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Transportation Noise Assessment

Anketell Road Upgrade (Leath Road to Treeby Road)

Reference: 23118529-01

Prepared for:
Main Roads WA

Reference: 23118529-01

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EXECUTIVE SUMMARY

Main Roads Western Australia (Main Roads) proposes to upgrade Anketell Road from Leath Road to Kwinana Freeway (Anketell Road West). The proposal involves construction of approximately 7km of new road along the existing Anketell Road alignment.

The acoustic criteria relevant to a road upgrade are provided in *State Planning Policy No. 5.4 Road and Rail Noise* produced by the Western Australian Planning Commission (WAPC), with outdoor noise targets of 60 dB $L_{Aeq(Day)}$ and 55 dB $L_{Aeq(Night)}$. It is recognised that in some instances, it may not be reasonable and/or practicable to meet the outdoor noise targets with mitigation measures to be implemented that balance reasonable and practicable considerations.

A model of existing noise levels was developed and calibrated with on-site noise measurements, referred to as the Existing Scenario. The calibrated model was then modified to consider the traffic noise in the future (2051) including the Anketell Road upgrade.

The analysis shows that there are no noise sensitive premises that are predicted to receive a future traffic noise level, assuming the 'Build' scenario, that exceed the *State Planning Policy No. 5.4 Road and Rail Noise* criteria. Therefore, for this project, further consideration of noise mitigation is not required under the Policy.

1. INTRODUCTION

Main Roads Western Australia (Main Roads) proposes to upgrade Anketell Road from Leath Road to Kwinana Freeway (Anketell Road West). The proposal involves construction of approximately 7km of new road along the existing Anketell Road alignment. Refer *Figure 1-1* for project locality.

Figure 1-1: Road Project Locality

This noise assessment of the proposed upgrade of Anketell Road includes:

- Traffic noise monitoring to assess existing conditions and calibrate the noise model;
- Identification of noise sensitive premises adjacent to the project area;
- Noise modelling to predict future noise conditions;
- Assessment of traffic noise and potential impacts; and
- Recommendations regarding priority areas and suitable treatments for noise mitigation measures.

Noise monitoring and modelling have been undertaken in accordance with *State Planning Policy 5.4 (SPP 5.4) Road and Rail Noise.*

Appendix B contains a description of some of the terminology used throughout this report.

2. CRITERIA

The criteria relevant to this project is provided in *State Planning Policy No. 5.4 Road and Rail Noise* (hereafter referred to as SPP 5.4) produced by the Western Australian Planning Commission (WAPC). SPP 5.4 is supported by the *Road and Rail Noise Guidelines* (the Guidelines) and the Department of Planning, Lands and Heritage mapping. The objectives of SPP 5.4 are to:

- Protect the community from unreasonable levels of transport noise;
- Protect strategic and other significant freight transport corridors from incompatible urban encroachment;
- Ensure transport infrastructure and land-use can mutually exist within urban corridors;
- Ensure that noise impacts are addressed as early as possible in the planning process; and
- Encourage best practice noise mitigation design and construction standards.

SPP 5.4 applies to major upgrades of roads as identified in *Table 2-1*.

Table 2-1: Transport Corridor Classification and Trigger Distances: Roads

Transport Road Classification	Trigger Distance	Distance Measured From
Strategic Freight and Major Traffic Routes Roads as defined by Perth and Peel Planning Frameworks and/or roads with either 500 or more Class 7 to 12 Austroads vehicles per day, and/or 50,000 per day traffic volume	300 metres	Road carriageway edge
Other Significant Freight/Traffic Routes These are generally any State administered road and/or local government road identified as being a future State administered road (red road) and other roads that meets the criteria of either ≥ 100 Class 7 to 12 Austroads vehicles daily or ≥ 23,000 daily traffic count (averaged equivalent to 25,000 vehicles passenger car units under region schemes)	200 metres	Road carriageway edge

Anketell Road is identified as a Strategic Freight and Major Traffic Route.

The application of SPP 5.4 is to consider anticipated traffic volumes for the next 20 years from when the noise assessment has been undertaken.

It is recognised that in some instances, it may not be reasonable and/or practicable to meet the outdoor noise targets. Where transport noise is above the noise targets, measures are expected to be implemented that balance reasonable and practicable considerations with the need to achieve acceptable noise protection outcomes.

Table 2-2: Noise Targets for Roads

Scenario	Outdoor Noise Target	
Road Upgrade	60 dB $L_{Aeq(Day)}$	55 dB $L_{Aeq(Night)}$

Notes:

- Day period is from 6am to 10pm and night period from 10pm to 6am.
- The outdoor noise target is to be measured at 1-metre from the most exposed, habitable[1] facade of a noise sensitive building.
- Outdoor targets are to be met at all outdoor areas as far as is reasonable and practicable to do so using the various noise mitigation measures outlined in the Guidelines. For example, it is likely unreasonable for a transport infrastructure provider to achieve the outdoor targets at more than 1 or 2 floors of an adjacent development with direct line of sight to the traffic.

[1] A habitable room is defined in State Planning Policy 3.1 as a room used for normal domestic activities that includes a bedroom, living room, lounge room, music room, sitting room, television room, kitchen, dining room, sewing room, study, playroom, sunroom, gymnasium, fully enclosed swimming pool or patio.

3. METHODOLOGY

Noise measurements and modelling have been undertaken in accordance with the requirements of SPP 5.4 and associated Guidelines as described in *Section 3.1* and *Section 3.2*.

3.1. Site Measurements

Noise monitoring was undertaken at two (2) locations in order to:

- Quantify the existing noise levels;
- Determine the differences between different acoustic parameters ($L_{Aeq(Day)}$ and $L_{Aeq(Night)}$); and
- Calibrate the noise model for existing conditions.

The instruments used were Acoustic Research Laboratories (ARL) noise data loggers, with the microphone located approximately 1.4 metres above ground level. The loggers recorded various acoustic parameters, with the L_{A1}, L_{A10}, L_{Aeq} and L_{A90} values reported. These loggers comply with the instrumentation requirements of *Australian Standard 2702-1984 Acoustics – Methods for the Measurement of Road Traffic Noise*. The loggers were field calibrated before and after the measurement session and found to be accurate to within ± 1 dB. Lloyd George Acoustics holds current laboratory calibration certificates for the loggers.

Table 3-1 provides details at each monitoring location with *Figure 3-1* providing their general location. Loggers were located within the road reserve, rather than at residences.

Table 3-1: Noise Logging Details

Location	Serial No.	Set-up Date	Collection Date
1. Anketell Rd – West of Kwinana Fwy	16-707-041	Monday, 11 December 2023	Tuesday, 19 December 2023
2. Anketell Rd – East of Kwinana Fwy	15-301-468	Monday, 11 December 2023	Tuesday, 19 December 2023

The noise data collected was verified by inspection and professional judgement. The weather conditions during the measurement period were obtained from the Bureau of Meteorology's Jandakot Airport weather station. This data was compared against the Main Roads WA specifications for measurement conditions and comments provided.

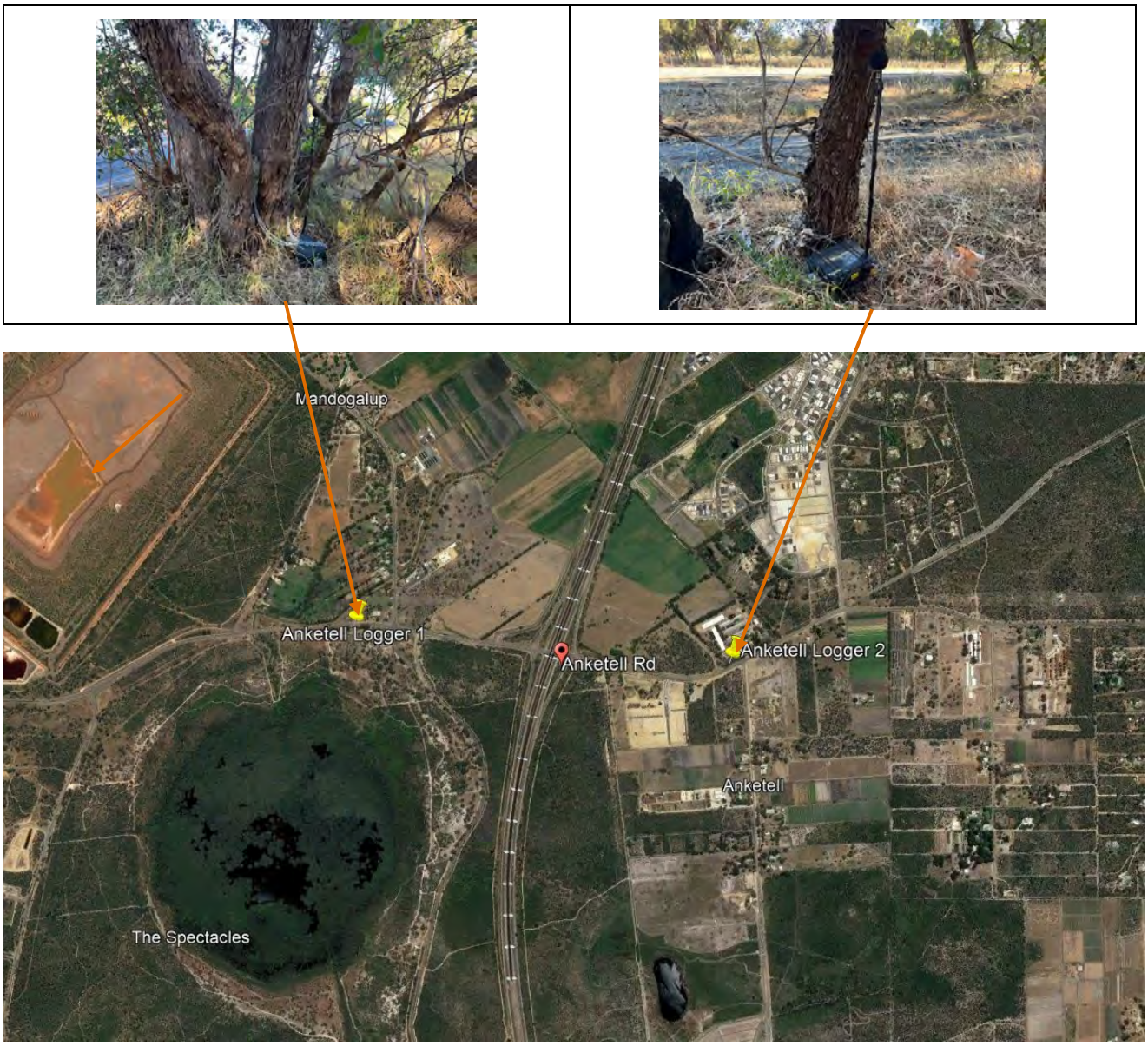


Figure 3-1: Noise Monitoring Locations

3.2. Noise Modelling

The computer program *SoundPLAN 9.0* was utilised incorporating the *Calculation of Road Traffic Noise* (CoRTN) algorithms, modified to reflect Australian conditions. The modifications included the following:

- Vehicles were separated into heavy (Austroads Class 3 upwards) and non-heavy (Austroads Class 1 and 2) with non-heavy vehicles having a source height of 0.5 metres above road level and heavy vehicles having two source heights at 1.5 metres and 3.6 metres above road level;
- A -0.8 dB correction has been applied to the lower level heavy vehicle noise source and -8.0 dB to the higher level noise source based on the *Transportation Noise Reference Book*; Paul Nelson (1987), so as to provide consistent results with the CoRTN algorithms; and
- Adjustments of -0.8 dB and -1.7 dB have been applied to the predicted levels for the 'free-field' and 'at façade' cases respectively, based on the findings of *An Evaluation of the U.K. DoE Traffic Noise Prediction*; Australian Road Research Board, Report 122 ARRB – NAASRA Planning Group (March 1983).

Various input data are included in the modelling and these are discussed in *Section 3.2.1* and *Section 3.2.2*.

3.2.1. Ground Topography

Digital 3-dimensional topographical data was provided by Main Roads WA. The data incorporates new and existing road levels including where roads are elevated.

3.2.2. Traffic Information

3.2.2.1. Road Surface

The corrections applied for different road surface finishes are provided in *Table 3-2*.

Table 3-2: Noise Relationship between Different Road Surfaces

Chip Seal				Asphalt			
14mm	10mm	5mm	Slurry	Dense Graded	Novachip	Stone Mastic	Open Graded
+3.5 dB	+2.5 dB	+1.5 dB	+1.0 dB	0.0 dB	-0.2 dB	-1.5 dB	-2.5 dB

The existing road surface is generally a worn chip seal. For the future scenario, all road surfaces are assumed to be dense graded asphalt (DGA).

3.2.3. Ground Attenuation

The ground attenuation has been assumed to be 0.0 (0%) for the roads, 1.0 (100%) in heavily vegetated areas and 0.5 (50%) for areas within any residential development areas, noting that 0.0 represents hard reflective surfaces such as water and 1.0 represents absorptive surfaces such as grass.

3.2.4. Percentage of Heavy Vehicles

The percentage of heavy vehicles used in the modelling is provided in *Table 3-3*.

Table 3-3: Percentage Heavy Vehicles Used in Modelling

Road Section	Percentage Heavy Vehicles
Leath Rd to Rockingham Rd	50%
Rockingham Rd to Abercrombie Rd	30%
Abercrombie Rd to Mandogalup Rd	20%
Mandogalup Rd to Kwinana Fwy	13%
Kwinana Fwy to Lyon Rd	15%

3.2.4.1. Traffic Volumes

Existing traffic volumes were obtained from Main Roads WA Traffic Map. Future (2051) traffic volumes were provided by Main Roads WA. These volumes are shown in *Table 3-4,* and includes main carriageways and distributer roads.

Table 3-4: Traffic Volumes Used in Modelling

Road Section	Vehicles per day	
	Eastbound	Westbound
Leath Rd to Rockingham Rd	3,100	3,500
Rockingham Rd to Armstrong Rd	13,300	11,100
Armstrong Rd to Abercrombie Rd	12,900	10,300
Abercrombie Rd to Mandogalup Rd	15,200	17,200
Mandogalup Rd to Kwinana Fwy	15,200	18,900
Kwinana Fwy to Lyon Rd	16,200	16,600

3.2.4.2. Vehicle Speed

The future posted and design speeds are provided in *Figure 3-2*.

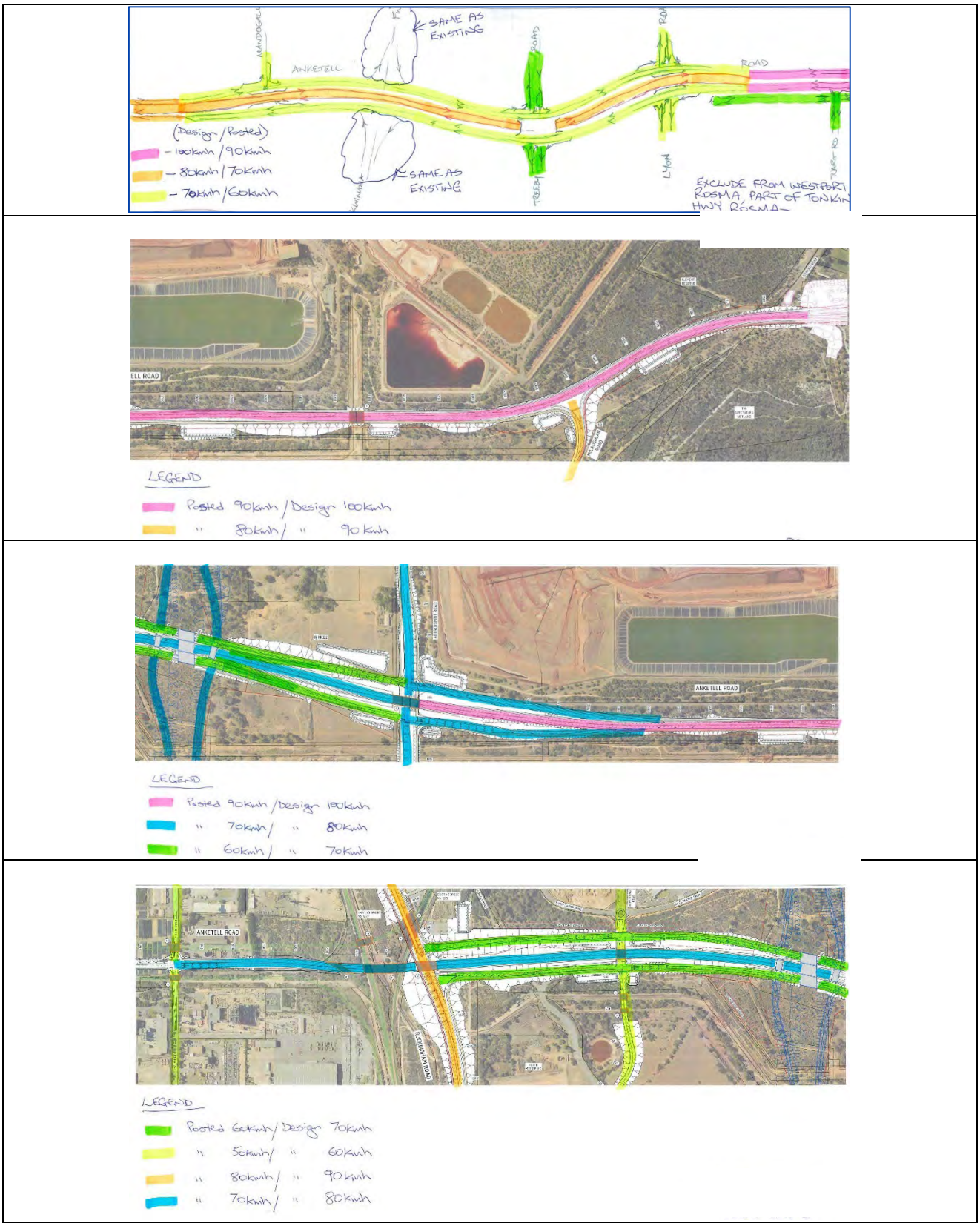


Figure 3-2: Future Posted Speeds

4. RESULTS

4.1. Existing Noise Monitoring

A summary of the noise monitoring is provided in *Table 4-1*. Full details of the noise monitoring results can be found at *Appendix A.*

Table 4-1 Summary of Measurement Results

Measurement Location	Average Weekday Noise Level, dB			
	$L_{A10,18hour}$	$L_{Aeq,24hour}$	$L_{Aeq\ (Day)}$	$L_{Aeq\ (Night)}$
Anketell Rd – West of Kwinana Fwy	75	72	73	68
Anketell Rd – East of Kwinana Fwy	67	64	65	60

The results show that as the difference between the $L_{Aeq(day)}$ and $L_{Aeq(night)}$ levels is exactly 5 dB. Therefore, either the day or night levels would apply in terms of compliance with the Policy criteria. For this assessment, only the results of the $L_{Aeq(day)}$ levels will be considered as these are generally more accurate due to the higher traffic volumes.

4.2. Noise Model Calibration

To calibrate the noise prediction model using the existing road design, the noise at the monitoring location is predicted based on the assumed traffic volumes during the measurement period. The noise prediction results, which are adjusted by -0.7 dB as discussed in *Section 3.2*, are then compared against the measured values and the model is adjusted accordingly.

Table 4-2 shows this comparison and comments on differences between the two values.

Table 4-2 Comparison of Predicted and Measured Noise Levels

Receiver Location	Traffic Noise Level $L_{Aeq\ (Day)}$ dB			Comment
	Measured	Predicted	Difference	
Anketell Rd – West of Kwinana Fwy	73.1	73.6	-0.5	Model is over predicting by 0.5 dB
Anketell Rd – East of Kwinana Fwy	65.2	66.8	-1.6	Model is over predicting by 1.6 dB

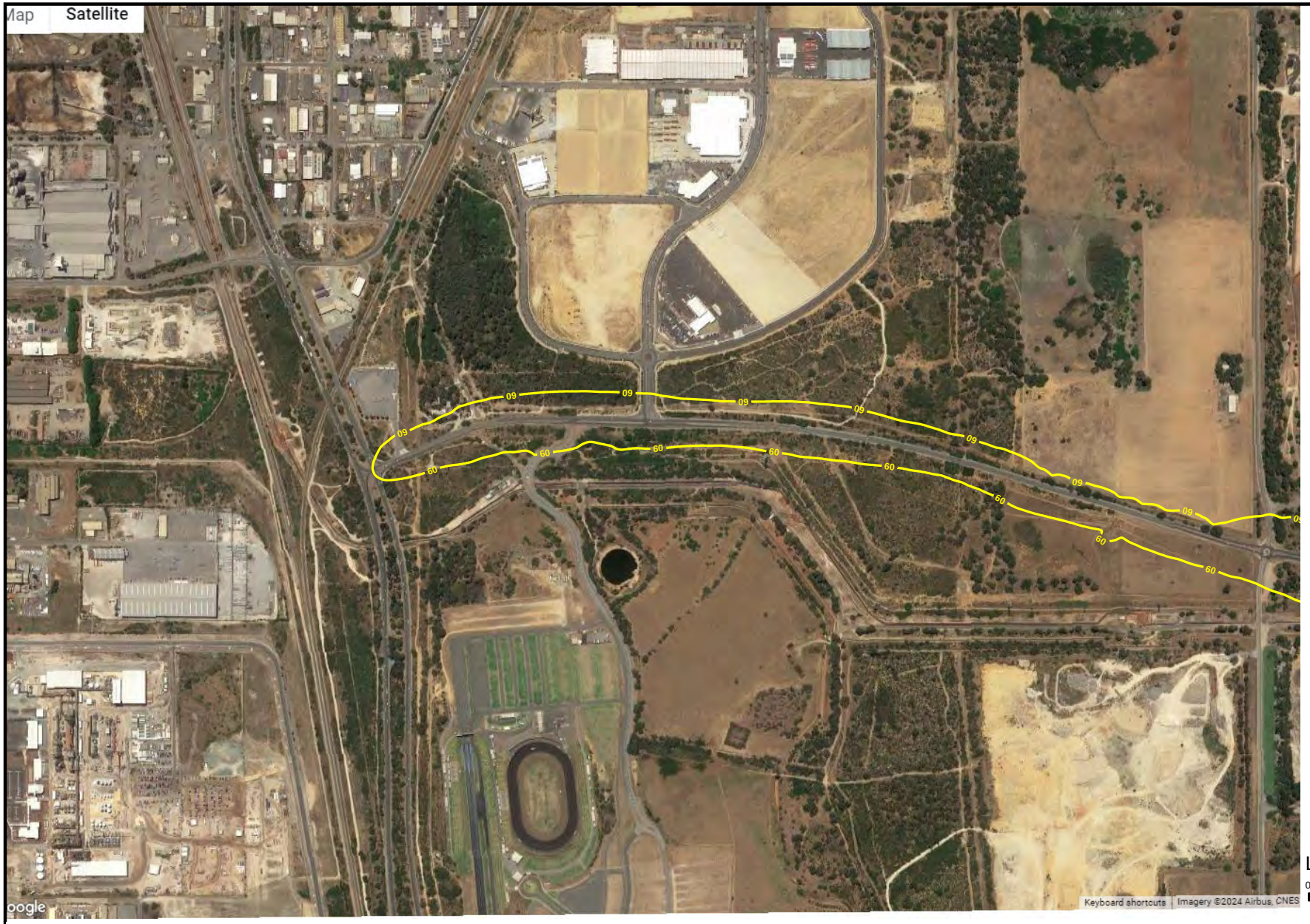
The above results show that noise model is over predicting the noise levels by 0.5 dB west of the freeway and 1.6 dB east of the freeway. The model was adjusted accordingly.

4.3. Noise Modelling

Initially, the noise model is set-up to reflect existing conditions and then calibrated against the ***Error! Reference source not found.*** noise monitoring results. A calibration of -0.5 dB for roads west of the freeway and -1.6 dB for roads east of the freeway (*Table 4-2*) was applied to the model and noise contours produced representing the existing road design with 2023 traffic volumes; and the future road design with 2051 traffic volumes.

The results are presented in *Figures 4-1 to 4-6*, with *Figures 4-1 to 4-3* representing the 'Existing Scenario' and *Figures 4-4 to 4-6* representing the 'Future Scenario'.

Figure 4-1



Noise level
$L_{Aeq(day)}$ dB

= 60

N

Length Scale

0 50 100 200 300 400 m

Anketell Road Upgrade Existing Noise Level Contours
$L_{Aeq(day)}$ Noise Level Contours based on 2023 Traffic Volumes

SoundPLAN v9.0
CoRTN Algorithms

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Figure 4-2

Anketell Road Upgrade Existing Noise Level Contours

$L_{Aeq(day)}$ Noise Level Contours based on 2023 Traffic Volumes

SoundPLAN v9.0
CoRTN Algorithms

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Figure 4-3

Anketell Road Upgrade Existing Noise Level Contours

$L_{Aeq(day)}$ Noise Level Contours based on 2023 Traffic Volumes

SoundPLAN v9.0
CoRTN Algorithms

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Figure 4-4

Noise level
$L_{Aeq(day)}$ dB

= 60

Length Scale

0 50 100 200 300 400 m

Anketell Road Upgrade Future Noise Level Contours
$L_{Aeq(day)}$ Noise Level Contours based on 2051 Traffic Volumes

SoundPLAN v9.0
CoRTN Algorithms

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Figure 4-5

Anketell Road Upgrade Future Noise Level Contours

$L_{Aeq(day)}$ Noise Level Contours based on 2051 Traffic Volumes

SoundPLAN v9.0
CoRTN Algorithms

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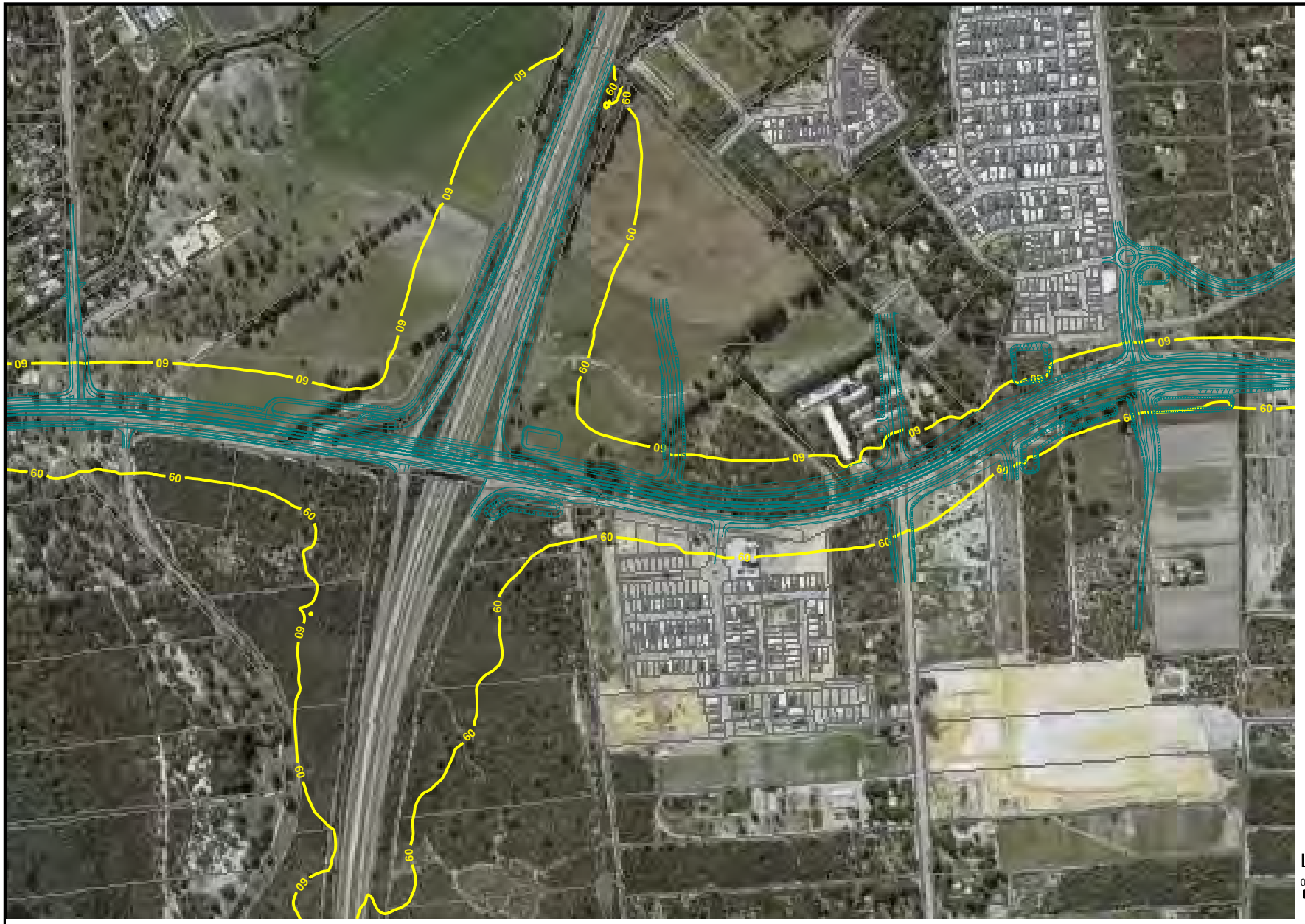
Figure 4-6



Anketell Road Upgrade Future Noise Level Contours

$L_{Aeq(day)}$ Noise Level Contours based on 2051 Traffic Volumes

SoundPLAN v9.0
CoRTN Algorithms

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5. CONSTRUCTION NOISE

The noise generated during the construction phase of a project can be an issue for residents of nearby noise sensitive premises and should therefore been considered during the design phase of the project. For example, in some circumstances, building noise walls early provides a good barrier for the noise during construction. In the case where there are no noise walls, such as this project, then good construction practices and limiting work to normal working hours is necessary.

5.1. Construction Noise Criteria

Construction noise must comply with the *Environmental Protection Act 1986* and the *Environmental Protection (Noise) Regulations 1997* (the Regulations). Specifically within the Regulations is regulation 13, which refers to noise from construction sites and states the following:

Regulation 7 does not apply to … construction work carried out between 0700 hours and 1900 hours on any day which is not a Sunday or public holiday if the occupier of the premises … shows that –

a) The construction work was carried out in accordance with control of environmental noise practices set out in section 4 of AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites;

b) The equipment used on the premises was the quietest reasonably available; and

c) If the occupier was required to prepare a noise management plan … in respect of the construction site –

i. The noise management plan was prepared and given in accordance with the requirement, and approved by the Chief Executive Officer; and

ii. The construction work was carried out in accordance with the management plan, excluding any ancillary measure.

Regulation 7 does not apply to … construction work carried out other than between the [above] hours if the occupier of the premises … shows that –

a) The construction work was carried out in accordance with control of environmental noise practices set out in section 4 of AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites; and

b) The equipment used on the premises was the quietest reasonably available; and

c) The construction work was carried out in accordance with a noise management plan in respect of the construction site –

i. Prepared and given to the Chief Executive Officer not later than 7 days before the construction work commenced; and

ii. Approved by the Chief Executive Officer;

d) At least 24 hours before the construction work commenced, the occupier of the construction site gave written notice of the proposed construction work to the occupiers of all premises at which noise emissions received were likely to fail to comply with the standard prescribed under regulation 7; and

e) It was reasonably necessary for the construction work to be carried out at that time.

Although it is stated that Regulation 7 does not apply, it is still referred to in terms of providing written notice. Regulation 7 states the following:

7. (1) Noise emitted from any premises or public place when received at other premises –

a) Must not cause or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and

b) Must be free of –

i. Tonality;

ii. Impulsiveness; and

iii. Modulation.

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics if:

a) The characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission; and

b) The noise emission complies with the standard after the adjustments of *Table 5-1* are made to the noise emission as measured at the point of reception.

Table 5-1 Adjustments of Intrusive Characteristics

Tonality	Modulation	Impulsiveness
+ 5 dB	+ 5 dB	+ 10 dB

Note: The above are cumulative to a maximum of 15 dB.

The assigned levels (prescribed standards) are specified in Regulation 8 and are shown below in *Table 5-2*.

Table 5-2 Baseline Assigned Noise Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise Sensitive[1]	0700 to 1900 hours Monday to Saturday (Day)	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays (Sunday)	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days (Evening)	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise Sensitive[2]	All hours	60	75	80
Commercial	All hours	60	75	80
Industrial	All hours	65	80	90

1. Applies within 15 metres of a building associated with a noise sensitive use, as defined in Schedule 1, Part C.
2. Applies at a noise sensitive premises greater than 15 metres from a building with a noise sensitive use.

5.2. Construction Noise Impact Assessment

For this project, due to the majority of the road alignment passing through industrial land, there are not many noise sensitive premises that would be affected by noise. In those areas that do have noise sensitive premises near to the project, such as between Kwinana Freeway and Lyon Road, then provided the work is undertaken during normal working hours and using well maintained plant, then compliance with regulation 13 would be achieved.

If work is required after-hours, and is justifiable, then the noise impacts would generally be assessed through computer modelling to determine the extent of the noise impact and area of notification sent to those residents likely to be adversely affected.

5.3. Construction Noise Mitigation Measures

For this project, the general noise mitigation measures would include:

- Barriers around noisy stationary plant;
- Facing the noisy side of stationary plant away from residents;
- Maintaining mobile equipment; and
- Ensuring any noise barriers fitted to equipment are being utilised.

5.4. Construction Vibration Criteria

At present there are no environmental criteria applicable to vibration in Western Australia. Relevant Australian and international standards provide some guidance as to appropriate vibration levels to prevent building damage and to minimise the likelihood of annoyance.

The following standards/guidelines are considered relevant to this investigation:

- Australian Standard AS 2436-2010, Guide to noise and vibration control on construction, demolition and maintenance sites;
- German Institute for Standardisation DIN 4150-3 (1999-02), Structural vibration - Effects of vibration on structures.

Historically in Western Australia, a safe working limit of 5 mm/s pcpv has applied to vibration to protect buildings from damage. This value is considered to be a level at which cosmetic damage to buildings (i.e. cracks in plaster and brickwork) will not occur in buildings when exposed to continuous vibration. For example, 5 mm/s pcpv is the current vibration limit applied by Main Roads Western Australia to most road construction projects in this State.

As a conservative criterion for this project, we would recommend that a ppv of 5 mm/s be set as the maximum level of vibration, to protect the surrounding buildings from general damage.

For ground compaction, recommended mitigation is in the form of using the compaction rollers on half power; using reciprocating compaction rollers; and ensuring the run-up and run-down of the vibration does not occur close to residences.

6. ASSESSMENT

With reference to SPP 5.4, the Outdoor Noise Target for a Road Upgrade project is 60 dB $L_{Aeq(Day)}$ and 55 dB $L_{Aeq(Night)}$.

From the noise contour plot presented in *Figures 4-4 to 4-6*, it can be seen that there are no noise sensitive premises that are predicted to receive a future noise level, assuming the 'Build' scenario, that exceed these criteria. Therefore, no further consideration of noise mitigation is required under the Policy.

Appendix A – Noise Monitoring Results

Westbound - West of the Freeway

Date	$L_{A10(18hour)}$	$L_{Aeq(24hour)}$	$L_{Aeq(16hour)}$	$L_{Aeq(8hour)}$
12/12/2023	75.3	72.2	73.3	68.6
13/12/2023	75.4	72.1	73.1	68.7
14/12/2023	75.8	72.1	73.3	68.1
15/12/2023	75.3	71.8	72.8	68.7
18/12/2023	74.9	71.8	72.9	68.0
Average	**75**	**72**	**73**	**68**

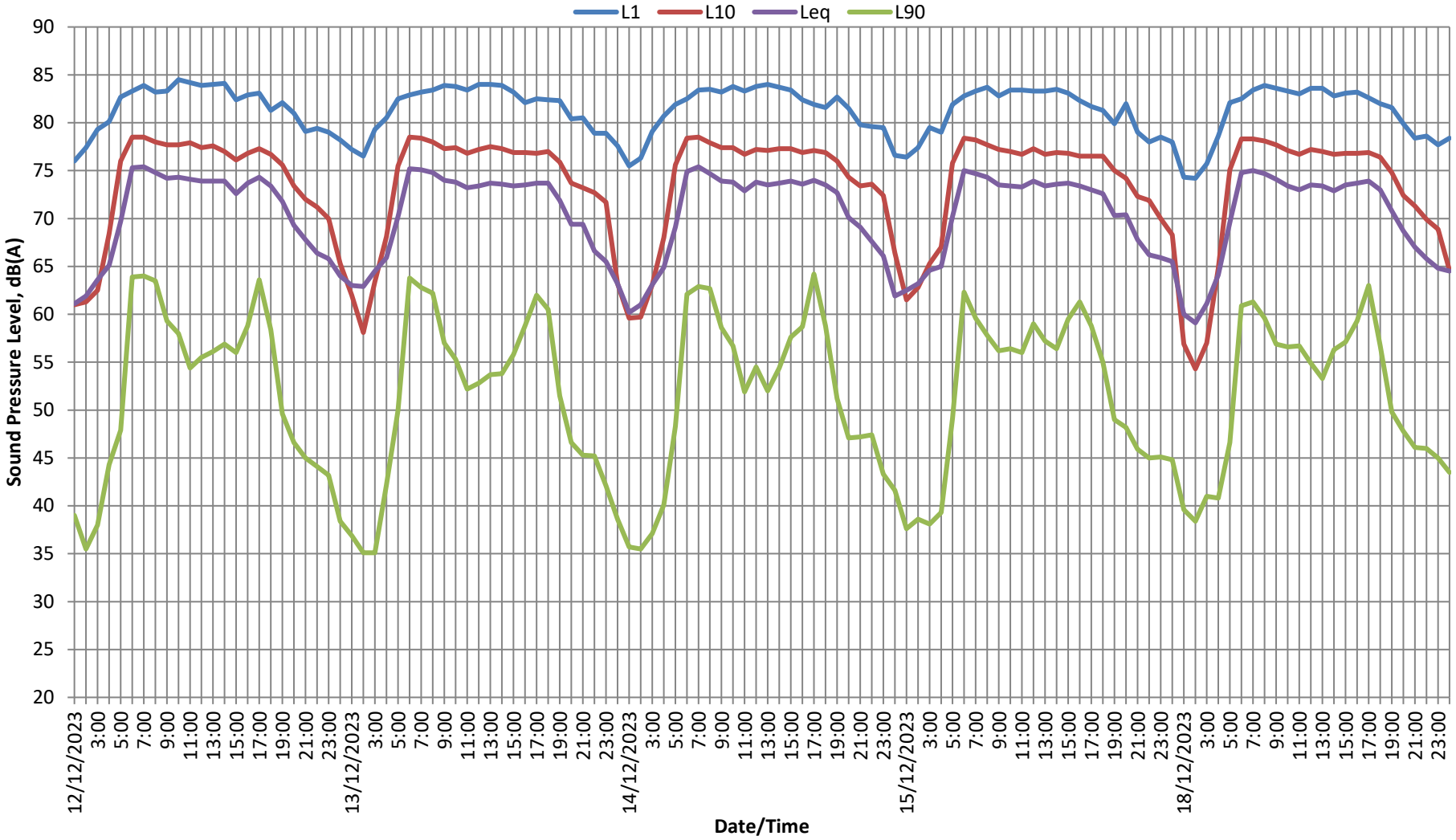
Hourly Noise Level Data

Anketell Rd - Westbound

Date	Time	L1	L10	Leq	L90	Rain mm	Wind degrees	Wind km/h
12-Dec-23	1:00	76	61	61.1	39	0	130	11.2
12-Dec-23	2:00	77.4	61.3	61.9	35.5	0	90	13
12-Dec-23	3:00	79.3	62.5	63.6	38	0	100	13
12-Dec-23	4:00	80.1	68.4	65.1	44.3	0	90	18.4
12-Dec-23	5:00	82.7	76	69.7	47.9	0	90	9.4
12-Dec-23	6:00	83.3	78.5	75.3	63.9	0	70	13
12-Dec-23	7:00	83.9	78.5	75.4	64	0	80	16.6
12-Dec-23	8:00	83.2	78	74.8	63.5	0	70	16.6
12-Dec-23	9:00	83.3	77.7	74.2	59.3	0	50	16.6
12-Dec-23	10:00	84.5	77.7	74.3	58	0	80	14.8
12-Dec-23	11:00	84.2	77.9	74.1	54.4	0	80	13
12-Dec-23	12:00	83.9	77.4	73.9	55.5	0	40	11.2
12-Dec-23	13:00	84	77.6	73.9	56.1	0	10	7.6
12-Dec-23	14:00	84.1	77	73.9	56.9	0	250	22.3
12-Dec-23	15:00	82.4	76.1	72.6	56	0	250	25.9
12-Dec-23	16:00	82.9	76.8	73.7	58.8	0	240	27.7
12-Dec-23	17:00	83.1	77.3	74.3	63.6	0	230	25.9
12-Dec-23	18:00	81.3	76.7	73.4	58.4	0	220	24.1
12-Dec-23	19:00	82.1	75.6	71.8	49.6	0	210	22.3
12-Dec-23	20:00	81	73.4	69.3	46.6	0	200	18.4
12-Dec-23	21:00	79.1	72	67.8	45	0	200	16.6
12-Dec-23	22:00	79.4	71.2	66.4	44.1	0	180	14.8
12-Dec-23	23:00	79	70	65.8	43.2	0	180	11.2
12-Dec-23	0:00	78.2	65.3	64	38.4	0	190	13
13-Dec-23	1:00	77.2	62	63	36.9	0	170	7.6
13-Dec-23	2:00	76.5	58.1	62.9	35.1	0	0	0
13-Dec-23	3:00	79.3	63.4	64.5	35.1	0	0	0
13-Dec-23	4:00	80.5	68.1	65.9	42.2	0	190	5.4
13-Dec-23	5:00	82.5	75.5	70.2	50	0	170	5.4
13-Dec-23	6:00	82.9	78.5	75.2	63.8	0	190	7.6
13-Dec-23	7:00	83.2	78.4	75.1	62.8	0	90	7.6
13-Dec-23	8:00	83.4	78	74.8	62.2	0	30	5.4
13-Dec-23	9:00	83.9	77.3	74	57	0	260	9.4
13-Dec-23	10:00	83.8	77.4	73.8	55.3	0	260	14.8
13-Dec-23	11:00	83.4	76.8	73.2	52.2	0	250	22.3
13-Dec-23	12:00	84	77.2	73.4	52.8	0	250	22.3
13-Dec-23	13:00	84	77.5	73.7	53.7	0	240	27.7
13-Dec-23	14:00	83.9	77.3	73.6	53.8	0	220	25.9
13-Dec-23	15:00	83.2	76.9	73.4	55.8	0	220	27.7
13-Dec-23	16:00	82.1	76.9	73.5	58.8	0	230	25.9
13-Dec-23	17:00	82.5	76.8	73.7	62	0	220	24.1
13-Dec-23	18:00	82.4	77	73.7	60.5	0	230	20.5
13-Dec-23	19:00	82.3	75.9	71.9	51.5	0	230	18.4
13-Dec-23	20:00	80.4	73.7	69.4	46.6	0	220	16.6
13-Dec-23	21:00	80.5	73.2	69.4	45.3	0	210	13
13-Dec-23	22:00	78.9	72.7	66.6	45.2	0	210	13
13-Dec-23	23:00	78.9	71.7	65.5	42.1	0	180	16.6
13-Dec-23	0:00	77.6	63.2	63.2	38.6	0	190	18.4

Hourly Noise Level Data								
Anketell Rd - Westbound								
Date	**Time**	**L1**	**L10**	**Leq**	**L90**	**Rain mm**	**Wind degrees**	**Wind km/h**
14-Dec-23	1:00	75.5	59.6	60.2	35.7	0	180	13
14-Dec-23	2:00	76.3	59.7	61	35.5	0	140	13
14-Dec-23	3:00	79.1	63.1	63.1	37.1	0	120	20.5
14-Dec-23	4:00	80.7	68	64.9	40.1	0	100	22.3
14-Dec-23	5:00	81.9	75.6	69.1	48.3	0	100	20.5
14-Dec-23	6:00	82.5	78.4	74.9	62.1	0	100	22.3
14-Dec-23	7:00	83.4	78.5	75.4	62.9	0	100	27.7
14-Dec-23	8:00	83.5	77.9	74.7	62.7	0	110	25.9
14-Dec-23	9:00	83.2	77.4	73.9	58.6	0	90	20.5
14-Dec-23	10:00	83.8	77.4	73.8	56.7	0	130	16.6
14-Dec-23	11:00	83.3	76.7	72.9	51.9	0	170	13
14-Dec-23	12:00	83.8	77.2	73.8	54.5	0	230	9.4
14-Dec-23	13:00	84	77.1	73.5	52	0	260	24.1
14-Dec-23	14:00	83.7	77.3	73.7	54.4	0	250	31.3
14-Dec-23	15:00	83.4	77.3	73.9	57.6	0	240	29.5
14-Dec-23	16:00	82.4	76.9	73.6	58.7	0	230	31.3
14-Dec-23	17:00	81.9	77.1	74	64.2	0	220	31.3
14-Dec-23	18:00	81.6	76.9	73.5	58.8	0	220	25.9
14-Dec-23	19:00	82.7	76	72.7	51.2	0	210	20.5
14-Dec-23	20:00	81.5	74.3	70.1	47.1	0	210	16.6
14-Dec-23	21:00	79.8	73.4	69.1	47.2	0	200	13
14-Dec-23	22:00	79.6	73.6	67.6	47.4	0	180	11.2
14-Dec-23	23:00	79.5	72.4	66.1	43.3	0	190	9.4
14-Dec-23	0:00	76.6	66.4	61.9	41.6	0	140	9.4
15-Dec-23	1:00	76.4	61.5	62.5	37.6	0	100	22.3
15-Dec-23	2:00	77.4	62.8	63.2	38.6	0	100	27.7
15-Dec-23	3:00	79.5	65.3	64.6	38.1	0	110	24.1
15-Dec-23	4:00	79	67	65	39.3	0	100	22.3
15-Dec-23	5:00	81.9	75.8	70.2	49.1	0	90	22.3
15-Dec-23	6:00	82.8	78.4	75	62.3	0	100	22.3
15-Dec-23	7:00	83.3	78.2	74.7	59.6	0	100	22.3
15-Dec-23	8:00	83.7	77.7	74.3	57.8	0	90	20.5
15-Dec-23	9:00	82.8	77.2	73.5	56.2	0	90	22.3
15-Dec-23	10:00	83.4	77	73.4	56.4	0	90	25.9
15-Dec-23	11:00	83.4	76.7	73.3	56	0	130	22.3
15-Dec-23	12:00	83.3	77.3	73.9	59	0	60	14.8
15-Dec-23	13:00	83.3	76.7	73.4	57.2	0	60	14.8
15-Dec-23	14:00	83.5	76.9	73.6	56.4	0	140	9.4
15-Dec-23	15:00	83.1	76.8	73.7	59.5	0	240	24.1
15-Dec-23	16:00	82.3	76.5	73.4	61.3	0	240	25.9
15-Dec-23	17:00	81.7	76.5	73	58.8	0	210	25.9
15-Dec-23	18:00	81.3	76.5	72.6	55	0	210	24.1
15-Dec-23	19:00	79.9	75	70.3	49	0	210	16.6
15-Dec-23	20:00	82	74.2	70.4	48.2	0	200	13
15-Dec-23	21:00	79	72.3	67.8	45.9	0	200	13
15-Dec-23	22:00	78	71.9	66.2	45	0	170	11.2
15-Dec-23	23:00	78.5	70	65.9	45.1	0	180	11.2
15-Dec-23	0:00	78	68.3	65.5	44.8	0	100	11.2

Anketell Road Upgrade
Pre-Construction Noise Monitoring
Westbound - West of Freeway



Reference: 23118529

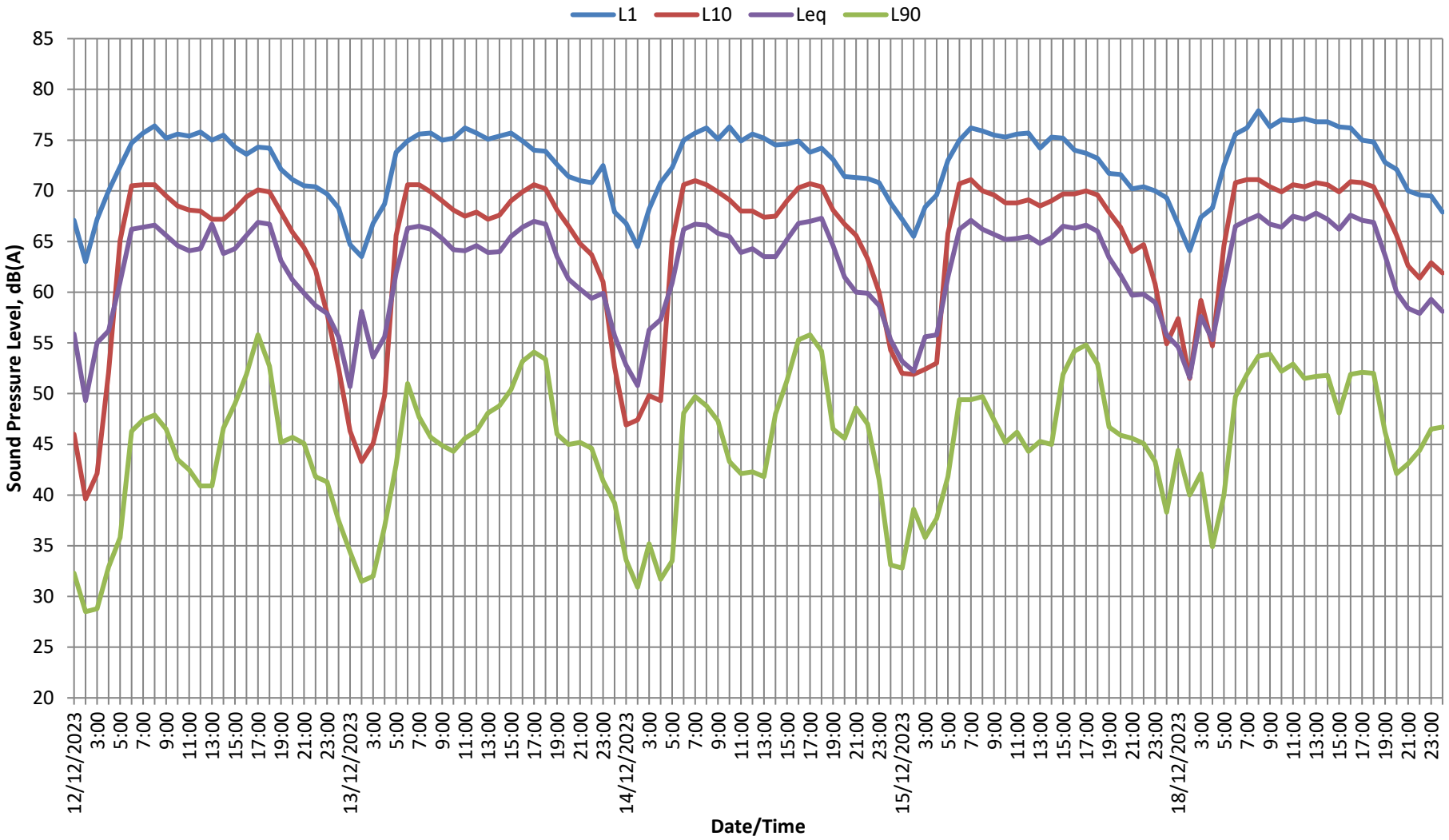
Eastbound - East of the Freeway

Date	$L_{A10(18hour)}$	$L_{Aeq(24hour)}$	$L_{Aeq(16hour)}$	$L_{Aeq(8hour)}$
12/12/2023	66.6	63.7	64.8	59.8
13/12/2023	66.9	63.7	64.8	60.3
14/12/2023	67.2	63.9	65.0	59.9
15/12/2023	67.4	64.0	65.2	59.9
18/12/2023	68.3	65.0	66.2	60.3
Average	**67**	**64**	**65**	**60**

Hourly Noise Level Data								
Anketell Rd - Eastbound								
Date	**Time**	**L1**	**L10**	**Leq**	**L90**	**Rain mm**	**Wind degrees**	**Wind km/h**
12-Dec-23	1:00	67.1	46	55.9	32.3	0	130	11.2
12-Dec-23	2:00	63	39.6	49.3	28.5	0	90	13
12-Dec-23	3:00	67.2	42.1	55	28.8	0	100	13
12-Dec-23	4:00	70	52.1	56.2	32.9	0	90	18.4
12-Dec-23	5:00	72.4	65.1	61	35.8	0	90	9.4
12-Dec-23	6:00	74.7	70.5	66.2	46.3	0	70	13
12-Dec-23	7:00	75.7	70.6	66.4	47.4	0	80	16.6
12-Dec-23	8:00	76.4	70.6	66.6	47.9	0	70	16.6
12-Dec-23	9:00	75.2	69.5	65.6	46.5	0	50	16.6
12-Dec-23	10:00	75.6	68.5	64.6	43.5	0	80	14.8
12-Dec-23	11:00	75.4	68.1	64.1	42.5	0	80	13
12-Dec-23	12:00	75.8	68	64.3	40.9	0	40	11.2
12-Dec-23	13:00	75	67.2	66.7	40.9	0	10	7.6
12-Dec-23	14:00	75.5	67.2	63.8	46.6	0	250	22.3
12-Dec-23	15:00	74.3	68.2	64.3	49	0	250	25.9
12-Dec-23	16:00	73.6	69.4	65.6	51.9	0	240	27.7
12-Dec-23	17:00	74.3	70.1	66.9	55.8	0	230	25.9
12-Dec-23	18:00	74.2	69.9	66.7	52.7	0	220	24.1
12-Dec-23	19:00	72.1	67.9	63.1	45.2	0	210	22.3
12-Dec-23	20:00	71.1	65.9	61.2	45.7	0	200	18.4
12-Dec-23	21:00	70.5	64.4	59.9	45.1	0	200	16.6
12-Dec-23	22:00	70.4	62.2	58.7	41.8	0	180	14.8
12-Dec-23	23:00	69.7	57.9	57.9	41.3	0	180	11.2
12-Dec-23	0:00	68.3	52.5	55.6	37.5	0	190	13
13-Dec-23	1:00	64.7	46.3	50.7	34.4	0	170	7.6
13-Dec-23	2:00	63.5	43.3	58.1	31.5	0	0	0
13-Dec-23	3:00	66.8	45.1	53.6	32	0	0	0
13-Dec-23	4:00	68.7	49.8	55.6	36.9	0	190	5.4
13-Dec-23	5:00	73.8	65.6	61.9	43	0	170	5.4
13-Dec-23	6:00	74.9	70.6	66.3	51	0	190	7.6
13-Dec-23	7:00	75.6	70.6	66.5	47.7	0	90	7.6
13-Dec-23	8:00	75.7	69.9	66.2	45.7	0	30	5.4
13-Dec-23	9:00	75	69	65.3	44.9	0	260	9.4
13-Dec-23	10:00	75.2	68.1	64.2	44.3	0	260	14.8
13-Dec-23	11:00	76.2	67.5	64.1	45.6	0	250	22.3
13-Dec-23	12:00	75.7	67.9	64.6	46.3	0	250	22.3
13-Dec-23	13:00	75.1	67.2	63.9	48.1	0	240	27.7
13-Dec-23	14:00	75.4	67.6	64	48.8	0	220	25.9
13-Dec-23	15:00	75.7	69	65.5	50.4	0	220	27.7
13-Dec-23	16:00	74.9	69.9	66.4	53.2	0	230	25.9
13-Dec-23	17:00	74	70.6	67	54.1	0	220	24.1
13-Dec-23	18:00	73.9	70.2	66.7	53.4	0	230	20.5
13-Dec-23	19:00	72.6	68.1	63.5	46	0	230	18.4
13-Dec-23	20:00	71.4	66.5	61.3	45	0	220	16.6
13-Dec-23	21:00	71	64.8	60.3	45.2	0	210	13
13-Dec-23	22:00	70.8	63.7	59.4	44.6	0	210	13
13-Dec-23	23:00	72.5	61	59.9	41.4	0	180	16.6
13-Dec-23	0:00	67.9	52.6	55.7	39.2	0	190	18.4

Hourly Noise Level Data								
Anketell Rd - Eastbound								
Date	**Time**	**L1**	**L10**	**Leq**	**L90**	**Rain mm**	**Wind degrees**	**Wind km/h**
14-Dec-23	1:00	66.8	46.9	52.8	33.6	0	180	13
14-Dec-23	2:00	64.5	47.4	50.8	30.9	0	140	13
14-Dec-23	3:00	68.2	49.8	56.3	35.2	0	120	20.5
14-Dec-23	4:00	70.8	49.3	57.3	31.7	0	100	22.3
14-Dec-23	5:00	72.3	65	60.9	33.5	0	100	20.5
14-Dec-23	6:00	75	70.6	66.2	48.1	0	100	22.3
14-Dec-23	7:00	75.7	71	66.7	49.7	0	100	27.7
14-Dec-23	8:00	76.2	70.6	66.6	48.8	0	110	25.9
14-Dec-23	9:00	75.1	69.9	65.8	47.3	0	90	20.5
14-Dec-23	10:00	76.3	69.1	65.5	43.3	0	130	16.6
14-Dec-23	11:00	74.9	68	63.9	42.1	0	170	13
14-Dec-23	12:00	75.6	68	64.3	42.3	0	230	9.4
14-Dec-23	13:00	75.2	67.4	63.5	41.8	0	260	24.1
14-Dec-23	14:00	74.5	67.5	63.5	48	0	250	31.3
14-Dec-23	15:00	74.6	69	65.2	51.3	0	240	29.5
14-Dec-23	16:00	74.9	70.3	66.8	55.3	0	230	31.3
14-Dec-23	17:00	73.8	70.7	67	55.8	0	220	31.3
14-Dec-23	18:00	74.2	70.4	67.3	54.2	0	220	25.9
14-Dec-23	19:00	73.1	68.1	64.6	46.5	0	210	20.5
14-Dec-23	20:00	71.4	66.7	61.5	45.6	0	210	16.6
14-Dec-23	21:00	71.3	65.6	***60***	48.6	0	200	13
14-Dec-23	22:00	71.2	63.3	59.9	47	0	180	11.2
14-Dec-23	23:00	70.8	60	58.7	41.5	0	190	9.4
14-Dec-23	0:00	68.8	54.3	55.3	33.1	0	140	9.4
15-Dec-23	1:00	67.2	52	53.2	32.8	0	100	22.3
15-Dec-23	2:00	65.5	51.9	52.2	38.6	0	100	27.7
15-Dec-23	3:00	68.4	52.4	55.6	35.8	0	110	24.1
15-Dec-23	4:00	69.6	53	55.8	37.7	0	100	22.3
15-Dec-23	5:00	73	65.8	61.5	41.8	0	90	22.3
15-Dec-23	6:00	75	70.7	66.2	49.4	0	100	22.3
15-Dec-23	7:00	76.2	71.1	67.1	49.4	0	100	22.3
15-Dec-23	8:00	75.9	70	66.2	49.7	0	90	20.5
15-Dec-23	9:00	75.5	69.6	65.7	47.4	0	90	22.3
15-Dec-23	10:00	75.3	68.8	65.2	45.2	0	90	25.9
15-Dec-23	11:00	75.6	68.8	65.3	46.2	0	130	22.3
15-Dec-23	12:00	75.7	69.1	65.5	44.3	0	60	14.8
15-Dec-23	13:00	74.2	68.5	64.8	45.3	0	60	14.8
15-Dec-23	14:00	75.3	69	65.4	45	0	140	9.4
15-Dec-23	15:00	75.2	69.7	66.5	51.9	0	240	24.1
15-Dec-23	16:00	74	69.7	66.3	54.2	0	240	25.9
15-Dec-23	17:00	73.7	70	66.6	54.8	0	210	25.9
15-Dec-23	18:00	73.2	69.6	66	52.9	0	210	24.1
15-Dec-23	19:00	71.7	67.9	63.4	46.7	0	210	16.6
15-Dec-23	20:00	71.6	66.4	61.7	45.9	0	200	13
15-Dec-23	21:00	70.2	64	59.7	45.6	0	200	13
15-Dec-23	22:00	70.4	64.7	59.8	45.1	0	170	11.2
15-Dec-23	23:00	70	60.8	59	43.3	0	180	11.2
15-Dec-23	0:00	69.3	54.9	55.8	38.3	0	100	11.2

Anketell Road Upgrade
Pre-construction Noise Monitoring
Eastbound - East of Freeway



Reference: 23118529

Appendix B – Terminology

The following is an explanation of the terminology used throughout this report:

- **Decibel (dB)**

The decibel is the unit that describes the sound pressure levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

- **A-Weighting**

An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A, dB.

- **L_{10}**

An L_{10} level is the noise level which is exceeded for 10 percent of the measurement period and is considered to represent the "intrusive" noise level.

- **L_{eq}**

The L_{eq} level represents the average noise energy during a measurement period.

- **$L_{A10,18hour}$**

The $L_{A10,18hour}$ is the arithmetic average of the L_{A10} levels between 6.00am and midnight. The CoRTN algorithms were originally developed to calculate this parameter.

- **$L_{Aeq,24hour}$**

The $L_{Aeq,24hour}$ level is the logarithmic average of the L_{Aeq} levels for a full day.

- **$L_{Aeq(Day)}$**

The $L_{Aeq(Day)}$ level is the logarithmic average of the L_{Aeq} levels from 6.00am to 10.00pm.

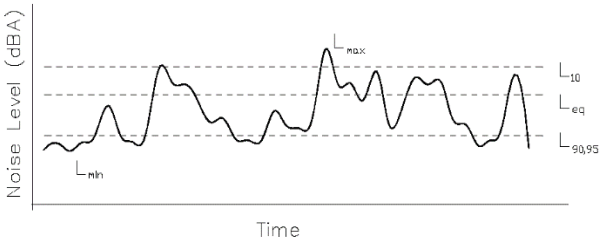
- **$L_{Aeq(Night)}$**

The $L_{Aeq(Night)}$ level is the logarithmic average of the L_{Aeq} levels from 10.00pm to 6.00am.

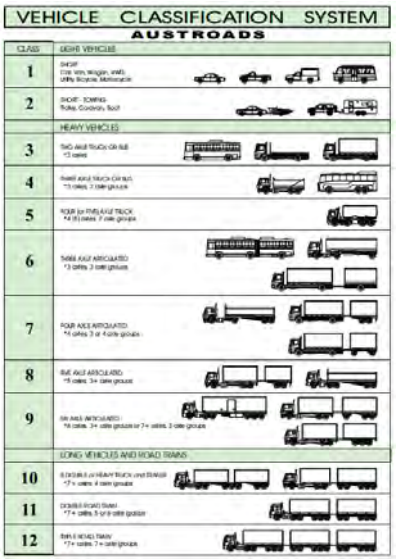
- **Noise-sensitive land use and/or development**

Land-uses or development occupied or designed for occupation or use for residential purposes (including dwellings, residential buildings or short-stay accommodation), caravan park, camping ground, educational establishment, child care premises, hospital, nursing home, corrective institution or place of worship.

- **Chart of Noise Level Descriptors**



- **Austroads Vehicle Class**



- **Typical Noise Levels**