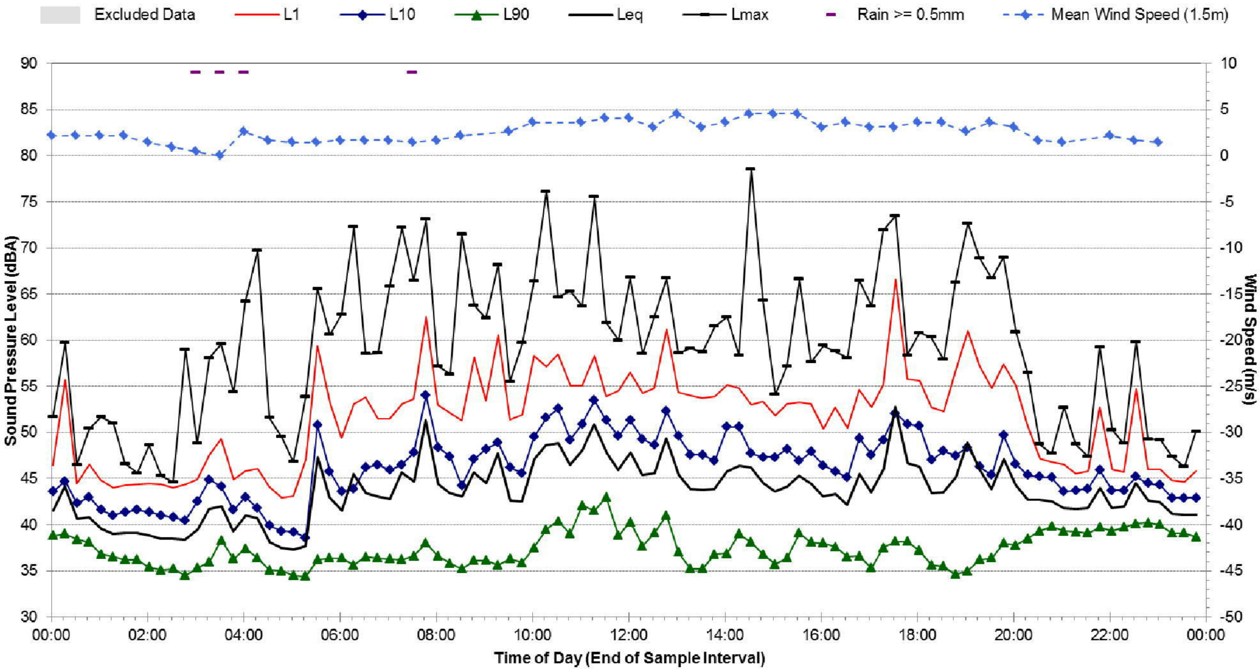
Statistical Ambient Noise Levels
L1 - Western Site Boundary - Saturday, 14 November 2015



L1 - Western Site Boundary - Ambient Noise Monitoring Results

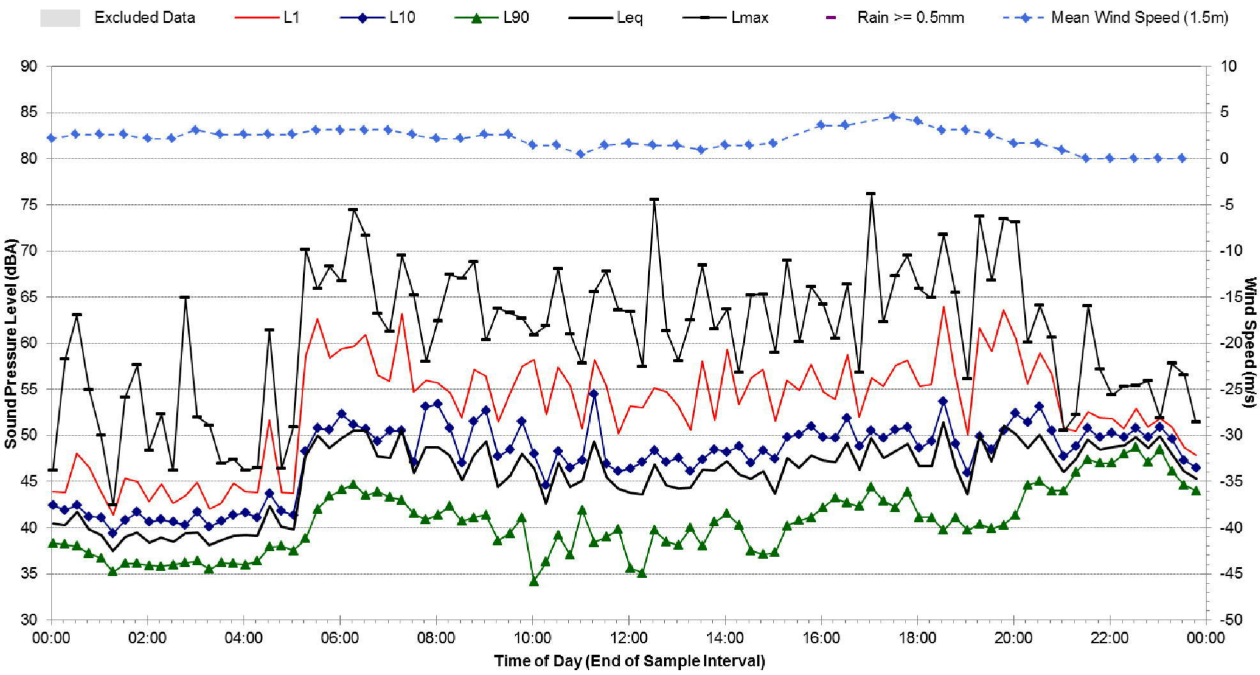
Statistical Ambient Noise Levels

L1 - Western Site Boundary - Sunday, 15 November 2015

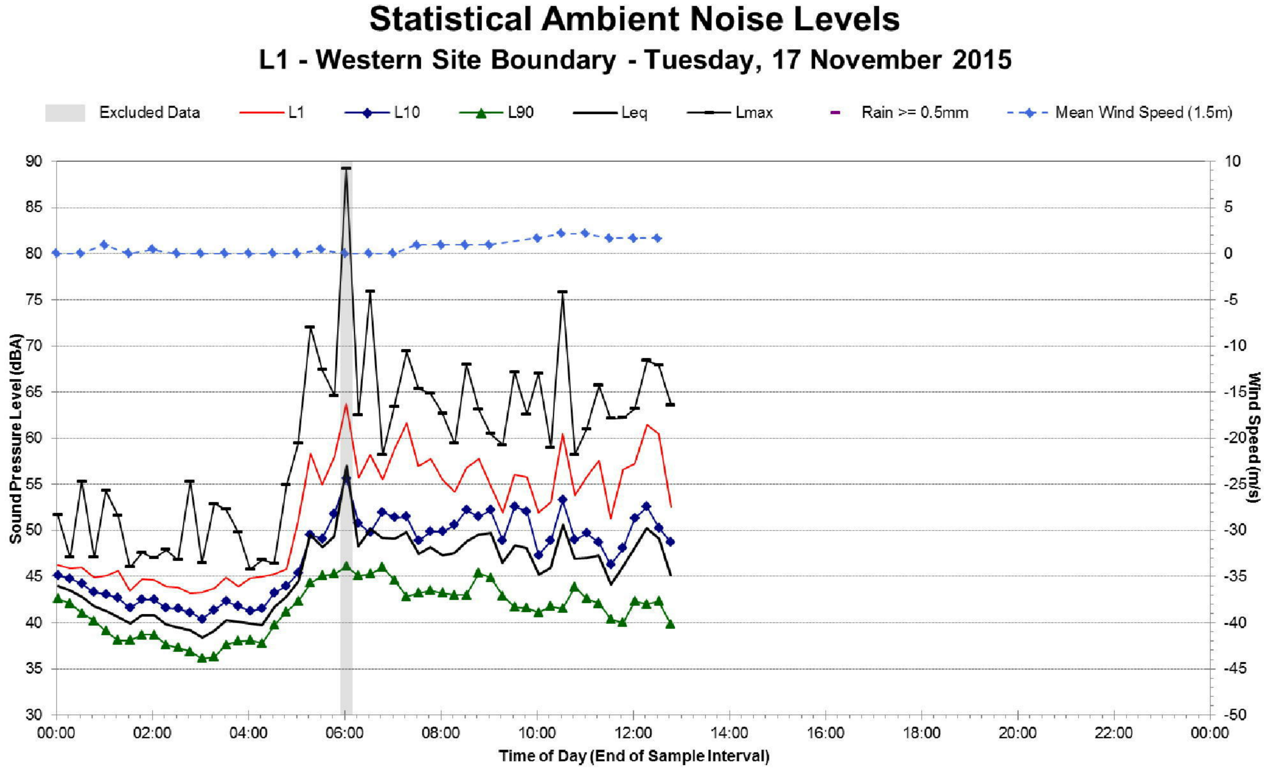


Statistical Ambient Noise Levels

L1 - Western Site Boundary - Monday, 16 November 2015



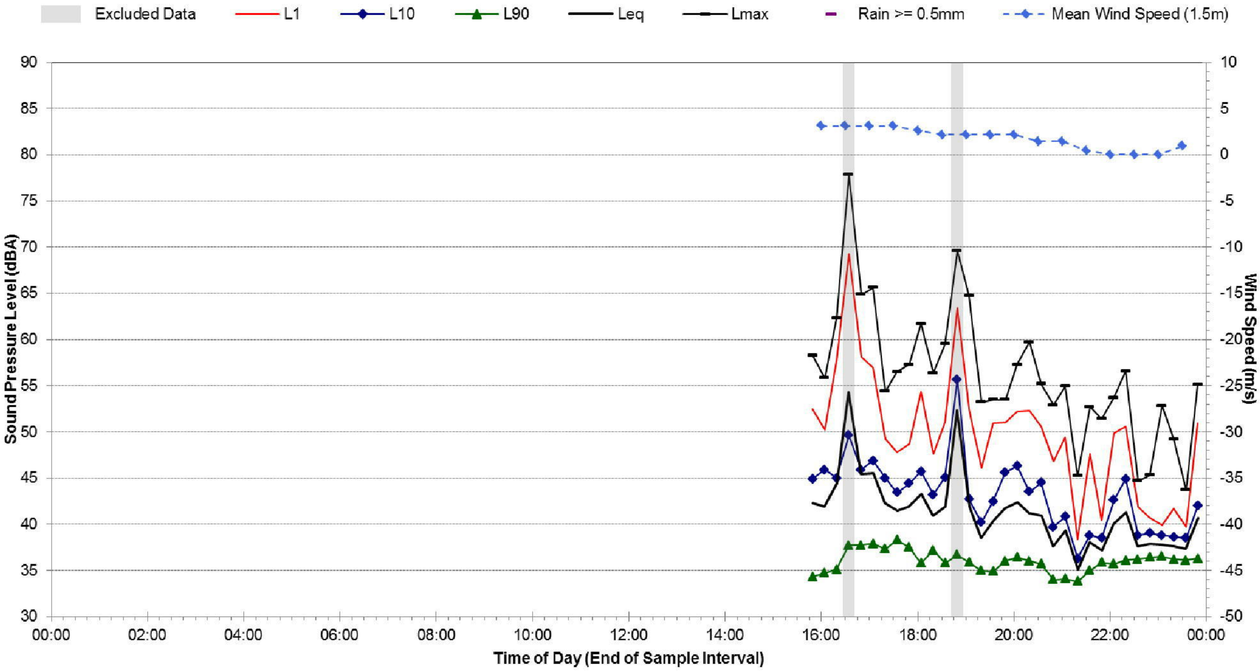
L1 - Western Site Boundary - Ambient Noise Monitoring Results



L2 - Southern Site Boundary - Ambient Noise Monitoring Results

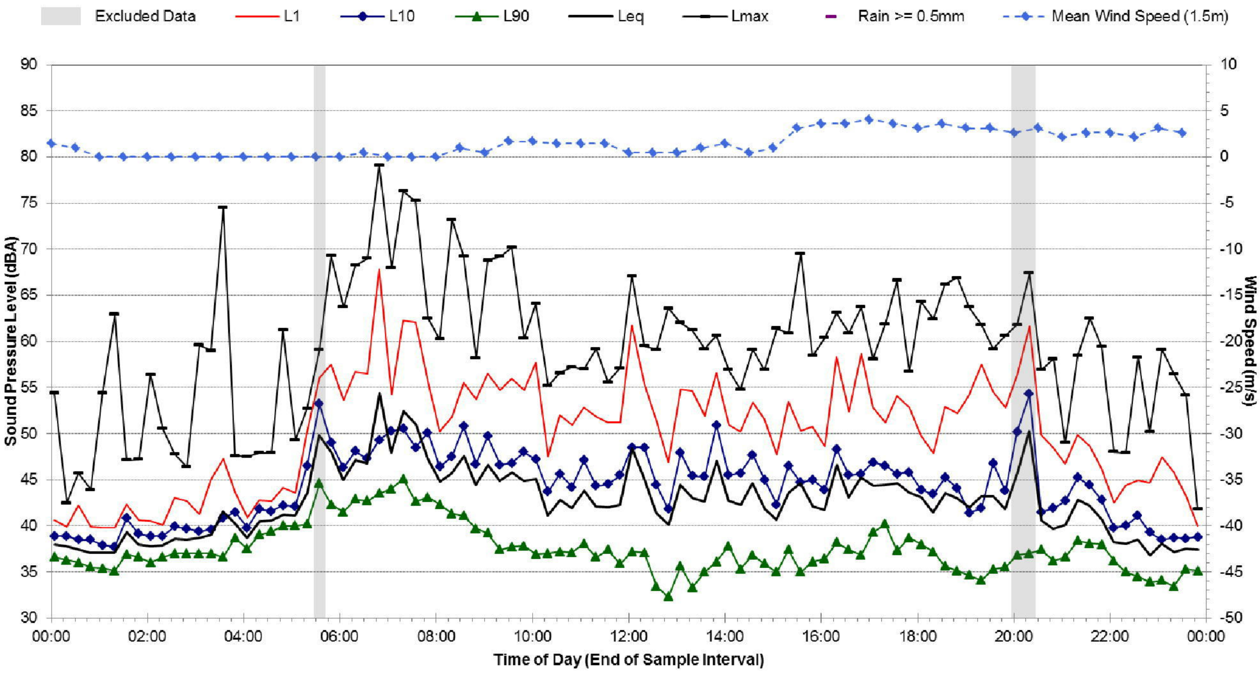
Statistical Ambient Noise Levels

L2 - Southern Site Boundary - Monday, 9 November 2015

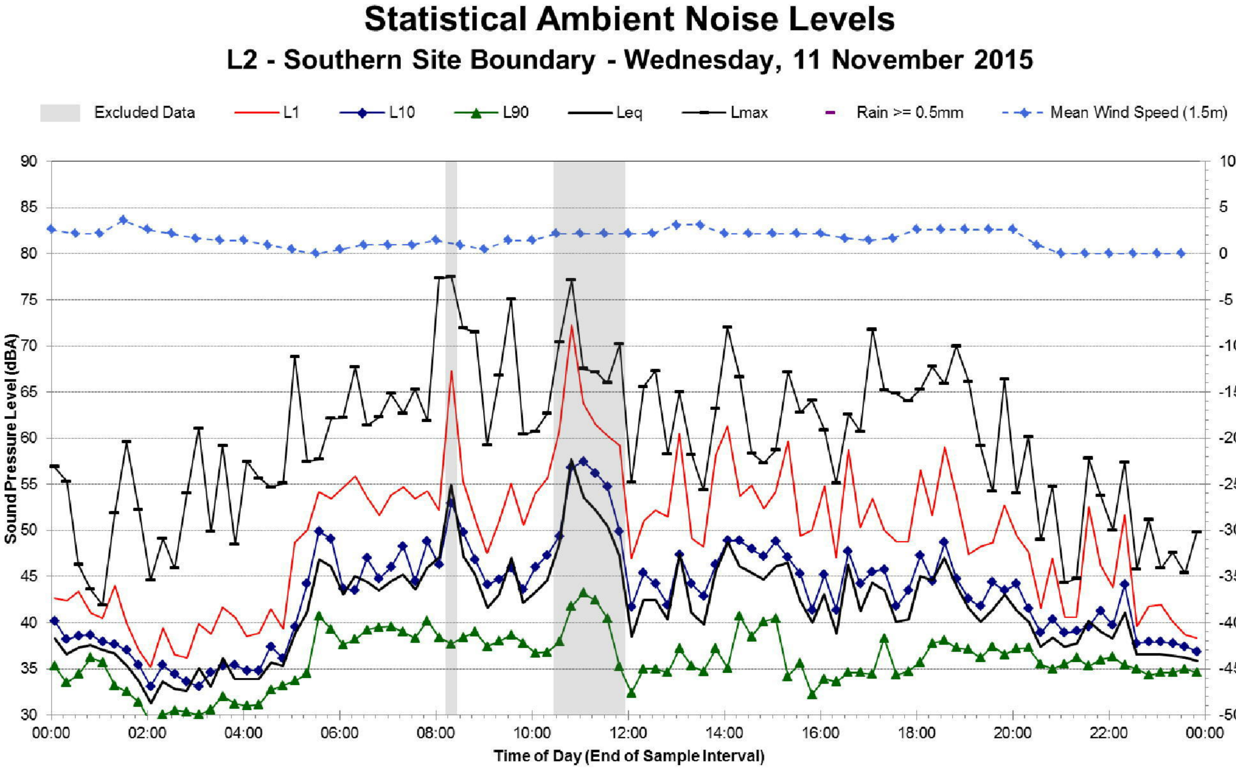


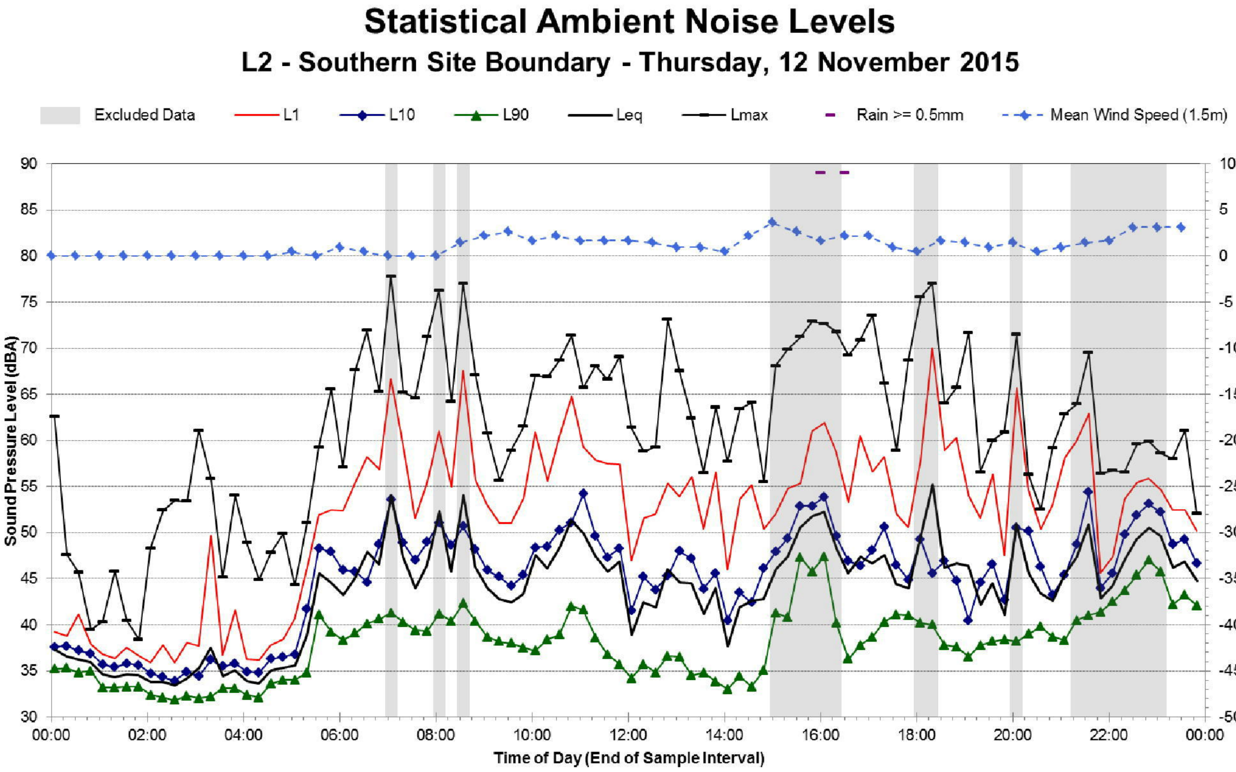
Statistical Ambient Noise Levels

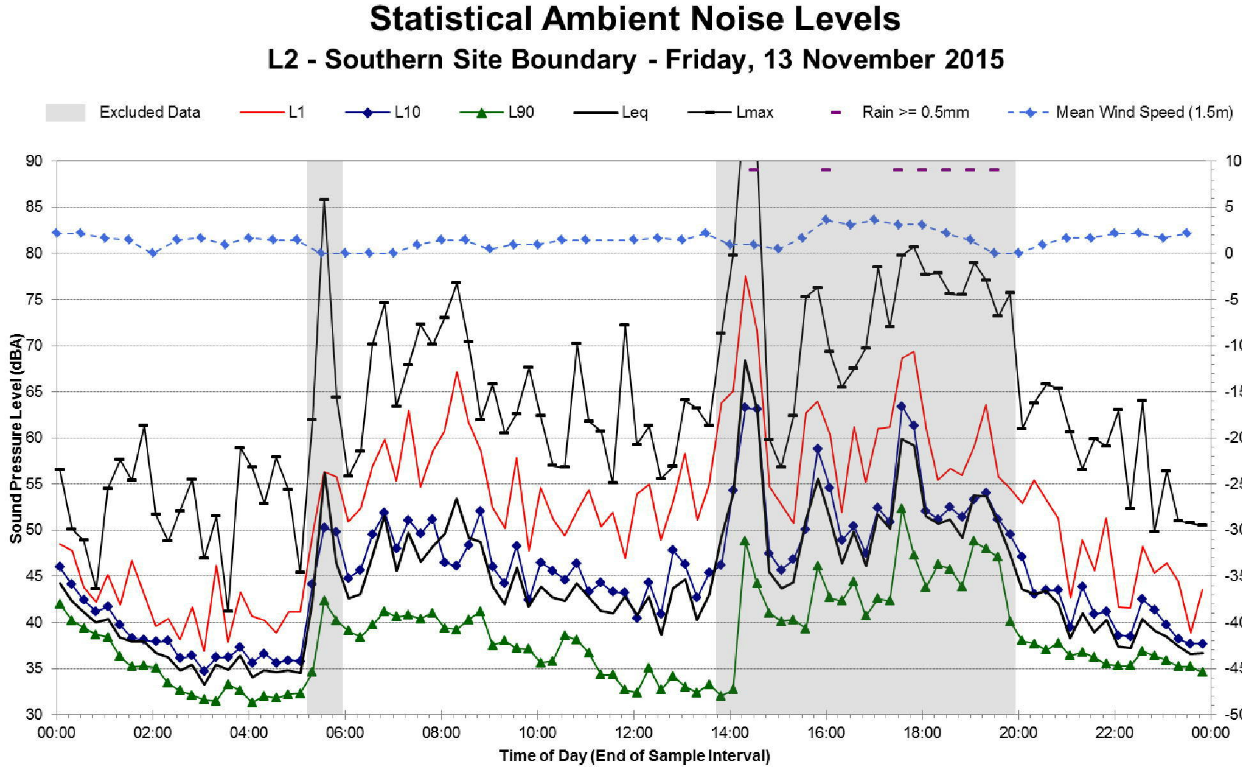
L2 - Southern Site Boundary - Tuesday, 10 November 2015

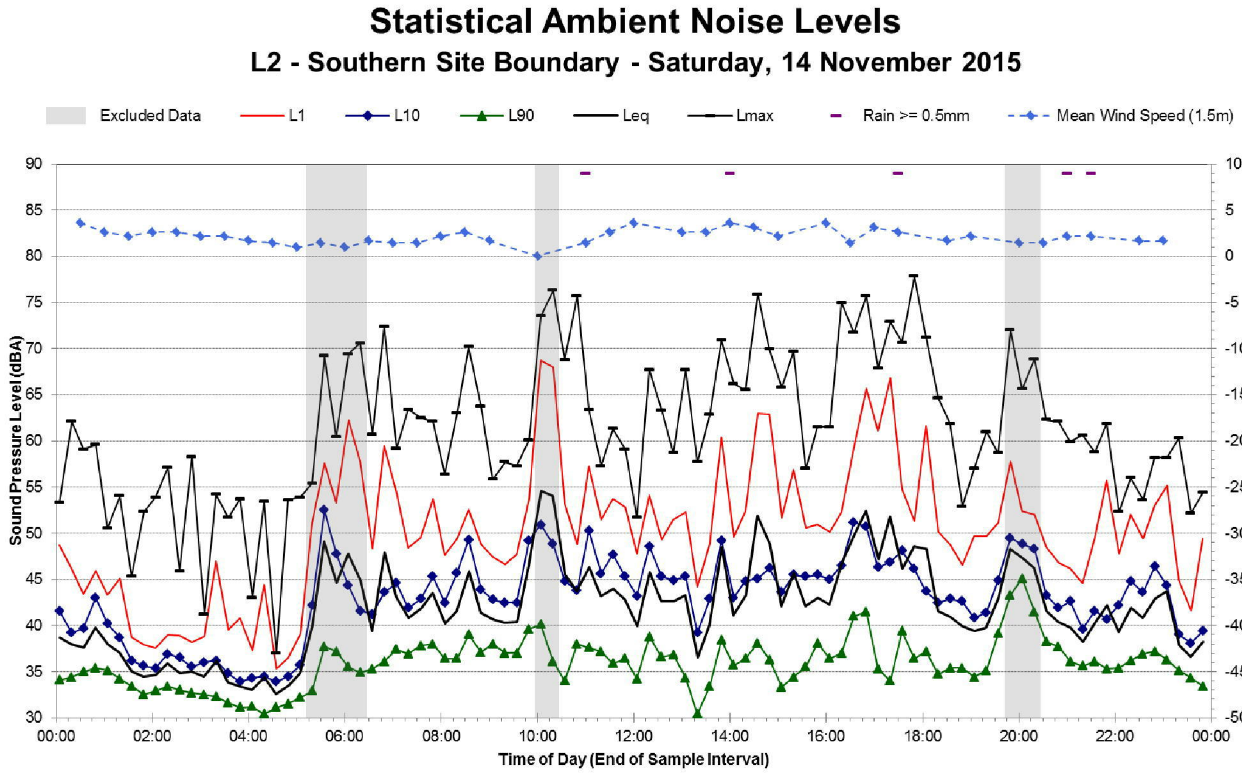


L2 - Southern Site Boundary - Ambient Noise Monitoring Results

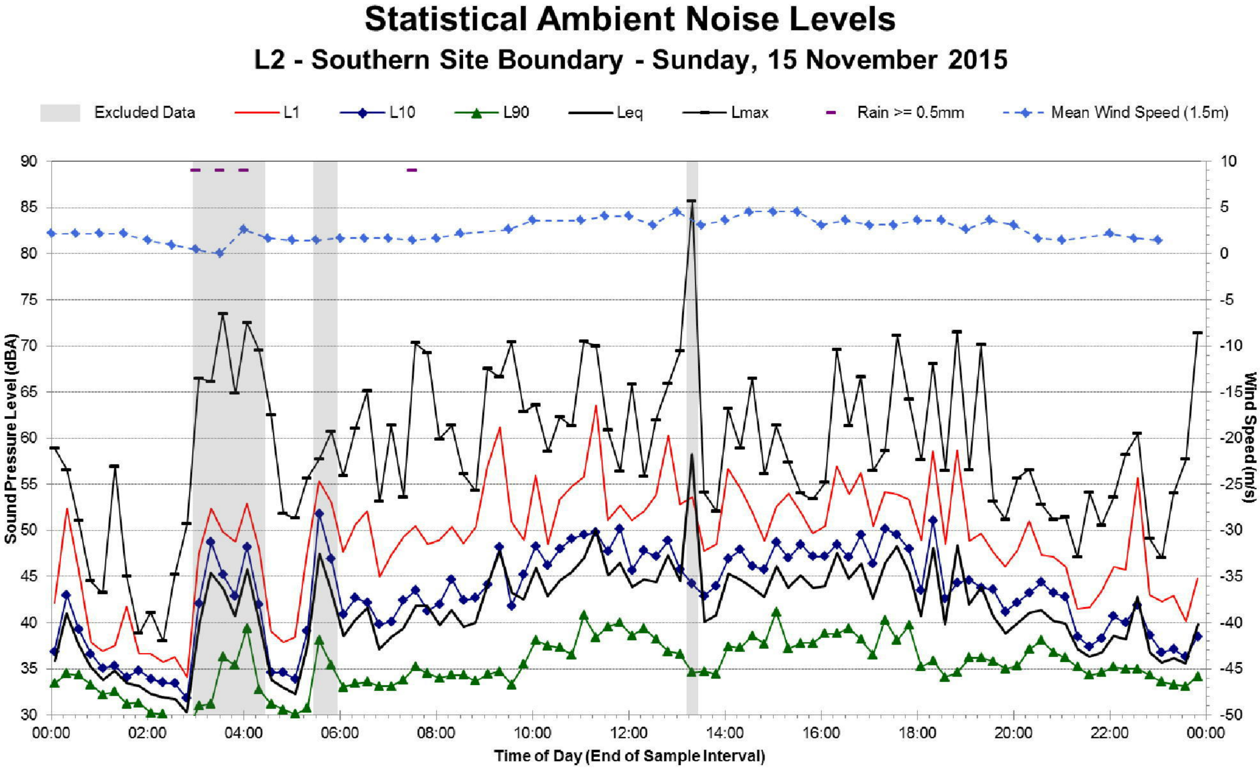


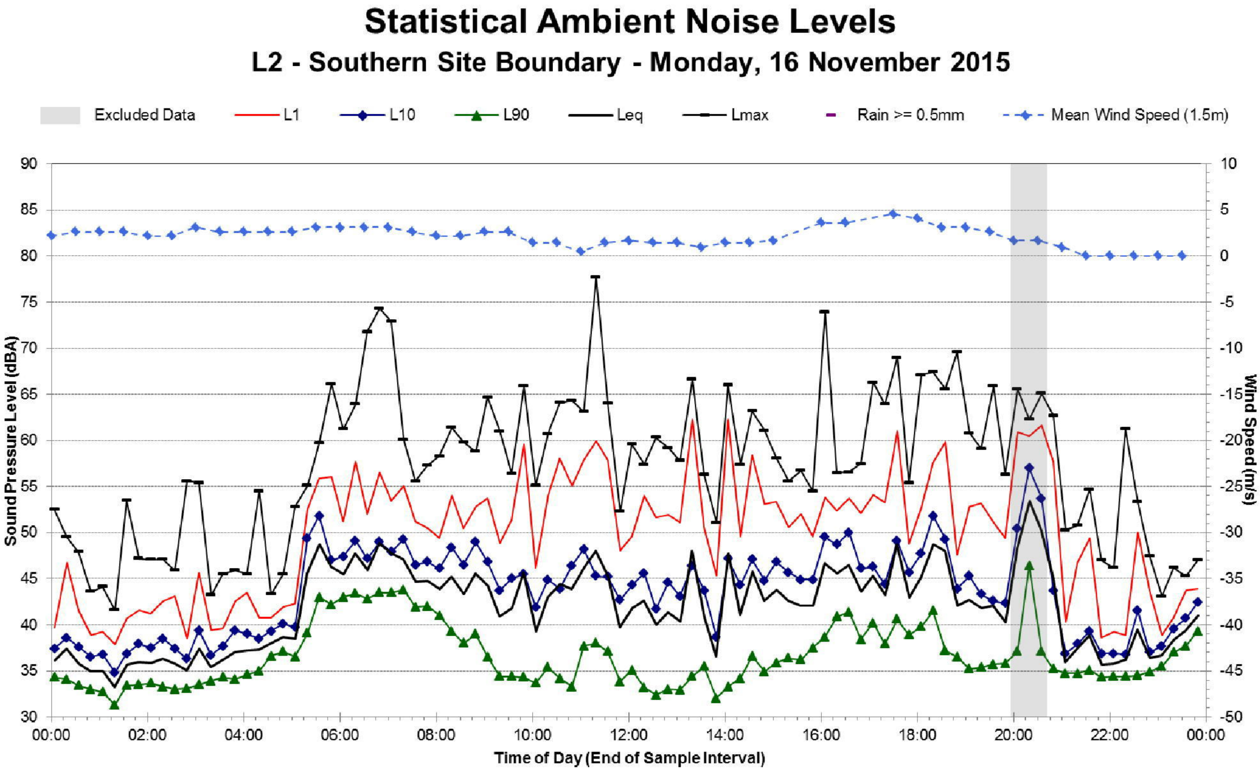



Statistical Ambient Noise Levels
L2 - Southern Site Boundary - Friday, 13 November 2015
Excluded Data
L1
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L2 - Southern Site Boundary - Saturday, 14 November 2015
Excluded Data
L1
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

L2 - Southern Site Boundary - Ambient Noise Monitoring Results





L2 - Southern Site Boundary - Ambient Noise Monitoring Results